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FACULTÉ DE GÉOGRAPHIE ET D'AMÉNAGEMENT

Thèse de Doctorat

Andrea Zenker

Innovation, perception and regions: Are perceptions of the environment related to firms' innovation behaviours?

– The cases of Alsace and Baden –

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Directeurs de Thèse:

M. Richard Kleinschmager, Professeur à l'Université Louis Pasteur, Strasbourg I

M. Jean-Alain Héraud, Professeur à l'Université Louis Pasteur, Strasbourg I

Membres du jury:

M. Richard Kleinschmager, Professeur, Faculté de Géographie et d'Aménagement, Université Louis Pasteur, Strasbourg I

M. Jean-Alain Héraud, Professeur, Faculté des Sciences Économiques et de Gestion, Université Louis Pasteur, Strasbourg I

Mme Christiane Weber, Directeur de Recherche, Faculté de Géographie et d'Aménagement, Université Louis Pasteur, Strasbourg I

M. Knut Koschatzky, Professeur, Geographisches Institut, Gottfried Wilhelm Leibniz Universität Hannover

M. Joost Heijs, Professeur, Instituto de Análisis Industrial y Financiero, Universidad Complutense Madrid

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Résumé

Le processus d'innovation au sein d'une firme est influencé par les facteurs internes de la firme ainsi que par des facteurs externes, ces derniers résultant des acteurs et activités localisés et exercées autour de la firme, ou de l'impact de l'environnement territorial. L'importance de l'environnement est dérivée de la vision d'innovation comme processus interactif et social, correspondant à une solution où plusieurs acteurs économiques collaborent pour parvenir à la réalisation d'un objectif. Comme des analyses préalables l'ont montré, les facteurs internes de l'innovation et les aspects externes sont liés. Dans ce contexte, l'environnement de la firme peut être considéré comme un soutien de ses activités innovatrices. Par contre, la relation entre la performance innovatrice des firmes, l'existence de soutien à l'innovation au niveau régional et les perceptions de leur environnement par les firmes semble revêtir un caractère complexe.

Au cœur de la thèse se trouve le processus d'innovation, c'est-à-dire le développement de produits, procédures ou services nouveaux ou améliorés d'une manière significatif. L'innovation comprend des activités scientifiques, technologiques, organisationnelles, financières et commerciales. L'observation de la mise en œuvre de connaissances d'origines diverses dont on peut s'efforcer de distinguer des composantes explicites (codifiées) et implicites (tacites) est particulièrement pertinente pour la réflexion.

L'analyse se concentre sur un échantillon de petites et moyennes firmes manufacturières et d'entreprises du tertiaire supérieur (*knowledge-intensive business services*, KIBS) localisées dans deux régions voisines appartenant à des contextes nationaux différents: l'Alsace et le pays de Bade. La question centrale du travail de thèse est d'analyser comment la région – ou plus précisément l'ensemble des acteurs et des activités constituant l'environnement de la firme - est perçue par les firmes qui y sont situées, et si ces perceptions sont liées aux phénomènes d'innovation. Dans ce contexte, la question est posée s'il existe des structures d'innovation et/ou des perceptions par les firmes qui caractérisent et distinguent les entreprises de chaque région. En outre, l'analyse s'efforce d'établir dans quelle mesure les perceptions et les comportements d'innovation sont stables dans le temps. A cette fin, les résultats de l'enquête réalisée dans le cadre du travail de thèse sont comparés avec les caractéristiques de l'échantillon au cours des années 1990.

La thèse est organisée en six parties et fait référence en premier lieu aux conceptions d'innovation et territoire. La seconde partie introduit la perspective de la perception. Celle-ci est analysée d'un point de vue psychologique et sociologique, avant que la dimension territoriale ne soit prise en compte en s'appuyant sur les théories de la géographie de la perception. La troisième partie condense les informations identifiées et

s'efforce d'en retirer les conclusions majeures pour l'analyse empirique. Comme l'approche adoptée présuppose que les activités d'innovation sont encadrées dans leur contexte territorial spécifique, les régions observées (et plus précisément les caractéristiques régionales liées au développement économique, scientifique et technologique) sont présentées dans la quatrième partie. L'analyse empirique est présentée dans la cinquième section. Elle se concentre sur les caractéristiques d'innovation et les perceptions des firmes analysées. Une analyse multi variables complète l'analyse descriptive, afin d'identifier de possibles associations entre les caractéristiques d'innovation, les perceptions et les territoires. La partie finale résume les résultats principaux.

La partie théorique donne un aperçu des conceptions d'innovation, des théories régionales et des approches mettant l'accent sur la proximité entre acteurs économiques. Les modèles linéaires d'innovation sont fondés principalement sur l'idée que l'innovation semble être un phénomène "en cascade". Ainsi l'innovation, résulterait d'un cheminement, partant par exemple d'une idée ou de la recherche fondamentale, passant par le développement, puis par la fabrication et l'introduction sur le marché (modèle *technology push*) ou suivant un cheminement résultant de la demande du marché et impliquant le développement d'artefacts adéquats (modèle *demand pull*). Les modèles interactifs de l'innovation, dont le plus connu est très probablement le *chain-linked model of innovation* développé par Kline et Rosenberg (1986), caractérisent le processus d'innovation par des interactions et des boucles de rétroaction (*feed-back*) entre les phases centrales de la chaîne d'innovation (design - développement – fabrication – marketing) mais également entre ces phases et les activités purement scientifiques. De surcroît, ce modèle reconnaît le rôle que jouent les relations que la firme innovante entretient avec ses partenaires externes.

Les modèles de systèmes d'innovation soulignent le caractère systémique de ces processus en mettant l'accent sur la dimension sociale de l'innovation ainsi que sur l'importance des flux de connaissances au sein de et entre acteurs. Ces approches intègrent l'innovation dans son contexte socioculturel, politique et économique, soulignant le caractère résiliaire des liens entre acteurs. La dimension sociale de cette approche résulte de la prise en compte des interactions entre protagonistes (innovateurs, clients, compétiteurs, instances publiques, du transfert technologique, de la science et la recherche, de l'éducation, etc.) – engagés dans des processus de génération et de mise en œuvre de connaissances. Ces processus s'inscrivent à chaque fois dans un contexte spécifique – le territoire - résultant de sa structure socio-économique, de ses normes et règles, de son type de gouvernance, etc. L'analyse des systèmes régionaux d'innovation propose d'examiner les conditions spécifiques de l'innovation à l'échelle d'un territoire limité à une échelle sub-nationale, en s'inspirant du modèle des systèmes d'innovation nationaux. L'approche par les systèmes régionaux d'innovation est enracinée dans les conceptions évolutionnistes et l'hypothèse de rationalité limitée (*bounded rationality*) des acteurs économiques qui agissent dans des contextes déterminés par incertitude.

Un système d'innovation est défini par des éléments constitutifs et par les relations engagées par ces éléments pour la génération, la diffusion et l'utilisation de connaissances. A l'échelle régionale, cette approche souligne le rôle de la proximité entre les acteurs innovants, ainsi que l'importance des connaissances et des processus d'apprentissage. Un système d'innovation régional est idéalement constitué de "sous-systèmes" qui (i) génèrent et diffusent, et (ii) exploitent et utilisent des connaissances. Des interactions parmi les différents acteurs génèrent des flux de connaissances. De plus, des relations externes créent des échanges d'information et de connaissances qui contribuent à rendre disponibles des connaissances extérieures à la région. La notion de systèmes d'innovation régionaux a une dimension fortement appliquée pour l'analyse des activités d'innovation dans un cadre territorial, et constitue la base conceptionelle du travail empirique de cette thèse.

La géographie économique et l'économie régionale, en tant que disciplines, considèrent en premier lieu le territoire et son développement, notamment économique. L'innovation joue un rôle prépondérant pour les régions qui réussissent à s'établir et à prospérer dans un contexte de compétition globale. A ce titre, les districts industriels et les milieux innovateurs, caractérisés notamment par des réseaux de petites et moyennes entreprises (PME) spécialisées ont valeur d'exemple. Tandis que les districts mettent en avant la production spécialisée et flexible et des coopérations verticales souvent dans les secteurs artisanaux, l'approche par les milieux innovants se concentre sur l'analyse des processus "d'apprentissage interactif" (*interactive learning*), sur les relations informelles, et sur les conditions locales préalables à l'innovation. Ces visions, qui font ressortir le caractère local de processus d'innovation sont complétées par d'autres approches, dont notamment celle des "régions apprenantes" (*learning regions*) qui place les processus d'apprentissage et de créativité, ainsi qu'une atmosphère favorable aux créateurs et diffuseurs d'idées, au centre de la réflexion. La proximité entre acteurs de l'innovation constitue également un domaine d'analyse. L'hypothèse de "retombées de connaissances" (*spillovers)* à proximité des lieux de génération de connaissance semble se confirmer notamment dans les phases initiales de création technologique et dans le cas de technologies fortement basées sur la science. Des approches récentes étendent la conception de proximité géographique aux dimensions cognitives, sociales, organisationnelles, et institutionnelles.

L'approche par les perceptions introduit la dimension subjective et individuelle dans l'analyse de l'innovation et des territoires. La perception est considérée comme un type de communication spécifique entre l'individu et l'environnement: Un stimulus en provenance de l'environnement atteint les organes sensoriels et génère un transfert de l'information vers le cerveau. L'information résultant du stimulus est comparée avec les structures disponibles, menant au processus d'attribution du sens. Sur cette base se forme la représentation subjective qu'un individu a de son environnement. Cette vision de création de sens et de représentation subjective ne se réfère pas exclusivement au stimulus, mais couvre également la démarche cognitive ainsi que des processus d'apprentissage. Pour qu'un stimulus puisse être perçu, il doit être sélectionné parmi d'autres stimuli. Par conséquent, le processus de perception dépend des caractéristiques et des expériences passées de l'entité percevante mais également de la situation dans laquelle la perception a lieu.

Les contributions sociologiques se fondent sur l'hypothèse que chaque individu "construit" sa réalité, laquelle résulte de processus cognitifs fondés sur les perceptions. D'où l'importance des relations avec l'environnement. Dans une logique d'interprétation des individus et des firmes en tant de systèmes, le milieu ou l'environnement ne peut pas exercer une influence directe sur les processus internes d'un système, mais stimuler (*trigger*) l'évolution des composants du système. La géographie de la perception souligne les aspects cognitifs et les interactions entre individu et le contexte social (qui forme le cadre mental du processus de perception) dans le cadre territorial. Elle vise à éclairer les comportements spatiaux à la base des perceptions, en adoptant la vision d'un caractère double de l'environnement: l'environnement objectif et l'environnement tel qu'il est perçu par les individus, ce dernier délivrant le contexte général dans lequel les individus agissent. La perception d'un objet, ainsi que le comportement qui découle de cette perception, se déroulent dans le cadre général résultant des attitudes d'un individu ou d'un groupe social concernant l'objet en question. De plus, au niveau individuel, l'état d'esprit (*mood*) ou l'"ambiance" dans laquelle se trouvent les personnes créatives, influencent leur processus créatifs, condition préalable au développement de nouvelles idées ou de nouvelles solutions. La littérature dans ce domaine indique qu'il n'y a pas de relation de causalité univoque entre ambiance et créativité (une ambiance positive ne mène pas nécessairement à un niveau de créativité plus élevé).

Le cadre de l'analyse empirique est indiqué par la présentation des profils socio-économiques des deux régions étudiées, de leurs caractéristiques d'innovation et des cadres nationaux respectifs. Séparées par le Rhin, les régions observées montrent certaines ressemblances, mais se distinguent également par certains aspects. L'Alsace (une unité administrative correspondant à une région française) et le pays de Bade (la partie occidentale du *Land* de Bade Württemberg) sont des régions prospères, dont les activités économiques dans le tertiaire sont très fortes, mais inférieure à la moyenne nationale, tandis que les activités manufacturières sont plus élevées qu'au niveau national. L'industrie dans les deux régions semble s'appuyer plutôt sur des technologies avancées que sur des activités purement "high-tech" bien que la haute technologie soit présente dans les deux régions, par exemple dans le domaine des biotechnologies. La structure des entreprises dans les deux régions est largement déterminée par des firmes de petite et moyenne taille, et d'un nombre restreint de grandes entreprises. Les performances en termes de dépôts de brevets sont bonnes comparativement aux moyennes nationales respectives, et les deux régions présentent de fortes activités de recherche (davantage tournées vers la recherche fondamentale en Alsace). Les deux régions disposent d'une infrastructure conséquente de soutien à l'innovation. En revanche, la différence de contexte national provoque des divergences dans les systèmes de gouvernance d'innovation avec une tradition plutôt verticale en France et des efforts récents vers l'interconnexion, et une structure plutôt décentralisée en Allemagne.

L'analyse empirique s'efforce de retracer l'évolution des perceptions de leur environnement régional par des dirigeants d'entreprise et responsables en charge de la recherche et développement et de l'innovation. Selon la littérature, les perceptions sont liées aux processus d'apprentissage, ce qui amène à s'interroger sur les modifications de la perception de l'environnement au fil du temps. Il est supposé que la perception et la génération d'une représentation subjective de l'environnement soient le résultat d'échanges continus entre l'individu percevant et l'environnement. Par conséquent, l'environnement socioculturel représente le contexte général pour les processus cognitifs des individus, et constitue notamment la base de leurs activités d'innovation. Ces réflexions mènent à la conclusion que les représentations de l'environnement ont un caractère individuel, mais en même temps social. Ce qui amène à supposer que les membres d'un même groupe social aient des représentations semblables. D'où l'interrogation: des entreprises localisées dans des régions différentes ont-elles une perception différente de leurs environnements respectifs. L'analyse a pour objectif de découvrir les structures potentiellement existantes dans les perceptions des firmes observées, et de déterminer si ces structures sont caractéristiques des types de firmes et de contextes différents. Par la suite, la possibilité d'un lien entre modèles d'innovation et perceptions dans les deux régions est examinée. Finalement, la dimension temporelle est introduite dans l'observation des caractéristiques d'innovation d'une part et des perceptions d'autre part.

L'analyse empirique est conçue le long de trois dimensions: (i) l'évaluation des perceptions de trois facteurs régionaux liés à l'innovation: la main d'œuvre, la capacité en recherche et technologie et le climat d'innovation, (ii) les caractéristiques d'innovation, mesurés à l'aide des dépenses et des personnels de recherche et développement, et (iii) les contextes régionaux, mesurés sur la base de la localisations des firmes et de leurs réseaux. A cette fin, une enquête portant sur 93 firmes innovantes a été effectuée. Cet échantillon contient des entreprises manufacturières et des entreprises du tertiaire supérieur situées dans les deux régions examinées. Les firmes en question ont été interrogées à deux reprises: en 1995/96 et en 2004/05, ce qui permet de retracer leur évolution.

Le travail empirique contient deux parties: une série d'analyses descriptives d'une part et d'une analyse multi variables de type *categorical principal components analysis* (CATPCA) d'autre part. La raison d'être de ce dernier type d'analyse est la détection d'associations possibles entre innovation, perception et environnement régional par un traitement simultané des variables concernées. Cette démarche est pertinente pour l'analyse des associations entre innovation et perception parmi les firmes examinées en Alsace et au pays de Bade du fait qu'une CATPCA représente simultanément les variables et leurs catégories ainsi que les objets (les types de firmes).

Les analyses indiquent l'existence de modèles d'innovation différents dans les deux régions: les firmes françaises de l'échantillon semblent préférer acquérir les connaissances nécessaires auprès de sources externes (majoritairement régionales), notamment auprès d'institutions de recherche. Ce modèle semble valoir en particulier pour les firmes du tertiaire supérieure, un résultat qui n'a pas pu être observé en 1995. Les firmes manufacturières semblent se concentrer sur des activités d'innovation incrémentale, une conclusion résultant d'une performance satisfaisante au niveau régional, mais des *inputs* d'innovation modeste. Elles semblent plutôt profiter du personnel qualifié disponible dans la région que les firmes de type KIBS. Associant ce résultat avec l'appréciation élevée des capacités scientifiques et technologique de l'Alsace, les analyses semblent confirmer l'hypothèse qu'une partie des firmes du tertiaire supérieur préfèrent l'acquisition de connaissances externes à la firme à la génération de connaissances par des activités internes de recherche et développement. Le climat d'innovation en Alsace est évalué de façon similaire par les firmes manufacturières et par celles appartenant su tertiaire supérieur.

Les résultats pour les firmes localisées au pays de Bade suggèrent des modèles d'innovation différents. Ces firmes semblent préférer créer des connaissances par des activités internes de recherche et developpement. En parallèle, la recherche et technologie générées par les organismes régionaux de recherche leur semblent moins importantes que pour leurs homologies alsaciennes. La main d'œuvre régionale est évaluée de façon favorable par plus de la moitié des firmes badoises, mais le climat d'innovation est davantage apprécié par des firmes manufacturières que par les firmes du tertiaire supérieur. Cela peut indiquer que les conditions générales d'innovation ont plus d'impact sur le secteur manufacturier.

Comparant les résultats de l'enquête de 2004 à celle de 1995, il est évident que, notamment parmi les firmes manufacturières, les évaluations se sont dans l'ensemble améliorées. L'enquête de 1995 révélait qu'une certaine proportion de firmes ne pouvaient pas clairement indiquer leur jugement concernant la main d'œuvre, la recherche et le climat d'innovation dans la région. En revanche, en 2004, les perceptions étaient généralement explicites et plutôt positives. Parmi les firmes du tertiaire supérieur examinées en Alsace, l'évaluation positive de la capacité régionale en recherche et technologie est particulièrement frappante (du fait de la différence avec les observations un de 1995). Une autre évolution entre 1995 et 2004 concerne l'évaluation du climat régional d'innovation par les firmes du tertiaire supérieur: tandis que ce jugement s'est amélioré au pays de Bade (tout en restant inférieur à celui des firmes manufacturières), le climat d'innovation est en Alsace perçu de façon moins positive en 2004 qu'en 1995.

En résumé, les analyses montrent que les firmes examinées poursuivent des modèles d'innovation distincts: les firmes allemandes affichant des *inputs* d'innovation (investissements et personnels de recherche et développement) plus élevés que leurs homologues françaises. D'où la conclusion que les processus d'innovation observés revêtent un caractère territorial spécifique. A la base de ce résultat, il apparaît comme possible de caractériser les types de firmes selon des structures des perceptions spécifiques. Une CATPCA similaire pour l'année 1995 montre que les structures d'innovation apparaissent comme relativement stables entre 1995/96 et 2004/05. En revanche, les perceptions semblent très clairement évoluer: les conditions régionales dans lesquelles se déroulent les processus d'innovation sont perçues par les firmes innovantes avec davantage de netteté à l'heure actuelle qu'une décennie auparavant.

L'ensemble des analyses réalisées montre qu'un lien simple et univoque entre innovation et perception ne peut pas être établi, mais que l'observation de firmes – différenciées selon leur appartenance régionale, leurs *inputs* d'innovation, et caracterisées par leurs perceptions – permet d'associer innovation et perception. L'approche adoptée se base sur l'hypothèse que les perceptions de l'environnement éclairent les choix relatifs aux activités internes d'innovation. Ces relations permettent d'établir des caractéristiques spécifiques pour les types de firmes considérées. Dans le cas de l'Alsace, par exemple, les firmes du tertiaire supérieur font preuve d'investissements conséquents consacrés à la recherche et développement (plus élevés en proportion que de la part des firmes manufacturières), et semblent entretenir des relations plus intenses avec les instituts de recherche que leurs entreprises manufacturières de la même région. Cela pourrait constituer un avantage pour l'Alsace du fait du rôle particulier que les KIBS peuvent jouer en tant que "co-innovateur" pour d'autres entreprises. En revanche, le climat d'innovation semble s'être dégradé en l'espace de dix ans. Dans le cas des firmes manufacturières alsaciennes, la recherche et développement semble ne revêtir qu'une faible importance. En revanche, les bons résultats évoqués dans l'analyse des contextes régionaux semblent indiquer que le modèle d'innovation Alsacien des firmes manufacturières relève davantage de l'innovation incrémentale que de l'innovation radicale (ou *breakthrough*).

Les firmes appartenant à l'échantillon badois semblent suivre quant à elles une stratégie d'innovation, et particulièrement de génération et d'acquisition de connaissances, différente. La création de connaissances est favorisée par des processus de recherche et développement internes. Les sources d'information pour l'innovation sont localisées à la fois en région et (principalement) hors du pays de Bade. Les conditions régionales en faveur de l'innovation semblent plus favorables du point de vue des firmes manufacturières que de celui des KIBS. D'où la supposition que les dispositifs de soutien à l'innovation sont davantage tournés vers le secteur manufacturier. Ceci suggère clairement la nécessité d'adapter les stratégies et instruments régionaux de soutien à l'innovation. De plus, cela renforce l'hypothèse de l'importance à accorder à la communication politique liée aux problématiques d'innovation. En effet, l'innovation est un phénomène qui affecte en premier lieu les activités internes de la firme, mais qui est également lié aux conditions externes auxquelles est soumise la firme, notamment l'ensemble des acteurs, institutions et activités de soutien qui constituent son environnement régional. En général, l'intégration des perceptions permet d'obtenir une vision plus complète des activités d'innovation internes de la firme et de leurs relations avec les acteurs, institutions et organisations de soutien à l'innovation.

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List of acronyms and abbreviations

ADA	Agence de Développement de l'Alsace
ADIRA	Association pour le Développement du Bas-Rhin
AER	Agence d'Evaluation de la Recherche
AFSSA	Agence Française de la Sécurité Sanitaire des Aliments
AiF	Arbeitsgemeinschaft industrieller Forschungseinrichtungen
AII	Agence d'Innovation Industrielle
ALS	Alternating least squares
ANR	Agence Nationale de la Recherche
ANVAR	Agence Nationale de Valorisation de la Recherche
BDPME	Banque du développement des PME
BETA	Bureau d'Economie Théorique et Appliquée
BfEL	Bundesforschungsanstalt für Ernährung und Lebensmittel
BLK	Bund-Länder-Kommission für Bildungsplanung und Forschungsförderung
BMBF	Bundesministerium für Bildung und Forschung
BMWi	Bundesministerium für Wirtschaft und Technology
CAHR	Comité d'Action du Haut-Rhin
C.I.R.A.C.S.	Centre International de Recherche Avancée en Chimie à Strasbourg
CATPCA	Categorical principal components analysis
CDT	Conseillers en développement technologique
CEMAGREF	Institut de recherche pour l'ingénierie de l'agriculture et de l'environnement
CEREQ	Centre d'Etudes et de Recherches sur les Qualifications
CIFRE	Convention industrielle de formation par la recherche
CNEVA	Centre National d'Etudes Vétérinaires et Alimentaires
CNRS	Centre National de la Recherche Scientifique
CNRT	Centre National de Recherche Technologique
CORTECHS	Convention de recherche pour techniciens supérieurs
CPER	Contrat de Projet Etat-Région
CRITT	Centre Régional d'Innovation et de Transfert de Technologie
CRT	Centre de ressources technologiques
DGE	Direction Générale des Entreprises
DREST	Direction de la Recherche, de l'Enseignement Supérieur et du Transfert de Technologie de la Région Alsace
DRIRE	Direction Régionale de l'Industrie, de la Recherche et de l'Environnement

DRRT	Délégation Régionale à la Recherche et à la Technologie
DRT	Diplôme de recherche technologique
ELM	Elaboration Likelihood Model
EPA	Etablissement Public à caractère Administratif
EPST	Etablissement Public à caractère Scientifique et Technologique
ERIS	European Regional Innovation Survey
ERP	European Recovery Program
FCE	Fonds de Compétitivité
FCPI	Fonds commun de placement dans l'Innovation
FDI	Foreign direct investment
FhG	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung
FIZKA	Fachinformationszentrum Karlsruhe GmbH
FRFI	Fonds Régional de Financement Initial
FZI	Forschungszentrum Informatik
GDP	Gross domestic product
GERD	Gross domestic expenditure on research and development
HCST	Haut Conseil de la Science et la Technologie
HGF	Hermann von Helmholtz-Gemeinschaft Deutscher Forschungszentren
ICT	Information and communication technologies
IFREMER	Institut Français de Recherche pour l'Exploitation de la Mer
IMIT	Institut für Mikro- und Informationstechnik
INRA	Institut National de la Recherche Agronomique
INSEE	Institut National de la Statistique et des Etudes Economiques
INSERM	Institut National de la Santé et de la Recherche Médicale
IRC	Innovation Relay Centre
IRD	Institut de Recherche pour le Développement
ISTPM	Institut Spécialisé de Technologie des Pêches Maritimes
IT	Information technologies
ITA	Innovations- und Technikanalyse
ITI	Institutions of the Technological Infrastructure
KfW	Kreditanstalt für Wiederaufbau
KIBS	Knowledge-intensive business service
KIK	Karlsruher Informatik Kooperation
KIS	Kiepenheuer-Institut für Sonnenphysik
KIT	Karlsruhe Institute for Technology

LEA	Laboratoire Européen Associé
LUBW	Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg
MDS	Multidimensional scaling
MPG	Max-Planck-Gesellschaft zur Förderung der Wissenschaften
NACE	Nomenclature générale des activités économiques dans les Communautés Européennes
NSI	National system of innovation
NUTS	Nomenclature des Unités Territoriales Statistiques
OECD	Organisation of Economic Co-operation and Development
PAXIS	The Pilot Action of Excellence on Innovative Start-ups
PCA	Principal Components Analysis
PETRA	Prospective Economique Territoriale en Région Alsace
PME	Petites et moyennes entreprises
PMI	Petites et moyennes industries
PRES	Pôle de Recherche et d'Enseignement Supérieur
R&D	Research and development
RDT	Réseau de Développement Technologique
RIS	Regional Innovation Strategy
RISI	Regional Information Society Initiatives
RIS-NAC	Regional Innovation Strategies in Newly Associated Countries
RITTS	Regional Innovation and Technology Transfer Strategies and Infrastructures
RRIT	Réseau de Recherche et d'Innovation Technologique
RSI	Regional system of innovation
RTA	Réseau Technologique d'Alsace
RTP	Regional Technology Plan
RTRA	Réseau Thématique de Recherche Avancée
SEMIA	Science, Entreprise et Marché, Incubateur d'Alsace
SGAR	Secrétariat Général pour les Affaires Régionales des Préfectures de Région
SME	Small and medium-sized enterprise
TRIPS	Trans-Regional Innovation Projects
TRK	TechnologieRegion Karlsruhe
ULP	Université Louis Pasteur

Introduction

Innovation researchers from different disciplines as well as regional development experts and policy-makers discuss the view that firms' innovation processes are influenced by firm-internal as well as external factors, and try to shed light into the significance and precise impact of innovation-stimulating aspects. From a spatial and a policy-oriented perspective, the contribution and impact of firm-external factors occurring in the environment of (innovating) firms is of special interest. This is based on the understanding of innovation as interactive, social and spatially rooted process. It is widely accepted that firm-internal and external factors are interrelated, and that firms' regional environments can play an important role in innovation support. In this line, Sternberg (1998: 289) argues that firms and their regional environments are characterised by an interdependent relationship. In their empirical study referring to more than 1,700 manufacturing firms in ten European regions (the ERIS database, cf. section 5.1), Sternberg/ Arndt (2001) find that firm-internal determinants influence innovation activities to a higher degree than most of the analysed regional variables. They conclude that "… a firm with favorable internal features can also have good innovation performance even if the region itself exerts more unfavorable influences. The reverse, however, is not true!" (Sternberg/ Arndt 2001: 374) and argue that firms' environments can have an impact on firm innovation, but that firms' internal competences for preparing innovation projects are crucial. According to them, the innovation potential of a firm is decisive for the generation of innovations. Especially the research and development (R&D) environment contributes to exploit firms' innovation potentials and influences firms' innovation behaviours. On the other hand, the creation of firms' innovation potentials can neither be achieved by the region nor by innovation networks. These findings lead to the conclusion that innovation policy should focus on firms (cf. Sternberg/ Arndt 2001: 379/ 380). Oerlemans/ Meeus (2005: 92) also argue that the major part of innovation in most industries is based on firms' internal competences. Koschatzky (1998b) comes to similar findings, namely the higher impact of internal firm characteristics on innovation than external factors.

The impact of the region for innovation activities of firms is difficult to measure and to treat empirically. Discussing with firm representatives about their innovation activities, it is challenging to grasp and to make explicit the precise influence of the region. The 'region' seems to be a rather abstract term for firm representatives that they not immediately connect to their internal innovation projects, at least not at first glance.[1] When

1 Lambooy/ Boschma (1998: 10/11) argue that "Many economic geographers suggest that regions matter in innovation, despite the fact that it remains difficult to assess the particular

further asking about (innovation) policies, about innovation supporting agencies or networking partners and particularly about proximity-based relations, respondents often have a more clear opinion. Indeed it is less the region as such that may foster innovations of regional firms, but regional institutions, organisations, actors and their relationships as well as the general attitude towards innovation.

One could assume that firms located in an environment with a high amount of innovation-supporting organisations have a positive view of their region and realise high innovation rates. But some recent empirical analyses have shown that firms in 'innovation friendly' environments – as external observers would argue on the base of an analysis of the regional innovation supporting infrastructure - do not necessarily rate their environment significantly better than firms in other regions. On the other hand, those firms are not necessarily less innovative. Comparing the French-German border regions of Alsace and Baden with respect to manufacturing and business service firms' innovation needs, Muller et al. (2001) find that Baden firms are in many aspects more dissatisfied than Alsatian firms even though the share of innovating firms in Baden is above the respective Alsatian rate and Baden has a dense net of innovation supporting institutions (cf. Muller et al. 2001: 27ff.). Similar findings are reported by Koschatzky et al. (2001: 19/20) who – referring to business service firms in Baden, Gironde and South Holland – find that especially in Baden, critical assessments of the regional framework conditions were higher than in the other regions, though coupled with higher shares of innovative firms (cf. Koschatzky et al. 2001b: 12).[2]

These findings indicate that innovation performance, firms' perceptions of their environments and the endowment of a region with innovation support are not necessarily related in the way 'the better the regional endowment with innovation support, the more positive firms' perceptions and the higher their innovation performance'. However, this could also indicate that firms in rather peripheral regions, i.e. in environments without a 'critical mass' of innovation-supporting infrastructure, can also be innovative. Muller (2001) shows that linkages between manufacturing small and medium-sized firms and knowledge-intensive business services may lead to a 'virtuous circle' of knowledge creation and innovation, and illustrates that due to these kinds of interactions, peripheral regions must not obligatorily be disadvantaged (cf. Muller 1999). In line with this result, Vaessen (1993) finds productive and competitive companies in comparatively "unfavourable" production environments: "Contrary to what is implied by mainstream

impact of the local environment on the innovative behaviour or capabilities of persons and firms."

2 These cited studies are based on data collected in the frame of the European Regional Innovation Survey (ERIS, cf. chapter 5).

regional development theory, entrepreneurs do not resign themselves to the whims of the production environment. They not only exploit the opportunities of the local production environment but also counteract regional shortcomings and disadvantages." (Vaessen 1993: 15). Firms respond actively to external conditions of their region and pursue an active approach to tackle locational disadvantages effectively (notion of the reactive organisation) through adaptation strategies (cf. Vaessen 1993: 40/41 and 77ff.).

Equally, the endowment of a region with innovation support – as evaluated by external observers - and a firm's view of its region do not necessarily coincide as the above cited examples show. From these findings could be derived that firms with more pronounced levels of innovative activities are more critical in assessing their environment, or that diverging perceptions reflect different mentalities of the respective firms. The perception perspective and the resulting assumption of the subjective and selective character of peoples' views of their environments would suggest that firm representatives' regional perceptions are related to their firms' internal innovation processes. This may contrast their view from that of external observers, since external observers may tend to study the regional endowment from a different – perhaps a more general – viewpoint. So the regional pictures gained by a firm representative and an external observer do not necessarily coincide. The following analysis focuses on the perception of innovative firms and their representatives, located in two neighbouring regions which are embedded in different national backgrounds: Alsace and Baden. The question is put forward if there are specific 'innovation and perception patterns' of firms in these regions, i.e. if there are spatial characteristics of innovation and perception of regional innovative firms that can be contrasted to the respective characteristics of innovative firms in the other region. It is asked how firm representatives perceive their environments, and if firms' perceptions as well as their innovation behaviours are stable or rather evolving in time.

This analysis argues that firms' actions including their innovation behaviours, are taking place in their specific environments, in the environment as firms (better: their representatives) see and perceive it. This view may differ from the impression an external observer gets of the region. The hypothesis is made that firms and their representatives have a certain view of their innovation environment which is associated to their internal innovation activities. But these relationships are not evident at first glance; they are supposed to be rather indirect, to build the mental framework of firms' actions. This picture of the region is assumed to shape the context for firms' innovation behaviours, less in the form of an independent variable with predictive impact, but rather as the general context in which innovators and their firms decide and act.

The following investigation refers to the different approaches of innovation in their spatial contexts and tries to add the subjective perspective of firm representatives, more precisely the perceptions of their environments with respect to innovation. The perception perspective is considered from the psychological and the sociological backgrounds, emphasising the cognitive and subjective character of peoples' mental representations. Finally, the spatial dimension is added through the reference to perceptive and behavioural approaches in geography. In the following, the innovating firm, its innovation behaviour and selected regional perceptions of firm representatives – the manager of the firm or the person in charge of research and development - are placed in the centre of the analysis. Perceptions are measured in terms of firm representatives' evaluations of selected innovation-related regional aspects. Innovation inputs in terms of expenses and human capital devoted to research and development (R&D) of manufacturing and knowledge-intensive business service (KIBS) firms in both regions are revealed and observed in the frame of their general national and regional contexts. Furthermore, the analysis considers innovation inputs and perceptions of the same firms at two points in time, attempting to search for possible intertemporal patterns. The explorative analysis shows that innovation inputs and perceptions are associated via the firm groups, displaying different patterns among manufacturing and knowledge-intensive business service firms in Alsace and in Baden and pointing at specific innovation modes. The analysis can draw conclusions concerning innovation and perception structures in time, revealing different degrees of stability.

The analysis is organised as follows: The first chapter gives a short overview of approaches in innovation and spatially oriented research. It shows that the innovation-space issue has different facets and research foci. Chapter 2 then introduces the perception perspective from different angles, starting from the psychological perspective, passing to sociologist and to spatially oriented concepts. The succeeding third chapter tries to summarise and synthesise the theoretical conceptions and to introduce the empirical analysis of manufacturing and knowledge-intensive business firms in the surveyed regions of Alsace and Baden. Since – as the following chapter will show – firms' innovative activities are supposed to be embedded in their respective regional and national settings, these context conditions are highlighted in the forth chapter. The fifth chapter then is devoted to the empirical analysis of sample firms' innovation characteristics and their representatives' assessments of selected innovation-related framework conditions. The final section summarises the main results.

1 Innovation and firms' environment: Basic concepts

1.1 Introductory remarks

Up to now, the 'region' has been considered as environment of the firm and is generally referred to as socio-cultural entity below the nation state level.[3] Regions can be defined by a homogenous structure, by functional relationships or interactions towards a centre, and as administrative entities (cf. Bathelt/ Glückler 2002: 45/46). Dicken/ Malmberg (2001: 354-357) prefer the term 'territory' which is not confined to the subnational scale. According to them, a territory contains physical, social, cultural, political and economic attributes. Firms and their innovative activities are rooted in labour markets, 'sticky' knowledge and technologies, production chains, as well as networks, personal contacts and trust. These factors make up firms' 'territoriality'. Knox/ Marston (2001: 282-284) derive territoriality from a specific type of embeddedness of individual humans in space. According to these authors, territoriality is related to a specific set of social rules, of control over resources, and is the frame for cultural identity. The following analysis is going to refer to two spatial entities below the nation state level: Alsace, one of the French *régions*, and Baden, the western part of Baden-Württemberg, Germany. Alsace is an administrative region, whereas the former *Land* Baden is a part of the federal state Baden-Württemberg (cf. section 4.1).

Reflections concerning the impact of the external innovation environment go back to the beginning of the 1900s, to Marshall who claimed the "atmosphere" around firms as having an influence on firm-internal activities. In the aftermath, different branches of reflections, concepts and empirical research focused on the role of "the region" in innovation. Innovation and the region are in the following section approached from three different viewpoints: (i) innovation models, (ii) regional research with innovation focus, and (iii) findings from spillover and proximity research (cf. figure 1). There are intersections between these three research lines, showing the interrelations between the considered issues.

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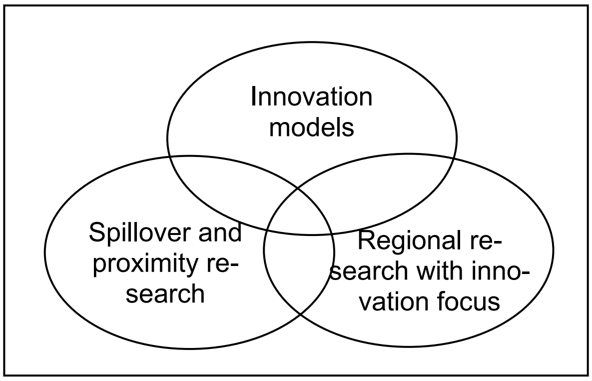
3 According to Gold (1980: 131) and in a very broad understanding, a 'region' is a part of the earth with some characteristics that distinguish it from other parts. This conception is flexible and relates to the specific purposes for which it is conceived. He describes regions as "… mental constructs and not objective realities. They are tools in developing an understanding of space, not phenomena with an independent corporeal existence." (Gold 1980: 131). This mental and subjective aspect already gives a preview to part 2 which elaborates the perspection viewpoint.

Figure 1: Basic research lines focussing on innovation, proximity and territories



In this chapter, theoretical reflections concerning innovation activities and the specific contribution of firms' environments are presented. While the first sub-section shortly refers to conceptions of firm-internal innovation processes, approaches presented in the second part start from the region. Finally, spillover and proximity research is based on assumptions concerning the character of innovation-relevant knowledge and its diffusion among actors as well as questions of agglomeration and co-localisation of firms.

1.2 Innovation models and innovation systems

1.2.1 The concept of innovation

It was the merit of Schumpeter to bring the concept of innovation in the discussion of market dynamics and competitiveness. He considered capitalism as evolutionary process, the decisive impulse originating from "… the new consumers' goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates." (cf. Schumpeter [1942] 1979/1976: 83). Schumpeter develops the notion of "creative destruction" - the regeneration of the economic structure from within, i.e. the destruction of the former structure and the creation of a new one – to describe economic development through radical innovation (cf. Schumpeter 1979/1976: 83). The entry of new entrepreneurs with their innovations on the market secures economic growth. Their market entrance reduces or destroys monopoly rents of established companies. This vision is related to the innovator/ imitator model: Characteristic for an innovator is his positive attitude towards risk and innovation. An innovator introduces new products, processes or structures to the market. This leads to a monopolistic rent, i.e. a profit resulting from the temporary monopolistic market situation. The monopolistic rent is the incentive to innovate. A successful innovation is followed by further innovations and imitations introduced by imitator-entrepreneurs striving for achieving a (however smaller) part of the monopoly rent. New entrepreneurs enter the market until the monopoly rent has vanished; this whole process leads to a dynamic economy and evolution as well as new firm foundations. Schumpeter describes in his vision (temporary) monopolies and disequilibriums, creative destruction, and economic fluctuations as crucial for the introduction of innovation and for economic development (cf. Koschatzky 2001: 29). He distinguishes five types of innovation: (i) introduction of new or improved products, (ii) introduction of new production processes, (iii) development of new markets, (iv) development of new supply sources, or (v) changes in the industrial organisation.[4] This cyclical development initiated by "radical innovation" is expressed in the theory of long waves, i.e. cyclical economic development induced by the "process of creative destruction". The initiation of a long wave is related to the introduction of a new technology. In parallel to long waves, shorter-lasting cyclical changes are described. The location of the first occurrence of the new technology initiating a long wave determines the spatial component of the theory (cf. Grupp 1997: 55/56, Bathelt/ Glückler 2002: 202/203 and 247ff., Schätzl 2003: 218ff., Koschatzky 2001: 26ff., OECD 1996: 16).

Empirical innovation studies rely on the definitions of the Organisation of Economic Cooperation and Development (OECD), the European Commission and Eurostat concerning innovation, and research and development (R&D), the Oslo manual: "**Technological product and process (TPP) innovations** comprise implemented technologically new products and processes and significant technological improvements in products and processes. A TPP innovation has been **implemented** if it has been introduced on the market (product innovation) or used within a production process (process innovation). TPP innovations involve a series of scientific, technological, organisational, financial and commercial **activities**. **The TPP innovating firm** is one that has implemented technologically new or significantly technologically improved products or processes during the period under review." (OECD/ European Commission/ Eurostat 1996: 31, emphasis taken over from the original text). This definition shows that (technological) innovations are related to new or significantly improved products or processes. It focuses on three crucial aspects, the first being the novelty character of the developed products and processes. Furthermore, the Oslo manual points at innovations as a broad activity, comprising science and technology,[5] organisational, financial and com-

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4 Koschatzky (2001: 26ff.) gives an overview of Schumpeter's central hypotheses on innovation and research work inspired by his analyses. A detailed presentation and critical discussion of Schumpeter's theory is given by Bathelt/ Glückler 2002: 247-250.

5 Kline/ Rosenberg (1986: 287) define science as "the creation, discovery, verification, collation, reorganization, and dissemination of knowledge about physical, biological, and social nature." Technology (in the narrow sense) refers to the utilisation of natural science. In a broader sense, "technology" comprises the application of knowledge, and methods for the

mercial activities. Finally, the implementation aspect emphasises the application of an invention, i.e. their introduction on the market or their integration in production processes.

An important indicator to measure knowledge creation as a prerequisite for innovation is research and development (R&D), "… a key indicator of government and private sector efforts to obtain competitive advantage in science and technology." (OECD 2006). According to the Frascati Manual, "[r] esearch and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications." R&D comprises basic and applied research, as well as experimental development: "**Basic research** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view. **Applied research** is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective. **Experimental development** is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed. R&D covers both formal R&D in R&D units and informal or occasional R&D in other units." (OECD 2002: 30, emphasis taken over from the original text. Cf. also OECD 2006). Personnel and especially expenditures on R&D are important indicators in innovation-related studies. In international comparisons, for instance, the gross domestic expenditure on R&D (GERD) is widely applied. GERD consists of the total expenditures on R&D by companies, research institutes, university and government laboratories (cf. OECD 2006). The share of expenditures on R&D from the total turnover is generally used as variable for indicating knowledge creation activities on the firm level.

1.2.2 Innovation in the context of evolutionary economics

Evolutionary economics is related to processes of evolution and of selection, referring to laws and principles in biology, thermodynamics and organisational theory (cf. Marinova/ Phillimore 2003: 49/50).[6] Being the focal point for the development of firms and

exploitation of scientific results, as well as the artefacts (cf. Grupp 1997: 10 and also Niosi et al. 1993: 209).

6 Grupp (1997: 52, footnote 9) explains the main differences between neoclassical and evolutionary innovation research: While the former is highly formalised in mathematical models, the latter has a much lesser degree of formalisation. Being based on findings from liv-

markets, the creation of new products and processes became the centre of evolutionary economics. Instead of perfect competition, atomistic markets, full availability of information, complete certainty, unbounded rationality and so forth, evolutionary economics considers evolving structures, bounded rationality (Simon 1957), opportunistic behaviours, uncertain conditions (complex, unstable production environments) and information asymmetries as well as cumulative learning processes. In this context, optimal allocation of resources through the price mechanisms is hampered. Evolutionary economics characterises the economic structure by growing variety and complexity through the development of technologies, organisations and firms. These dynamic processes are embedded in complex and uncertain contexts. Evolutionary reflexions are based on the work of Schumpeter and on his conception of the entrepreneurial impact on the economic structure (see above); evolutionary economics is therefore also referred to as 'Neo-Schumpeterianism'. Economic actors and the economic structure are interrelated; the given structure influences the actors, who, in turn, also change the economic structure through their economic behaviour. This particularly refers to innovators, i.e. to innovative entrepreneurs. The environment offers different options for entrepreneurs' actions, is therefore considered as 'selection environment', as "structural composition of a society within a framework of time and space" (Lambooy/ Boschma 2001: 114). The local environment acts as selection mechanism in the sense that it influences success or failure of innovations through its guiding and constraining impact on behaviour.[7] However, firms are supposed to potentially co-determine selection, because of cumulative and self-reinforcing advantages (increasing returns), resulting from economies of scale, localised learning-by-doing processes leading to the cumulation of tacit knowledge, and network externalities. Due to decentralised decision-making, market outcomes cannot be predicted. Economic growth, according to these assumptions, is the consequence of increasing complexity, the evolution of new variety and changes in the environment, this new variety and increased complexity being the result of new technologies, products, organisations, institutions and locations. Selection mechanisms reduce variety and thus lead to efficiency. The framework conditions of uncertainty, imperfect information, combined with bounded rationality, may lead to the

ing populations, evolutionary innovation models have a high argumentative character. Furthermore, neoclassical approaches are very much about market equilibrium whereas evolutionary models rather look at the processes and paths towards certain market structures (cf. Grupp 1997: 53).

7 As Lambooy/ Boschma (2001: 116) argue: "New variety that does not fit into the environment is bound to disappear. […] In other words, the local environment acts as a sort of selection mechanism that may, or may not, provides conditions favourable to meet the new requirements of change." The selection environment refers to market and non-market factors, i.e. technological principles, institutions as well as norms, beliefs, practices and customs (cf. Lambooy/ Boschma 2001: 116).

phenomenon that firms in certain cases do not follow superior alternatives due to high adjustment costs, high risks and uncertainty. From this can be derived that "… the boundaries of existing trajectories act as constraints on the ability of economic agents to react to changing market signals or changing technologies" (Lambooy/ Boschma 2001: 116); firms behave according to established 'routines'. The concept of standardised action patterns or 'routines' (Nelson/ Winter 1982) points at behavioural patterns of innovators in the problem-solving process of innovation.[8] Specific characteristics of the evolutionary approach are the definition of innovation as changes in existing decision rules and the corporate function of search and problem solving activities. Consequently, the evolutionary innovation approach is not restricted to technical manufacturing innovations, but – through defining innovation as learning process of firms - extends the innovation concept to other, non-technical and non-manufacturing fields (cf. Lambooy/ Boschma 2001: 114-118, Muller 2001: 5-6, Camagni 1991a: 214ff., Bathelt/ Glückler 2002: 195/196 and 237ff.).

1.2.3 Linear innovation models

Linear innovation models describe innovation processes as linear sequences of individual single stages without or with small overlappings. Single phases may be idea generation, research, development, production, introduction to the market. This understanding of the innovation process has in the 1960s led to 'technology push' models which assume that innovation can be induced by technical progress. Basic research is according to this vision the starting point of the innovation process, followed by applied research and experimental development. 'Market driven' models of the 1970s assume linear sequences on the base of the market demand. Here, fundamental research is not attributed a crucial importance. 'Technology push' ideas can be found in policy conceptions that strongly focus on science support, the first and basic stage of the innovation process. This understanding of innovation as linear sequential process is transposed to the spatial perspective by Vernon (1966) and Hirsch (1967). They assume a life cycle of products consisting of the introduction, growth, maturation and decline phases with specific production characteristics and thus different requirements concerning the optimal production location. As a consequence, this optimal location changes in the course of the product life cycle from the centre to the periphery (cf. Mar-

8 According to Nelson and Winter, firms are steadily searching for opportunities to improve their gains, their behaviour being influenced by (i) their knowledge and skills and (ii) the application of certain decision rules (routines). These are being modified with time through new experience and random effects. Firms are in a concurrence situation towards other firms, and the least successful ones are crowded out of the market. Methodologically, this routine-related model is analysed with simulation procedures (cf. Grupp 1997: 76-79).

inova/ Phillimore 2003: 46, Koschatzky 2001: 38, Schmoch et al. 1996: 89-91, Schätzl 2003: 211ff., Bathelt/ Glückler 2002: 228ff.).

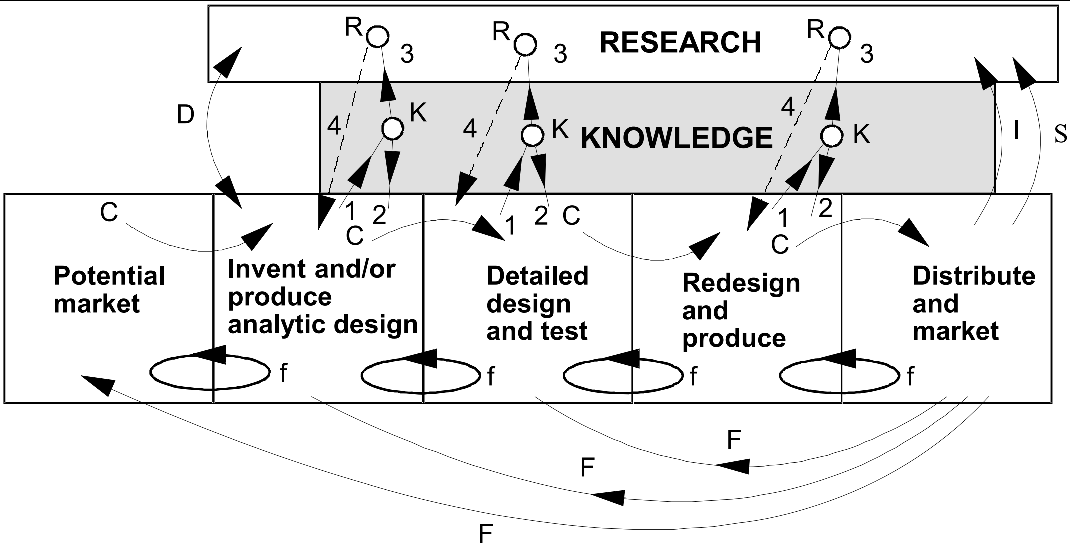
1.2.4 Interactive innovation models

Interactive innovation models understand innovation processes as complex nets of communication paths within the firm, but also with external partners. So these types of models establish the theoretical link between in-house activities and the innovation-relevant community outside the company as well as with the market. Perhaps the most known example of an interactive innovation model is the chain-linked model developed by Kline and Rosenberg (1986).[9] Kline and Rosenberg emphasise the technological and the economic components of the innovation process and consider innovation as "... an exercise in the management and reduction of uncertainty" (Kline/ Rosenberg 1986: 275/276). Essential are the inclusion of market needs and feedback processes. The chain-linked model of innovation consists of five major paths of activity (cf. Kline/ Rosenberg 1986: 289 ff.; cf. figure 2):

1. The central-chain-of-innovation: design-development-production-marketing, based on reflections of the potential market (C)
2. Feedback between the steps and from market needs and users to the next round. Feedback thus belongs to the interrelations between product specification, product development, production, marketing, and service components (F, f)
3. Linkage between the whole innovation process and science. Science occurs in two stages: (i) under the form of stored knowledge, and (ii) as research work in order to create new knowledge (K, R)
4. Radical innovations based on new science (D)
5. Feedback from innovative products to science (I, S).

9 Cf. also Marinova/ Phillimore 2003: 45-48.

Figure 2: The chain-linked model of innovation



C = central-chain-of-innovation

f = feedback loops

F = particularly important feedback

K - R = Links through knowledge to research and return paths. If problem solved at node K, link 3 to R not activated. Return from research (link 4) is problematic - therefore dashed line.

D = Direct link to and from research from problems in invention and design.

I = Support of scientific research by instruments, machines, tools, and procedures of technology.

S = Support of research in sciences underlying product area to gain information directly and by monitoring outside work. The information obtained may apply anywhere along the chain.

Source: Kline/ Rosenberg 1986: 290

Science is in this model not considered as initial step towards innovation as in the linear model, but as inspired by innovation and thus interrelated with all stages of the innovation process (cf. Kline/ Rosenberg 1986: 287 and 290/291).[10] Research can be interpreted as the sum of all accumulated knowledge, including knowledge of the employees and knowledge gained through former research activities. This stored knowledge is continuously supplemented and improved through feedback from the innovation stages design, production, marketing, distribution. If new knowledge is needed,

10 According to Kline/ Rosenberg (1986: 297), innovative companies "... maintain scientific work covering the areas underlying their products, not only because the output of the work will itself produce long-range results, but even more importantly to be sure that in-house knowledge of scientific advances worldwide are observed, understood, and available to the development projects in the organization." This points at the concept of absorptive capacity, i.e. "… the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen/ Levinthal 1990: 128).

known knowledge – stored knowledge of the firm or other knowledge that is commonly available – is referred to first and only in the case where this is not sufficient, new knowledge is generated through research activities (cf. Kline/ Rosenberg 1986: 291. See also Senker 1995: 432).[11] This explains why the direction of technological change is generally determined by technologies already in use. Firms do not need to change their processes if they are successful, thus they prefer to develop their activities along existing lines (cf. Senker 1995: 430). Summarising, the function of research – horizontal to the central-chain-of-innovation and penetrating the innovation process at every point – as well as feedback loops are the main characteristics of the chain-linked model of innovation that distinguish it from linear innovation models (cf. Kline/ Rosenberg 1986: 286-288). Innovation can occur at any stage of the whole process and not only as an end product during the final stage. By referring to factors relevant for innovation, but located outside the innovating firm, interactive models consider firm-internal processes and their environments. Nowadays, innovation is to an increasing extent understood as continuous process which is necessary for firms to maintain their position on the market.[12] Attention is not only paid to radical product innovation, but also to incremental innovation processes, and to process and service innovation. Additionally, besides technological innovation, organisational and social inventions are focused on.[13] This renewed vision of innovation also focuses on the multitude and diversity of knowledge sources that are of importance for a successful innovation project.[14]

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11 As Kline/ Rosenberg (1986: 291) explain it: "… the use of the accumulated knowledge called modern science is essential to modern innovation; it is a necessary and often crucial part of technical innovation, but it is not usually the initiating step. It is rather employed at all points along the central-chain-of-innovation, as needed. It is only when this knowledge fails, from all known sources, that we resort to the much more costly and time-consuming process of mission-oriented research to solve the problems of a specific development task."

12 As Lundvall/ Johnson (1994: 25, footnote 6) describe it, "... innovation has become a ubiquitous process." Cf. also Lundvall 1992c: 49.

13 As Drucker (1985: 29) analyses in retrospection: "This meant that social innovation was far more critical than steam locomotives or the telegraph. And social innovation, in terms of the development of such institutions as schools and universities, a civil service, banks and labour relations, was far more difficult to achieve than building locomotives and telegraphs."

14 According to Drucker (1985: 102), a unique characteristic of knowledge-based innovation is "that they are almost never based on one factor but on the convergence of several different kinds of knowledge, not all of them scientific or technological."

1.2.5 System models of innovation

Rooted in the evolutionary framework, system models of innovation explicitly include firms' environments through their focus on network relationships[15] between different economic actors and through the systemic view of innovation, resulting from its interactive and thus social character, as well as from the knowledge intensity of innovation processes. Contrary to the early understanding of innovation processes, the environment of innovating firms has increasingly been integrated into innovation conceptions, including elements external to the firms with their impact on firms' innovative activities (cf. Marinova/ Phillimore 2003: 47-49, Niosi et al. 1993: 210, 222). The 'National System of Innovation' expression is used since the beginning of the 1990s (cf. Lundvall 1992a); however, as Freeman (1995: 5) states, the conceptual idea can be traced back to List at the beginning of the 1840s.

According to Lundvall (1992b: 2), a system of innovation "... is constituted by elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge...". The system character results from interrelationships between those elements, from the social character of interaction which involveds feedback loops at different stages of the innovation process (cf. Cooke et al. 1997: 478, Niosi et al. 1993: 210).[16] Consequently, a national system of innovation describes elements and relationships "... either located within or rooted inside the borders of a nation state." (Lundvall 1992b: 2). Two main assumptions nourish this definition: First of all the crucial importance of knowledge and the process of learning and secondly the interactive character of innovation.[17] Innovation is thus understood as resulting from so-

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15 Camagni (1991a: 230) describes a network as "… **a closed set of selected and explicit linkages with preferential partners in a firm's space of complementary assets and market relationships, having as a major goal the reduction of static and dynamic uncertainty.**" (emphasis taken over from the original text). Innovation networks integrate different actors and activities with the aim of realising an innovative activity. Interactions between network partners are facilitated by geographical and social proximity (cf. Koschatzky 2001: 120ff. and 145ff.).

16 Niosi et al. (1993: 210) understand the relationship between the system and its environment as follows: "The notion of system also implies an environment, a set of units that lies outside the system; most systems are to some degree open – they have some interaction with their environment. The links between the system and the environment, however, have to be weaker than the interactions between the units of the system itself, for the system to have some level of coherence and persistence through time."

17 McKelvey (1997: 201) describes innovation as collective learning and selection process, and defines systems of innovation as "… a network involving individual and collective processes of searching, learning, and selection among different innovation opportunities, including technical and economic dimensions." Niosi et al. (1993: 212) detail the types of interactions within an innovation system: According to them, interactions can have a techni-

cial interaction between economic actors, since "… firms almost never innovate in isolation." (Edquist 1997: 1). This refers to the institutional and cultural context and leads to consider innovation in its national framework (cf. Lundvall, 1992b: 1, Cooke 1998: 11, Johnson 1992: 23).[18] In this context, Patel/ Pavitt focus on intangible investment in learning and argue that national technological development paths are cumulative and rely on formerly gained experience. "Intangible capital" (personal, organisational, institutional skills) – considered as prerequisitie for countries to appropriate and develop product and process technologies - is widely country-specific and rather immobile on an international scale (cf. Patel/ Pavitt 1994: 78 and 92).

Innovation is related to the context in which it takes place;[19] it is not isolated from other activities in the economic, cultural and political sphere. Innovation is not merely discussed on the level of the single innovating firm, but as taking place in a specific environment which may have a positive influence on the innovation process in firms or innovative networks. Edquist (1997: 1/2) refers to firms' interactions with other organisations – other firms, but also research institutes and universities, banks, government ministries, etc. – as well as to the institutional setting, comprising laws, regulations, norms, rules and standards in the innovation context. Nelson/ Rosenberg (1993: 4/5) conclude that "... the "systems" concept is that of a set of institutional actors that, together, plays the major role in influencing innovative performance." As such, an innovation system is an integral part of the whole activity system of a spatial entity: "... it is somewhat artificial to try to describe and analyze a nation's innovation system as something separable from its economic system more broadly defined, or to depict the policies concerned with innovation as quite apart from those concerned with the economy, education, or national security." (Nelson/ Rosenberg 1993: 13).

Historical and cultural development, institutional patterns and networking structures may differ between different territories of a nation state which may lead to specific patterns of innovation in the territories on a sub-national scale. Thus, when analysing regions and the innovation patterns of firms located there, national as well as regional

cal, commercial, legal, social, or financial character, aiming at developing, protecting, financing or regulating new science and technology.

18 Freeman (1992: 169) distinguishes between the broad sense of the national system of innovation concept, referring to all institutions related to the introduction and diffusion of new products or processes, and the narrow sense focused on institutions with scientific and technical orientation.

19 Vandervert (2003: 23) emphasises the importance of the context in assessing innovations: "… innovation is a feature of learning that occurs regularly in everyone. What makes an innovation an 'important' innovation, or a deeply experienced 'insight' is a matter of its cultural or organizational context, and its degree of generalization."

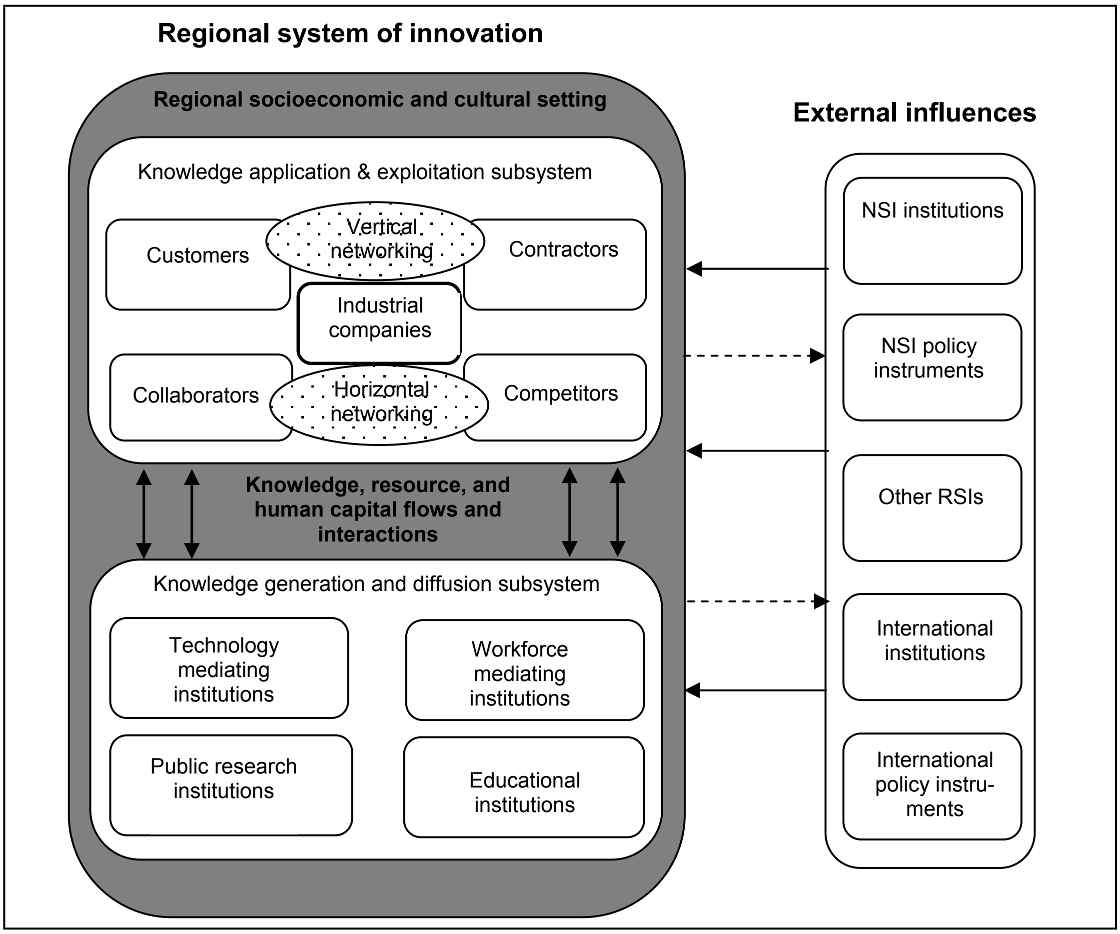
differences are assumed to have an impact on innovation activities and innovation patterns of regional firms. So conceptions of innovation systems on the regional level have been developed (cf. for instance Cooke et al. 1997, or Braczyk et al. 1998, Cooke et al. 2004). Regions are understood in this respect as spatial entities on a sub-national level with own governance structures enabling to implement political measures in favour of innovation (cf. Cooke et al. 1997: 480, Koschatzky 2001: 177). The regional innovation system approach integrates elements from evolutionary economics, innovation theories, governance aspects, as well as new production concepts and industrial district research (cf. section 1.3.1). The approach has a specific focus on proximity between innovation actors and region-specific innovation factors. Spatially oriented innovation approaches argue on the base of the interactive and social character of innovation, and on the base of knowledge and learning processes (cf. Koschatzky 2001: 5/6, Asheim/ Cooke 1998: 203). Johnson (1992: 23) for instance understands innovation as localised in space and time. At first glance, this may not fit to the globalisation tendencies, but firms' "home bases", not easily transferable tacit knowledge as well as personal communication and the facilitating spatial proximity are considered as important location-specific factors in the context of global competition. Heidenreich (2004: 369/370) explains the importance of the regional perspective by the concentration of businesses' core competencies, suppliers and customers in the region.

At the centre of the (regional) innovation system approach is the proximity-based generation and use of knowledge. Regional innovation systems are thus defined as "interacting knowledge generation subsystems" (Asheim et al. 2005: 2). Autio (1998) discusses differences between the national and the regional innovation system concepts. From this point of view, the concept of national systems of innovation (NSIs) is rather codified whereas regional systems of innovation (RSIs) to a higher extent contain tacit elements.[20] According to Autio, two main sub-systems constitute a regional system of innovation: (i) the knowledge generation and diffusion sub-system and (ii) the knowledge application and exploitation sub-system (cf. figure 3). Concerning the former, Autio distinguishes between technology and workforce mediating institutions, educational

20 As he explains: "From the evaluation perspective, NSIs carry several characteristics that help differentiate them from RSIs. As NSIs are conceived as systems of institutional elements and various flows between these, the concept is, in a sense, fairly codified. The concept defines the parts of the system and the links that hold these parts together. As individual agents and their interactions are not the main concern, many of the more tacit elements are left out from the formal concept of NSIs. The same concerns the flows of knowledge, resources and human capital. These are fairly easy to measure and quantify, and summary information relating to these is often readily available from national statistics centres. Finally, as the interactions between agents are not in direct focus, the concept of NSIs carries less socio-cultural elements than does that of RSIs." (Autio 1998: 133).

and public research institutions that create and diffuse codified and tacit knowledge as well as skills. Knowledge produced in public research institutions is to a large extent publicly available and also mainly of codified nature, for instance scientific reports. Those research institutions may directly diffuse this knowledge, or it can be transferred by technology mediating institutions such as technology service centres, licensing offices, etc. Educational and workforce mediating institutions are for instance universities, vocational training institutions, polytechnics, workforce training measures, regional labour offices or career planning offices. Their activities aim at the creation of an appropriate regional skill base. The knowledge application and exploitation sub-system is composed of industrial companies. Autio describes them as "Four Cs", namely customers and contractors whose co-operations are summarised as vertical networks, and additionally collaborators and competitors. Co-operations of the latter are described as horizontal networks (cf. figure 3). According to Autio, the knowledge generation and diffusion sub-system comprises different, mainly public institutions whereas the knowledge produced is mostly exploited and commercialised by industrial companies. Interactions both within and between organisations and the sub-systems generate knowledge flows that, in turn, govern the evolution of a regional system. Thus, in order to describe and comprehend a regional system, both sub-systems as well as the interfaces between them should be considered (cf. Autio 1998: 133-135).

Figure 3: Structure of a regional system of innovation: Schematic illustration



Source: Autio 1998: 134.

Figure 3 indicates that a regional system is embedded in its specific context and that its shape and structure is also influenced by external factors.[21] The regional socio-economic setting of a RSI has an impact on behaviours, norms and rules of regional actors and their interactions: "All RSIs are embedded in their regional socio-economic and cultural setting. The distribution of roles between operating institutions evolves over time, as do the channels and mechanisms for interaction between these. This context specificity makes it more difficult to identify, analyse and transfer good practices and policies from one regional setting to another." (Autio 1998: 136).

21 As Asheim/ Herstad (2003: 2-5) argue in their analysis of regional innovation systems and globalisation, the exclusive reference to regional resources and knowledge cannot guarantee competitiveness. Rather, the (additional) reference to national and supra-national knowledge sources is considered important.

The innovation system concept has a highly applied notion and is frequently used in innovation studies as conceptual base for national or regional case-studies.[22] Cooke (2004: 8/9) presents some recent findings on regional innovation system research. He classifies regional innovation systems according to a matrix with the governance infrastructure and the business superstructure dimensions. Concerning the modes of regional innovation (innovation governance infrastructure), Cooke (2004: 10ff.) distinguishes between grassroot, network and dirigiste regional innovation systems. Grassroot regional innovation systems are characterised by the importance of local institutions and applied research relevance, in that technology transfer and innovation funding are generally rather originating from local sources. Research and technical specialisation tends to be market-oriented and application- or problem-solving oriented. These characteristics entail limited supra-regional co-ordination activities. Network regional innovation systems have a multi-level structure of technology transfer actions, and funding is guided by the government, banks, and firms. Research activities are both in the fields of basic and of applied sciences. These basic characteristics require a high degree of system co-ordination. France and the French regions are described as examples for dirigiste innovation models where technology transfer activities are initiated outside the region. Typical is the central organisation of funding, though through decentralised agencies in the regions. Research in such regions is assumed to be emphasised on basic activities and rather related to the needs of large firms. According to Cooke, regional innovation systems of this type require much co-ordination and also have a high degree of specialisation (cf. Cooke 2004: 10-13. See also Cooke 1992: 366ff.).

The second dimension of this matrix, the business innovation dimension, focuses on firms in their regional economic context, i.e. on relationships between firms and other actors, and distinguishes between local and global reaches of the firms. This dimension looks at innovation patterns, research activities and the regional milieu for innovation. In this line, Cooke distinguishes between localist, interactive and globalist regional innovation systems. A localist regional innovation system is characterised by few or no (large) indigenous firms and further firms having their headquarters outside the region. The research culture is mainly oriented towards the region itself, and research resources tend to be smaller in scale. Regional actors tend to be highly associated to each other. Compared to this type, interactive regional innovation systems have a mixture of large and small (regional or external) firms that both use regional and external

22 As Lundvall et al. (2002: 221) argue: "The focus on innovation systems is less reflecting a theoretical abstraction and more the practical needs of the participants in the complex division of productive and innovative labour in modern economies."

innovation sources. Public and private research institutes respond to the research needs of the firms, and the regional government has a policy focus on innovation. Regional actors are associated to a high degree. Globalist regional innovation systems finally are characterised by a dominance of global corporations and (partly dependent) SMEs in the supply chain of these large firms. The dominance of these large firms leads to rather private internal research activities and guides the regional association structure. However, regional SMEs may be supported by the public innovation infrastructure in the region (cf. Cooke 2004: 13-16).

Contrary to the geographically defined innovation system approaches, sectoral systems of innovation and production focus on the sectoral level of production and innovation (cf. Malerba 2002, 2004a, 2004b). Sectoral systems of innovation and production are understood as comprising new and established products related to specific demands, and actors who create, produce and sale those products. These latter activities are achieved through market and non-market, i.e. network interactions. Specific for sectoral systems of innovation which focus on specific product groups, is their knowledge base, technologies, demand and input (cf. Malerba 2002: 248, Malerba 2004a: 1). Malerba (2004b: 10 and 17ff.) distinguishes three building blocks of a sectoral system of innovation: (i) A specific knowledge base, technologies and inputs, referring to the specific scientific and technological knowledge base for innovation in this sector, and knowledge concerning the application and use of sectoral products, (ii) the major actors (firms, clients, suppliers, universities, financial institutions, government agencies, local authorities, etc.) that innovate, produce and sale the sectoral products. They generate, adopt and use new technologies, they thus accumulate knowledge and they learn, and (iii) institutions, including norms, routines, habits, practices, rules, law, standards, in short: conditions that influence cognition and interactions among agents. Sectoral innovation systems overlap with nationally and regionally defined ones, with the regional level being often more appropriate to the analysis of sectoral systems due to the highly localised character of sectoral innovation and production (cf. Malerba 2002: 251ff., Malerba 2004a: 1-3, Malerba 2004b: 17-28 and 33-35).

Concluding, the innovation system research integrates evolutionary economics and regional development theory and thus aims at a better understanding of innovation processes. Cooke (2004: 17) characterises innovation systems as "… evolving as their contextualisation elements shift with globalisation, the rise of knowledge-intensive industry and the hollowing-out of 'Industrial Age' industries." The understanding of the different actors, actor groups and sub-systems, thus the elements and their interactions, guides applied analyses of interrelated innovation processes and allows the formulation of implications for the support of innovation. On this conceptual base, it can be evaluated if the region in question meets the regional innovation system characteristics. This is of importance for regional and innovation policies (cf. Koschatzky 2001: 178). However, following Iammarino (2005: 504 and 513), only a few functioning regional innovation systems exist, since the system characteristics (i.e. internal coherence, collective identity) are not met in every region. Morgan (2004: 17) also points in this direction when he states: "Like clusters, subnational territorial innovation systems may also be more problematical than we think, at least if we distinguish between genuine innovation processes that have assumed a territorial form and the more common situation whereby localities and regions have created an enterprise support system for the express purpose of promoting innovation. […] The specification of a *territorial innovation system* needs to be more than an inventory of the institutions and the interactions considered necessary for success." (emphasis taken over from the original text).

1.3 Regional research focusing on innovation

The regional innovation systems concept can be considered as interface between innovation-oriented and region-oriented approaches due to its focus on the interactive character of innovation projects and on the social and localised character of learning and innovating.

In regional sciences, the region as a socio-economic entity is at the centre of analysis. Approaches dealing with firms' actions in their (regional) environments embrace:

- location theories i.e. theories explaining location decisions of single-plant firms from a cost viewpoint, searching for least-cost locations[23]
- regional development theory that focuses on the development of territories and especially on regional inequalities.[24]

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23 Industrial location theory goes back to Weber and his locational reflections for one manufacturing firm (Alfred Weber 1909: "Über den Standort der Industrie"). Under certain simplifying assumptions, the optimal location is first and foremost determined by transport costs, further influenced by labour cost and by agglomeration effects. Von Thünen ("Der isolierte Staat in Beziehung auf Landwirtschaft und Nationalökonomie" 1826) develops a locational approach for the agricultural and Christaller ("Die zentralen Orte in Süddeutschland" 1933) for the service sector (cf. Schätzl 2003: 63ff., 72ff., Bathelt/ Glückler 2002: 93ff. and 124ff. Cf. also Vaessen 1993: 18). These approaches incorporate the spatial dimension into economic analysis by relying on micro-economic assumptions such as competition, homogeneous physical environment, rational decisions, and uniform tastes. In this context, 'homo oeconomicus' behaves rationally in his strive for an optimal solution (cf. Gold 1980: 30/31).

24 Different models have been developed to explain inequalities in regional growth and development (cf. Schätzl 2003: 158ff.). These are for instance the sectoral growth pole approach (Perroux 1964, e.g. "L'économie eu XXème siècle"), the hypothesis of the circular causation of a cumulative socio-economic process (Myrdal 1957: "Economic Theory and Underdeveloped Regions"), or the hypothesis of sectoral and regional polarisation (Hirschman

Organisational or behavioural approaches on the other hand understand the environment as spatial manifestation of human behaviour (in the case of firms: entrepreneurial decisions). Pred's behavioural approach of decision-making in the spatial context for example can be mentioned under this heading. Pred (1967) developed the 'behavioural matrix' of locational decision-making based on the availability of information and the ability to use this information. The quality of an entrepreneur's decision making thus depends on the quantity and quality of available information and on the entrepreneur's skills to use this information: The probability of a good location decision is higher when the entrepreneur has high information availability and high skills.[25] Pred conceives the entrepreneur as operator in conditions of uncertainty, rather reaching satisfactory than optimal solutions in the spatial context (cf. Bathelt/ Glückler 2002: 131, Gold 1980: 30-33, Walmsley/ Lewis 1985: 57/58). More recent approaches focus on economic activities, their spatial manifestation and dynamics within an evolutionary framework.[26] "New" conceptions in geography are discussed in the frame of the knowledge economy, more precisely related to the relationship between technical change and space. They refer to dynamic approaches to explain interregional and international shifts in economic activities – for instance the spatially oriented product life cycle approach (cf. page 10), or the Schumpeterian long waves with reference to the spatial context in which radical innovations occur – as well as evolutionary approaches in the context of the knowledge economy. Three more recent approaches – industrial districts, innovative milieus and learning regions – are shortly presented below.

1.3.1 Industrial districts

Having a strong focus on interwoven, territorially rooted production processes, two conceptions of success stories have been discussed in the 1970s and 1980s: Industrial districts and creative or innovative milieus (cf. section 1.3.2). Industrial districts can be

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1958 "The Strategy of Economic Development"). More recent dynamic approaches in the evolutionary context will be treated in this section.

25 The quantity of information depends on the use of the media, the ability to select information, and information source's credibility. Individual's ability to make use of the available information is influenced by his/ her intelligence, experience, flexibility and adaptiveness as well as desires, preferences, attitudes and expectations (cf. Walmsley/ Lewis 1985: 57). However, the focus is on probability; it is not impossible – though relatively unlikely - that an entrepreneur with little information and skills reaches a better solution (cf. Gold 1980: 32).

26 Generally, the 'rediscovery of space' in economics, based on the work of Krugman and Porter, is associated with the term "new economic geography". It incorporates assumptions like endogenous technical change in growth and trade theories which – in contrast to equilibrium models in neoclassical economics - can refer to convergence and divergence in interregional growth (cf. Koschatzky 2001: 1ff. and 378-380, Schätzl 2003: 201ff.).

described as networks of small and medium-sized enterprises with flexible production modes, a high degree of specialisation and mainly vertical production linkages. They have particularly been observed in the north east of Italy ("third Italy"), in (parts of) the regions Emilia-Romagna, Toscana, Umbria, Marche, Veneto, Trentino-Alto Adige and Friuli-Venezia-Giulia. Characteristics are high growth rates in rather traditional hand-craft branches such as textiles, clothes, shoes, leather or ceramics. The conception of industrial districts dates back to Marshall (1920) and comprises local networks of highly specialised and co-operating SMEs. The district is characterised by a distinct division of labour between the firms that have their core competencies in single steps of the whole production process. The whole network of firms thus holds broad production competences built up by the specific competences of the network members. Thus, the network is able to react in a flexible way on changing demand.[27] Geographical proximity enables frequent personal interactions which, in turn, facilitates co-ordination within the network, fosters information flows and thus the generation of new ideas and collective learning. On the other hand, the risk of opportunistic behaviour of single network members is decreased. The stability of production networks is enhanced by trust and the embeddedness in the specific socio-cultural environment. Finally, the high density of formal institutions (institutional thickness) supports production and growth (cf. Bathelt/ Glückler 2002: 182ff., Koschatzky 2001: 186ff., Asheim/ Cooke 1998: 211). The success story of industrial districts in Italy led to search for similar locally rooted production structures in other places and to discuss the transferability of the concept. Indeed further industrial districts have been identified and discussed, for instance the mechanical engineering sector of Baden-Württemberg, eyewear in the French Jura, or the high-tech-industry in Silicon Valley. But, as Bathelt and Glückler (2002: 188/189) argue, the specific socio-institutional environment in the Italian regions - the base for the development of those districts - is hardly reproducible through policies in other regions and settings. Bathelt/ Glückler assess industrial districts of the third Italy as a rather singular phenomenon. Additionally, though the stability of interorganisational networks within the district has been identified as success factor, the inward orientation of industrial districts may prove unfavourable to cope with future structural problems (cf. Koschatzky 2001: 192), and the strong internal structures may be an obstacle for generating new production modes: "Regional or national lock-in effects tend to cement yesterday's success formulas as permanent institutions." (Heidenreich/ Krauss 2004: 188).

27 This is based on production in small series answering client demand, on economies of scale and scope through flexible organisation of production, on co-operation, mobility within the district, and on vertical production linkages (cf. Koschatzky 2001: 186).

1.3.2 Innovative milieus

Partly in parallel to the "identification", description and discussion of industrial districts, researchers of the GREMI[28] group developed the conception of innovative or creative milieus. A milieu (or firms' local environment) is defined as a set of complex territorial relationships that comprise the production system, various economic and social actors with a specific cultural background and representation system. Innovations are generated in formal and informal networks of interrelated actors through dynamic collective learning processes within limited spatial borders. Thus, the focus of the milieu approach is on innovative firms in their specific local environment and socio-institutional structures. Innovative capacities, according to this approach, result to a lesser extent from individual firms' activities, but rather from collective actions that are related to specific economic and social processes and patterns. Territorial interrelations between firms and market relations are at the core of the milieu that supports entrepreneurial activity and, in turn, profits from regional co-operations between actors. Regional innovation-related framework conditions and the endowment of the region with production factors frame the context and conditions for firms' innovative activities which, in turn, shape the regional innovation conditions and lead to a favourable regional evolution. The innovative milieu approach is particularly referring to small and medium-sized enterprises. Innovative milieus have been identified in regions with high innovation potentials and firm agglomerations in high-tech sectors. The localised value chain, specialised in certain technology fields, is embedded in the socio-institutional structure and profits from transaction cost advantages through geographical proximity. The impact of proximity is deduced from local human resources, the importance of (mainly informal) contact networks and the common cultural, psychological and (often) political background. Key actors are embedded in complex networks with strong local bases. Networks facilitate co-operation, and make information, know-how and financing available to the members; formal and informal flows of information and knowledge provide a common knowledge base. Based on the common cultural background, the milieu has specific routines, norms and behaviours, common representations and beliefs, and is characterised by a high degree of trust among its members. The local milieu can contribute to reduce uncertainty, one crucial aspect in the evolutionary paradigm. Though innovative milieus are territorially bounded, external knowledge exchanges are considered crucial. The absorption and use of this knowledge requires a high absorptive capacity from local innovative firms (cf. Bathelt/ Glückler 2002: 189ff., Koschatzky 2001: 6/7 and 201ff., Schätzl 2003: 233ff., Camagni 1991a: 223 and 226).

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28 *Groupe de Recherche Européen sur les Milieus Innovateurs.*

An example for an innovative milieu is the clock and watch industry in the Swiss Jura (cf. Bathelt/ Glückler 2002: 192). Precision engineering had a long tradition in this region, and after the decline of the traditional industry in the 1970s, the local production shifted to microelectronics. This successful change is based on formerly accumulated competences. Restructuring has been widely advanced by regional firms, leading to new specialisation patterns, as well as transfer of the accumulated knowledge and experience in microtechnologies and electronics to other fields. This process was accompanied by an increased external orientation of the firms on the one hand, enabling the acquisition of external knowledge and technologies, and the intensification of interactions between local firms – mainly specialised SME – and between local firms and research and education institutes on the other hand. Innovation was fostered through the involvement in formal and informal local institutional networks, which reduced uncertainty and increased identity and the sense of belonging among local actors.

Summarising, innovation is conceived as localised phenomenon based on available resources. Innovation is understood as resulting from a collective, dynamic process of various regional actors. The milieu is constituted by firms, policy-makers, institutions, employees and their interactions, related through collective learning processes. Interactive learning is highly supported by a mobile workforce, production linkages and face-to-face contacts. Collective learning processes reduce uncertainty for firms within the milieu. They develop a 'transcoding function' which translates externally available information into knowledge that can be applied. These processes require a common language and a common culture (cf. Camagni 1991b, in Lawson/ Lorenz 1999: 309, Fritsch et al. 1998: 245/245). The juncture between innovation activities in firms and the region is knowledge: Knowledge is the crucial input necessary for any innovation activity which can be made available by the regional infrastructure and especially in networks of different regional actors.

1.3.3 Learning regions

In the mid-1990s, the high value attributed to knowledge – particularly tacit parts which are not easily transferable, thus localised – and learning led to the conception of the 'learning region' (cf. Florida 1995, Morgan 1997). Attention is on knowledge generation and continuous learning, more precisely in intellectual labour: "In the knowledge-intensive organization, intelligence and intellectual labour replaces physical labour as the fundamental source of value and profit." (Florida 1995: 528). Innovation is conceived as continuous process within the firm, thus not separated from firms' production activities. This leads to the notion of the "knowledge-intensive factory" characterised as an "… increasingly clean, technologically advanced and information-rich environment." (Florida 1995: 529). Learning occurs in every sphere of production and social life. This enhances flexibility and continuous development. Within the general context of internationalisation of economic activities, regions are supposed to become focal points for economic, technological, political and social organisation, in short: "The new age of capitalism requires a new kind of region. In effect, regions are increasingly defined by the same criteria and elements which comprise a knowledge-intensive firm-continuous improvement, new ideas, knowledge creation and organizational learning. Regions must adopt the principles of knowledge creation and continuous learning; they must in effect become *learning regions*. Learning regions provide a series of related infrastructures which can facilitate the flow of knowledge, ideas and learning." (Florida, 1995: 532, emphasis taken over from the original text). The conception of learning regions thus focuses on creativity and intellectual capital, on interactive learning in the regional innovation environment, and has an important focus on human capital. Innovation in a learning region is not an exception and singular event, but something that happens continuously. Innovative activities must be supported by an appropriate production and education system, by suitable governance structures and by a favourable mentality and climate towards learning. Regional success factor is the ability to mobilise and use knowledge and ideas. Education and training are conceived as learning systems, supporting life-long learning and team orientation. Florida (1995: 534) thus requires governance structures similar to those in knowledge-intensive firms, including networks, a decentralised form of decision making, flexibility, and an emphasis on the needs of customers. Summarising, a learning region can be considered as a territory in which firms are connected to the regional environment and in which learning takes place on different levels. Innovation processes are closely embedded in and related to the context conditions, innovation is thus localised. Communication, collaboration, interaction and common projects are outstanding characteristics of a learning region which is thus a dynamic region. Regional actors – individuals, firms and institutions – are in continuous learning processes which gives a learning region an evolutionary character (cf. Florida 1995, Maillat/ Kébir 1999: 440).

Florida further develops his concept of regional learning, focusing on creative and talented human capital and the relationship between human capital, technology and regional income (cf. Florida 2002). He identifies a high geographical concentration of talent – measured as percentage of the population with bachelor's degree – at the regional level of the United States. Talent appears to be associated to regional openness or diversity, indicating that regions with an 'open' attitude and thus low barriers to entry have a high share of talented people. Talent is also associated with high-technology industry location: "[t]alent and high-technology industry work independently and together to generate higher regional incomes. In short, talent is a key intermediate variable in attracting high-technology industries and generating higher regional incomes."

(Florida 2002: 744). Consequently, less the attraction of (high-tech) firms, but of talents, supported by an open attitude (tolerance), is placed at the centre of the studied relationships. The creation of favourable regional framework conditions for the attraction of talented people is thus considered crucial (cf. Florida 2002: 754).[29]

1.4 Knowledge and proximity

Proximity-related approaches focus on agglomerations and spatial clusters based on (knowledge) spillovers. Analyses in the late 1980s and in the 1990s show that parts of new knowledge generated through R&D activities in firms or research institutes may spill over to other actors and can be used by further firms. This is due to the non-rivalry character of knowledge, which results in the fact that knowledge cannot fully be appropriated by its creators (cf. Oerlemans/ Meeus 2005: 92). This relationship leads to the assumption that firms tend to locate near knowledge-generating institutes such as universities. Proximity is assumed to be important for knowledge flows, particularly for tacit knowledge spillovers: "Although the cost of transmitting information may be invariant to distance, presumably the cost of transmitting knowledge rises with distance. That is, proximity and location matter." (Audretsch/ Feldman 1996: 630).[30] Audretsch/ Feldman (1996) find that industries in which knowledge spillovers frequently occur – industries that strongly rely on business R&D, university research and on skilled labour – rather tend to cluster their innovative activities than industries in which knowledge spillovers are less prevalent (cf. Audretsch/ Feldman 1996: 639). Empirical studies show that firms can benefit from the R&D activities of other actors in near technological proximity.

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29 In the European context, Florida/ Tinagli (2004) find that competitive locations shift from France, Germany and the United Kingdom to northern European Countries. Concerning the "creative class" index, i.e. the share of creative occupations (scientists, engineers, artists, musicians, architects, managers, professionals and others) of the total employment, Belgium (29.97 %) and the Netherlands (29.54 %) nearly achieve the US share of 30.08 %. The United Kingdom has 26.73 % and Germany 18.17 % (cf. Florida/ Tinagli 2004: 13/14).

30 Knowledge economics distinguishes between data, information and knowledge. Data are the result of single activities like experiments. Information comprises data in a systemised manner, and knowledge includes a cognitive component which allows to understand and to interpret the transmitted information (cf. Nonaka et al. 2000: 8): "Without being put into a context, knowledge is just information, not knowledge. Knowledge-creating processes are necessarily context-specific, in terms of who participates and how they participate in the process." This latter requires skills to grasp information and to be able to assess this information, i.e. it is necessary to know the code that is necessary to transform information into knowledge (cf. European Commission, 2000: 10, footnote 6, Senker, 1995: 427). Liebeskind (1996: 94) characterises knowledge as information which has been proven for validity; thus, unproven information such as opinion or belief are not considered as knowledge in this respect. This cognitive element is also emphasised by Polanyi (1997: 142) and his example: "… mathematical theory can be learned only by practicing its application: its true knowledge lies in our ability to use it."

Localised knowledge spillovers from science-based activities effect higher innovation rates, increased entrepreneurial activity and productivity. However, spillover of new economic knowledge is geographically limited (cf. Feldman 1999: 7/8 and 30). Audretsch et al. identify universities as location factor of new high-technology firms. Crucial in this respect are the knowledge type (share of tacit and codified parts) and the spillover mechanism (referring to the human capital educated in universities) (cf. Audretsch et al. 2005: 1120/1121).

Geographical closeness to research institutes has been considered particularly important in emerging technologies and in first development phases of an innovation (cf. for instance Oerlemans/ Meeus 2005: 91 and 95. Cf. also Koschatzky 2001: 49/50). Rallet and Torre of the French Proximity Dynamics group[31] argue that proximity relationships are more complex, i.e. that besides geographical proximity, other proximity types should be referred to. They attribute organisational proximity a central role whose advantages may be compared to geographical proximity.[32] Torre and Rallet argue that organisational proximity combined with mobile human resources may be an adequate basis for knowledge exchanges that no longer require permanent co-location (cf. Rallet/ Torre 1998, Torre/ Rallet 2005). Industrial districts and innovative milieus or local production or innovation systems dispose of both proximity types, but organisational proximity must not necessarily have a geographical dimension. Geographical proximity facilitates interactions, but it cannot induce them. Due to the increased mobility of information, goods and especially people, "the constraint of geographical proximity, which is real for certain types of interactions – in particular for services or the sharing of knowledge – can be fulfilled temporarily through travelling without the interaction lead-

31 Cf. http://w3.univ-tlse1.fr/LEREPS/proximite/VF/indexbis.html.

32 Geographical proximity "… expresses the kilometric distance that separates two units (e.g. individuals, organizations, towns) in geographical space." Since geographical proximity depends on (i) the means of transport used and (ii) the judgement made by individuals on the geographical distance as well as individuals' perception of these two indicators, Torre and Rallet understand geographical proximity at a time t as "… a physical space data representing a constraint imposed, at that particular time, on the actors to develop their actions." (Torre/ Rallet 2005: 49). On the contrary, organisational proximity – an organisation's support of interactions between its members - is relational (cf. Torre/ Rallet 2005: 49). Torre/ Rallet explain this by (i) the logic of belonging to this organisation, i.e. being member of the same organisation facilitates interactions due to rules and routines and (ii) the logic of similarity, i.e. a common system of representations, shared beliefs or knowledge by members of the same firm, consortium or network (Torre/ Rallet 2005: 49/50. Cf. also Rallet/ Torre 1998: 6).

ing to the permanent co-localization of the partners." (Torre/ Rallet 2005: 53. Cf. also Rallet/ Torre 1998: 6-8).[33]

Boschma (2005) relates different proximity types - cognitive, organisational, social, institutional and geographical proximity[34] - to the "degree" of proximity. He argues that a certain distance is helpful to avoid for instance lock-in effects. Boschma declares cognitive proximity as prerequisite for learning and thus for innovation. Organisational, social, institutional and geographical proximity mainly facilitate contacts and co-ordination between different actors. As Boschma (2005: 71) summarises: "In theory, geographical proximity, combined with some level of cognitive proximity, is sufficient for interactive learning to take place. Other forms of proximity may, however, act as a substitute for geographical proximity." This is due to his argument that geographical proximity can facilitate co-operation and interaction, but is not declared as prerequisite or sufficient precondition for interactive learning (cf. Boschma 2005: 71). Morgan (2004: 3ff.) argues that geographical proximity still has an important role to play, particularly on learning, innovation and development. According to him, the capacity of information and communication technologies to reduce or destroy distance effect is often overestimated. This is due to the fact that information may be easily transferable, but that understanding does not, and that tacit knowledge is at the core of learning and innovation. The spatial dimension is added through the character of tacit knowledge, being person-embodied and context dependent; thus "locationally 'sticky'" (Morgan 2004: 7).

Empirical studies have shown that the combination of local embeddedness and more distant relations favour successful innovation. Bathelt (2005) discusses the role of proximity relations in the media cluster in Leipzig, and shows that the combination of close, i.e. cluster-internal, and distant, cluster-external interactions is necessary for a well-functioning local industrial system. He argues that "… the role of proximity in day-to-

33 Torre/ Rallet argue that the necessity for face-to-face interactions and thus the need for geographical proximity differs according to the different phases of common processes between actors. According to them, the starting phase of an innovative project and conflict management between innovators require face-to-face interactions (cf. Torre/ Rallet 2005: 54).

34 Boschma (2005: 63ff.) defines cognitive proximity as knowledge base shared by different actors, necessary for the communication, understanding, absorption and processing of information. Organisational proximity refers to the degree of shared relations in an organisational arrangement; that is the rate of autonomy and the degree of control of arrangements such as networks. Social proximity points at the social embeddedness of relations; social embeddedness being caused by trust. Institutional proximity is related to the institutional framework, and thus mediated by laws, rules, norms and habits. Institutional proximity provides a framework of stability. Geographical proximity finally points at the spatial or physical distance between actors.

day communication between a cluster's actors is greatly supported by knowledge inputs over larger distances from outside." (Bathelt 2005: 106).[35] Sternberg/ Arndt (2001: 370-373) emphasise the importance of the milieu, combined with external relationships for the introduction of innovation: In their analysis of manufacturing firm innovation in ten European regions (ERIS database, cf. section 5.1), they reveal that firms with mainly intraregional as well as those with intra- and interregional network relations have a higher propensity for innovation than firms with mainly interregional innovation linkages or the control group with low co-operation intensity.[36] In their investigation on the analysis of firm-internal resources, organisational and geographical proximity as well as sectoral factors for the relative firm performance of Dutch firms, Oerlemans/ Meeus (2005: 101) also conclude that "… firms with both intra- and interregional innovative ties with buyers and suppliers tend to outperform other firms in the same sector as far as the percentage of innovated processes/ products and relative growth of sales are concerned." Munier/ Rondé (2001) finally show the importance of "knowledge externalities" from academia for the development of private firms' innovation capacities. These externalities are supposed to be (directly or indirectly) related to firms' R&D. Following their findings, a region can support firms' innovation capacities by fostering their innovation competencies via public-private research links (cf. Munier/ Rondé 2001: 517).

1.5 Innovation and the region: Concluding remarks

The preceding section showed different facets of the innovation process and its relation to the place in which it occurs. The understanding of innovation changed from the conception of a linear succession of well-defined stages towards an interactive and evolutionary process containing feedback mechanism between single steps: "Being rooted in evolutionary economics, the innovation process is seen as an interactive process containing feedback loops between the different phases of the whole innovation process and showing interrelationships to the knowledge base at every point of the process."

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35 According to his arguments, knowledge is created both through local interactions or 'buzz' and trans-local 'pipelines' (cf. Bathelt 2005: 106).

36 However, they emphasise the importance of firms' absorptive capacities in order to benefit from network relations and knowledge flows: "Accordingly, it is not the quality of the firm's regional environment and its integration in regional innovation networks that are the main factors in influencing the commercial success of innovations. Rather, it is the intelligent use of intraregional and interregional knowledge resources and networks that create success." (Sternberg/ Arndt 2001: 374).

(Héraud et al. 2000: 3).[37] Knowledge and processes of knowledge generation and application are at the centre of innovation-related research. These conceptions are rooted in evolutionary thinking, in considering uncertainty, change and complexity, as well as interactive learning in innovative processes. Economic agents under these premises are not characterised as 'rational' anymore; and their behaviour is supposed not to be predictable, but to be related to actors' contexts (cf. Lundvall 1992c: 46-48).

Innovation is understood as technical and social process, as a process of interaction between firms and their environment involving different actors and institutions. Different actors generate innovation-related knowledge, and interactive learning occurs; innovation is thus understood as socially embedded, localised process (cf. Asheim/ Cooke 1998: 206/207). This points at the spatial context of innovation, at firms' external environments. Here, different conceptions have been developed which point at specific characteristics of innovation. Industrial districts incorporate successful patterns of inter-firm organisation in rather traditional sectors leading to growth and stability on the regional level. The production mode is characterised by a high degree of flexibility, specialisation and vertical integration (cf. Bathelt/ Glückler 2002: 182). The innovative milieu approach supposes that the local environment creates the socio-institutional framework that fosters collective learning and innovation. The 'milieu', characterised by regional culture and identity, creates the base for co-operative relations and networks. Constituting factors are the high degree of informal relationships as well as collective learning processes (cf. Bathelt/ Glückler 2002: 189-192, Fromhold-Eisebith 1999: 168-171). Even though district and milieu approaches first and foremost emphasise the strong regional identification of the actors, they consider knowledge inputs from external sources as important ingredient for success. However, both industrial district and innovative milieu conceptions have been developed along empirical observations; their strong relationships to the specific local conditions limit generalisation and transferability to other regions. Thus, both conceptions consider innovativity as resulting from collective action and from economic and social processes. This reflects the idea of transferring the competence perspective from individual firms to the regional production system, thus the regional level (cf. Bathelt/ Glückler 2002: 189).[38] The learning region ap-

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37 This view is nowadays broadly accepted: "Among economists who study innovation and technical change, the linear model, has been abandoned. Rather than seeing innovation as a uni-directional process involving basic research, applied research, development and marketing, with each function separated both in principle and in location, economists now use a network or web model of the innovation process." (European Commission 2000: 20).

38 This follows Lawson's arguments: "In other words, although firms and regions are not the same things, both are ensembles of competences that emerge from social interaction and

proach and the geography of talent have a new focus on human capital, learning and creativity, pleading for regions to adopt the learning perspective and to strengthen efforts to attract talents since they are related to technology and regional success.

The knowledge and learning dimensions clearly point at the spatial perspective of innovation. Further common characteristics of the above presented approaches are the interactive character of innovation, the strong focus on SMEs, and the conception of common cultural and social backgrounds of the actors. Geographical proximity is particularly pertinent for explaining tacit knowledge flows, in the case of science-based technologies and for initial stages of technology development (cf. Koschatzky 2000a: 5). Besides spatial proximity, also the cognitive and the organisational variants are considered important. Contrary to approaches related to innovation activities in their regional contexts – which focus on conscious and planned interactions between different actors – research on knowledge spillovers considers those knowledge flows as unintended. These approaches refer to the (partial) non-rivalry of knowledge.

The innovation system approach has been widely used for the analysis of innovation processes in nations and regions. It enables the investigation of the respective settings for innovation and provides an analytical framework for the study of firms' innovation activities (cf. Cooke 1998: 11/12). The investigation of different actors and the matching with knowledge about the functioning of innovation systems allows to assess regional conditions and to draw conclusions about possible weaknesses. Innovation system analyses are generally conceived as case studies. However, some authors (cf. Bathelt/ Glückler 2002: 246) are sceptic concerning the system character and plead for differentiating between regional development paths and regional systems.

Summarising, it has been shown that various conceptions and models exist for explaining the relationship between innovation and the region. The understanding of the role of firms' environments developed from a rather physical dimension, referring to the regional endowment with innovation supporting factors, to a rather relation-oriented function, i.e. as being in interchange with the actors located here and as being modified through their action and behaviour. This is for instance mirrored in the different viewpoints on proximity, enlarging the pure physical concept to the consideration of cognitive, organisational, social or institutional dimensions. Further, the development of institutions and actors, policies, as well as the cultural, socio-economic and historical setting are increasingly taken into consideration.

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so there appears to be no reason at all why the competence perspective should not be as equally relevant to the study of the region as to the study of the firm." (Lawson 1999: 158).

Firms' perceptions concerning their regional environments so far have been indicated in the preceding section. Industrial districts and innovative milieus are based on a strong identity of their actors; the literature points at common representations of the milieu members (cf. page 24). This refers to common visions among the members of the local milieu, thus indicating similar perceptual processes leading to a high degree of identity and feeling of belonging to the milieu. However, the picture innovation researchers gain from their analyses of spatially rooted innovation processes may not always be identical to the picture local firms have of their activities and their environment. There might be different views from integrated actors themselves and from researchers with a rather external view; internal and external images of the region might differ. These issues are discussed in the following section. First, the perception perspective will be treated from the psychological viewpoint, focusing on individuals and their perception processes. Afterwards, cognitive and social perceptual aspects are presented before perception is placed in a spatial context and related to (spatial) behaviour. Finally, two affect-related phenomena, attitudes and mood, are discussed.

The consideration of perceptions aims at deepening the picture of innovation in its territorial context. Due to its applied and policy-oriented character, the regional innovation system approach seems to be appropriate as conceptual framework for the analysis of innovation and perception in the regional context. Together with the high value attributed to knowledge and learning, the underlying conception refers to diverse knowledge sources to be combined in innovation. Thus, innovation is understood as interactive and social process, performed with contributions from diverse (tacit and codified) knowledge sources. From these assumptions results the embeddedness of innovation in its (regional) environment, i.e. in firms' immediate context of actors, organisations and institutions. Through the systemic perspective, the focus is on the different actors as well as interrelations between them.

2 The perceptions perspective

2.1 Introduction

In his book "Innovation and Entrepreneurship", Drucker (1985) defines seven sources of innovative opportunities for entrepreneurs. One of them is the change in perceptions, understood as change in the perception of consumers: "In mathematics there is no difference between 'The glass is half full' and 'The glass is half empty'. But the meaning of these two statements is totally different, and so are their consequences. If general perception changes from seeing the glass as 'half full' to seeing it as 'half empty', there are major innovative opportunities." (Drucker 1985: 90). "What determines whether the glass is 'half full' or 'half empty' is mood rather than facts. It results from experiences that might be called 'existential'." (Drucker 1985: 95).

Although originating from a slightly different context, this citation clearly illustrates the outline of the following chapter. Starting from the verifiable fact that a glass contains 50 % of the original content, it shows that this fact can either be assessed at half full, or as half empty. Both statements are somewhat correct, but referring to different perceptions of the fact. The statement makes clear that one and the same fact can be perceived and assessed differently; these differences shaping the (subjective) view of the fact in question. Two further aspects are of interest: Firstly, assessments or evaluations are rather based on states of the mind - expressed here as moods - than on facts. Secondly, experience, i.e. former learning processes and knowledge gained play a crucial role in the way facts are perceived.

These aspects are in the following transferred to firms, their innovation activities and their territorial environments. In this context, the perceptions firm representatives have of their own activities as well as of their external environment receive a central position. Regional policy-makers might engage in innovation support and the region might provide a close net of infrastructure supporting innovative activities, but this has to be perceived by individual firm representatives and team members of innovative networks in order to be incorporated and applied in their innovative projects. The view an innovator gets from the external environment – mediated by perceptions – forms his/her representation of the situation and thus his/her "reality". This relates to the other aspect Drucker mentions – the importance of mind states or mood of the perceiving individual. The availability of innovation support structure, for instance a technology transfer organisation or a research institute, can be considered as a measurable fact. But how it is assessed seems to be related to the mind state of the perceiver.

In order to get further indications concerning these aspects, a closer view to perception research, especially from the fields of psychology and the social sciences as well as from the geographical perspective seems useful since "[m]any of the decisions that men make seem to be related, at least in part, to the way in which they perceive the space around them and to the differential evaluations they place upon various portions of it." (Gould 1974: 183).

2.2 Perceptions

2.2.1 Psychological perception research

Perception research is a field of central importance in psychology, since perceptions are concerned as basic for further psychological functions: Thinking, feeling, wishing and acting require perceiving.[39] Perception enables individuals to gain information about their environments without being conscious about how perceptions are generated (cf. Hajos 1972: 12). Perception can thus be understood as a specific kind of communication between the individual and his or her environment, and can be considered under physiological or cognitive aspects. On the base of perception processes, pictures or representations of the environment are created.[40]

Physiologically, the perception process starts with a stimulus that reaches the sense organs and is followed by a transfer of information to the brain. Crucial in this process is the central nervous system – brain and spinal marrow – which is connected to the sense organs via nerve cords. External world stimuli or physiological impulses are received by the sense organs, led within the nervous system to brain and are there further processed. Perception research aims at exploring those processes that transfer external environments' features and characteristics into subjective representations, as well as the structure of the sense system that is responsible for this transformation.

39 Rock (1983: 1) emphasises this: "... perception is intelligent in that it is based on operations similar to those that characterise thought." However, he emphasises the reference to individuals' environments as crucial characteristic of perception: "What distinguishes perception from other modes of cognition (such as imagination or dreaming or thought) is that perception is the mental representation of external objects and events that is based upon or in some way corresponds to the stimulation reaching our sense organs." (Rock 1983: 28).

40 As Hajos (1972: 15) analyses: "*Wahrnehmungen sind raumzeitlich organisierte Abbildungen der Außenwelt, raumzeitlich organisierte Informationsgewinne über die Umwelt, über Erfolge und Mißerfolge des Agierens und Reagierens.*" (emphasis taken over from the original text). Perceptions give every person an individual picture of reality because "Wir bilden in unserem Gehirn nicht Wirklichkeit ab, sondern errechnen in unserem Gehirn das, was wir Wirklichkeit nennen." (Eckerle 2000).

Research on perception comprises (i) the description of perception and its content, (ii) physiological processes that describe how stimuli are processed by the sense organs, the central nervous system and the brain, and (iii) the control of behaviour. Perception is usually understood as information processing, i.e. as process that receives and further processes incoming information according to given rules, producing a certain output. Perception thus explains how people interpret messages from their senses (cf. Hajos 1972: 12, Prinz 1990: 27/28).[41]

2.2.1.1 Psychophysics

Classical perception research or psychophysics is based on the works of Fechner (1860), Helmholtz (1866) and Wundt (1862) and concentrates on the relation between the content of perception and available stimulus information.[42] It laid the base for experimental research in psychology. The perception process is assumed to start with a certain (physical or physiological) stimulus which is received by the sense organs (sensation) and then transformed into a (psychological) perception content. Classical (dimensional) psychophysics[43] tries to find out how these (assumed objective) physical dimensions are related to (subjective) psychological dimensions. Since the relation between brain processes and perception content (inner psychophysics) could not be measured in the 19th century, Fechner started from the relation between stimuli of the sense organs and percepts (outer psychophysics) (cf. Hajos 1972: 18ff. and 54, Prinz 1990: 35ff.).[44]

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41 Central in perception research is the process of seeing. The functioning of our eyes enables us to get information about our environment, about "reality" (cf. v. Keitz 1986: 97ff., Prinz 1990: 30/31).

42 Wundt founded the psychological school of structuralism in the 1870s. Its main concern was the study of human consciousness, i.e. peoples' thoughts and feelings. Structuralists do not understand phenomena as single events, but as being in a structural relation to each other. This relationship can be constructed in models. Characteristic for structuralism is the application of introspection. Structuralism influenced the further development of psychology; functionalism - based on Darwin's evolution theory - was one of the reactions to structuralist ideas. Functionalists focus on the personality of the human mind and human behaviour, understood as an individual's adaptation to his/ her environment (cf. Gold 1980: 8).

43 Perception is understood here as simple dimensional transformation of a physical to a psychological dimension (cf. Prinz 1990: 34).

44 Methodologically, Fechner measured the stimuli relations which produced a certain subjective presentation, i.e. he presented the participants of his experiments certain objectively measurable stimuli (light, tone) and analysed the effects on the senses. In order to measure the psychological equivalent of the (physiological) stimulus, he introduced the principle of "*ebenmerkliche Empfindung*" as psychological unit (just noticeable difference, i.e. stimuli differences noticed by the participants of the experiments). Those just noticeable differ-

Structural psychophysics proceeds conversely. Contrary to dimensional psychophysics, the structural approach starts from the perception content and not from the stimulus, trying to analyse this content in detail and then further elaborating why it has the given representation. Structural psychophysics is related to the work of Wertheimer, Köhler and Koffka who developed their ideas between 1890 and 1920. The related ideas are known as Gestalt theory. The basic postulation of Gestalt theory is that perception is based on a certain structure of interrelated elements and that "[b]ehaviour was mediated by the perceptual process, being caused not by the stimulus properties of the environment but by the way these stimuli were perceived." (Gold 1980: 11). The kind of interrelations is described in Gestalt rules which are supposed to be innate. Gestalt theory assumes that human brains work according to a holistic structure with self-organising principles. Single phenomena are assumed to be only understandable in a holistic way since the whole is understood to be greater than the sum of its parts. Perception depends on the filing of a given stimulus into the entire available structure of stimulus patterns. Summarising, perception does not only depend on the stimulus given, but also on the placement of this stimulus within the whole structure of impulse relations. The structure of the impulses or stimuli is organised according to (Gestalt) rules, producing the perception content. Following this understanding, the perception content may have characteristics that could not directly be derived from the stimuli; structural psychophysics can thus be considered broader than the dimensional approach. Thus, the psychophysical relationship is understood as relation between the stimulus structure and the perception structure, i.e. a certain perception is produced on the base of the structure of the whole pattern of stimuli and the role of individual perceptions within this overall structure (cf. Prinz 1990: 34 and 44ff.).

Gestalt theory attributes perception a crucial position between stimulus and response. It considers behaviourism – the assumption of behaviour as a response to stimuli, excluding human mind or human will – as too simplifistic and refers to human mind processes, being placed between the stimulus and the response. Contrary to Gestaltists, behaviourists conceive behaviour as individual's (passive) reaction to events in its environment without paying much attention to mind processes, social or cultural influences. They thus assume a stimulus-response relationship. According to this argumentation,

ences have been analysed with sensory thresholds; a certain threshold is necessary for individuals to notice the stimulus. Perception is then measured by the intensity of the percept. Subsequent approaches rather investigated frequencies of reactions answering given stimuli and determined probabilities of reactions (cf. Hajos 1972: 22ff. and 81/82, Prinz 1990: 39 as well as Prinz 1990: 36ff. concerning measurement, results and discussion of this approach).

behaviour becomes predictable in view of given stimuli (cf. Prinz 1990: 44ff., Walmsley/ Lewis 1985: 55, Gold 1980: 10-12).

The correlative psychophysics approach states that the main function of the psychophysical mechanism is the provision of information about the physical environment as a base for individual action. This does not require a detailed pictographic image of the environment; the representation of the environment is rather considered as symbol. These ideas have been developed by Helmholtz and his Zeichen theory. According to him, the *Zeichen* or symbol must not necessarily resemble the original entity, but should have a stable relationship with it. That means that a certain entity of the environment must – when perceived in similar framework conditions – be consistently represented in human minds. This approach understands psychophysical processes as information processing and not as reproduction of the external environment. A given characteristic can be determined by various aspects of stimulus information, and learning processes determine which information is taken into account in order to construct perceptions. Thus, according to this theory, perception is resulting from construction processes of combining stimuli information from different sources, i.e. different senses – visual perception may according to this approach not only be effected by visual, but by further additional information (cf. Prinz 1990: 34 and 54/55).

2.2.1.2 Cognitive perception research

Contrary to these approaches – which all assume that the process of perception is based on stimuli which are then transformed into the (content of) perception, but which differ in their underlying assumptions concerning the kind of transformation (cf. Prinz 1990: 35) – the more recent cognitive perception research focuses not only on the psychological representation of physical parts of reality, but concentrates on their identity and meaning. Perception is rather placed in relation to cognition and selection, i.e. perception recognises objects and assigns them to object groups or classes. Perception processes are selective in the sense that they absorb certain parts instead of the full range of the available stimuli information.[45] The attribution of meaning results from former learning processes, thus the environmental stimulus reaching the brain is considered as one source for perception, the other ones being experience, knowledge and

45 Downs/ Stea (1974a: 4) summarise the cognitive process as follows: "… the essential characteristics of the cognitive process are its limited ability to cope with and store information and its attempt to form impressions of and tentative decisions about the environment on the basis of limited, fragmentary information under severe time constraints." According to Harré (2002: 6), the principal characteristic of cognitive science is "that there are neural mechanisms by which cognitive tasks are performed."

learning. Stimulus and memory information are according to this approach interrelated in the whole process. The conception of selection refers to the fact that only a part of the stimuli reaching our senses is identified and integrated in the perception process. In other words, our sense organs continuously produce stimuli information and lead them to brain, but only a part of it will be identified, consciously or unconsciously. This aspect is treated as attention or selective attention. Selection is not only a question of volume or content of attention, but also due to the limited capacity of information processing (cf. Hajos 1972: 12/13, Prinz 1990: 33/34, 73ff. and 92ff.).[46]

The whole perception process is understood as follows: First of all, the stimulus is absorbed by the sense organs and modified into biochemical signals. Even though first information about the perceived object is already available at this step – colours are for instance emphasised by the uvulas on our retina – the real information processing takes place in human brain. Here, the characteristics of the stimuli are analysed and then compared with patterns already available from former experience. In the case an appropriate reference is available, the stimulus can be associated a certain meaning.[47] This process of assigning a meaning takes places in working memory. Consequently, working memory is of central importance since only information that arrives here can be perceived consciously. Prior learning processes and accumulated knowledge enable the perceiving person to "know about perceived things". Thus, learning processes and their traces in the cognitive parts of peoples' brains are of crucial importance for them to attribute relevance and identities to perceived phenomena. Since the process of perception requires interrelated information of stimuli and of memory, perception is to a certain extent depending on characteristics of the perceiver and his or her back-

46 From a theoretical perspective, the selection process can be based on emphasising important information parts, and on disregarding or partially processing of irrelevant information (cf. Prinz 1990: 95). These issues are of special relevance for marketing and for market research since stimuli with a higher probability of being perceived are important for advertisement. For instance, certain physical stimuli (large, loud, bright), emotional as well as surprising and complex stimuli have a high chance of being perceived (cf. v. Keitz 1986: 100). On the other hand, our sense organ can experience adaptations: If, for instance stimuli are constantly occurring and are not important or do not carry new information, they can be ignored by the senses (cf. Hajos 1972: 105).

47 As Lynch (1960: 8) formulates: "The visual recognition of a door is matted together with its meaning as a door." Harré describes the observable stimulus with the unobservable cognitive process as resulting in the observable response and concludes: "Therefore, perception of something as something is not just a response to a stimulus. It is the upshot of a cognitive process, …" (Harré 2002: 104).

grounds and attitudes as well as on the specific perception situation.[48] Since the mid-1960s, the interrelationships between stimulus and memory information is central in information processing approaches of perception and memory research. Generally, as Gold describes, the human mind consciously and unconsciously scans the environment and selects those information cues that are useful to the individual – thus, the selection process depends on the particular situation of the individual and the particular need for information (cf. Gold 1980: 48, Prinz 1990: 73ff., v. Keitz 1986: 99ff.).

These perceptive and cognitive aspects are related to innovation by Vandervert (2003) and the working memory / cerebellar theory of innovation. In his analysis of neurophysiological aspects of creativity and innovation, Vandervert investigates how human brain works to produce new ideas. Collaboration between working memory and the cerebellum, precisely patterns built in the cerebellum, are found to lead to discoveries. Innovation is understood as a process of evolutionary adaptation; reciprocal learning of memory and the perceptual-cognitive cerebellar functions lead to efficiencies which are responsible for advantages of innovation. Problem-solving cognitive models are continuously updated in the cerebellum, and enable rapid and flexible thoughts to develop novelties. Cerebellum patterns are permanently reduced, made more efficient and fed back to working memory where they are learned by neural networks. This leads to the phenomenon that "[h]uman innovation is prolific and its pace has accelerated, because constantly increasing levels of generalization are produced by the reciprocal relationship between the cerebellum and working memory." (Vandervert 2003: 28).

2.2.2 The constructivist perspective

2.2.2.1 Constructivism and perception

Constructivist approaches originated as social constructivism in sociology in the 1960s.[49] Radical constructivism attributes perception and the resulting view of reality a crucial position.[50] Basic assumption is that people's knowledge is "constructed", that

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48 Golledge/ Stimson (1990: 36) express this as follows: "The perception of two individuals vary as a function of the differences in the content of the information presented and the differences in the ability of the individuals to pick up the information messages."

49 Schmidt (1994a: 4) describes constructivism as a discourse from different disciplines rather than a consistent theory, with the common basic assumption of reality construction. Social constructivism is based on the work of Berger and Luckmann ("Die gesellschaftliche Konstruktion der Wirklichkeit", 1967) who analysed social processes of reality construction (cf. Knorr Cetina 1997: 131).

50 Radical constructivism is connected to the work of Maturana (cf. section 2.2.2.2), Varela, v. Glasersfeld, v. Foerster, Watzlawick, and Roth. Schmidt (1994a: 4) differentiates between

people do not view an "objective" (ontological) reality, but have a "constructed" picture of their external environment.[51] Individuals have a subjective ("constructed") view of reality which results from information processing in their brains on the base of perceptions of their environment. So peoples' views of reality are cognitive constructs. This view of a social construction of reality is based on research in psychology and biology with the closest connections to neurobiology, pointing at the assumptions that humans developed cognitive mechanisms during evolution which determine social and physical reality. However, these mechanisms are in steady change and co-evolve with their environment. Thus, based on processes rooted in perception, cognition, emotions, etc., individuals and social communities develop similar subjective realities, whereby specific patterns of perceiving, thinking, behaving and communicating are rooted in the cultural background (cf. Hejl 1994: 49-53, Schmidt 1994b: 592-594).[52]

Sociocultural constructivism (S.J. Schmidt) deals with the construction of reality in socio-cultural systems. Systems in this context are understood as entities that consist of different elements; system behaviour is generated by interactions of these single elements. Human beings, but also social entities such as companies or networks are considered as systems (cf. Hejl/ Stahl 2000: 16). Institutions and social behaviour are of particular interest in this context; they are assumed to actively generate knowledge and reality. Schmidt (1994a: 5-10) describes the process of reality construction as unconscious and not intended. Accordingly, the perception process is believed to be based on construction, not being an accurate representation of reality. Perceiving as well as recognising and behaving are based on history, experience, knowledge, norms, communication, etc. From these assumptions follows that every "observing system", i.e. every individual human being, has an individual and subjective picture of reality. This "cognitive reality" results from individual contexts and backgrounds as well as specific conditions of social interaction with other humans. Important for the processes of perceiving and learning are humans' emotional states. Summarising, according to radical constructivism, environmental stimuli activate cognitive systems, whereas the subjective reality is exclusively resulting from a self-organised structuring process and attribution of meaning. Subjective reality is generated in the neural structure of indi-

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the biological-neuro-scientific, the cybernetic, and the philosophical-sociological approaches.

51 Ontological reality is thus differentiated from constructed reality. German terminology distinguishes between *Realität* and *Wirklichkeit* (cf. for instance Roth 2000: 65ff.).

52 Jakle et al. (1985: 4) define 'culture' from a social geography perspective: "**Culture** is quite simply a population's shared experience accumulated through time. A person's culture acts as a **cognitive field** against which stimuli from one's surroundings are given meaning." (emphasis taken over from the original text).

viduals' brains on the base of former experience; this continuous process resulting in dynamic evolution of the perceiving system. Since the perception process as such, i.e. the attribution of meaning to a stimulus, is generated within the human brain, principally every individual generates an individual subjective reality. However, communication and interaction between individuals effect that they know about other peoples' subjective realities. These processes generate overlappings, thus leading to "intersubjectivity" of individual perceptions and images (cf. Kruse/ Stadler 1994: 32 and 40, Hejl/ Stahl 2000: 15, Fallgatter/ Koch 2000: 81). According to Kruse/ Stadler (1994: 26/27), Gestalt theory (cf. page 38) is the psychological theory with highest contributions to radical constructivism. Here, perception is understood not as the mere representation of reality, but resulting from structure generating processes of the cognitive system.

Constructivist ideas are not exclusively related to people or human systems. Firms are also considered as social systems, and are conceived as constructing their realities and as behaving according to these constructs. In the case of firms, this means that their environments are also relative and subjective. For instance, firms' knowledge about markets, clients, competitors, etc. is generated by the firm. Hejl/ Stahl (2000: 14) state that these relations have to be known in order to improve dynamic evolution and innovativeness.[53] Thus, firms are also supposed to generate their realities; which, in turn, are internal to the system and can only be accessed through the firm itself. Precondition for the "construction" of firms' realities are interactions between firms and their environments (cf. Hejl/ Stahl 2000: 16ff.). Hejl (2000: 34) claims that many disciplines based on perceptions and related activities such as social sciences and economics, refer to the traditional assumptions of the recognition of an "objective" or ontological reality as it is and not as object of perception and image. However this reality is not accessible by firms as social systems, they can only perceive events of this reality. They perceive sensory changes whose structures are then compared with further events and experience, leading to revised images of reality (cf. Hejl 2000: 45-47).

53 Hejl/ Stahl (2000: 14, emphasis taken over from the original text) argue "…, dass Unternehmen *Sozialsysteme* sind, die eigengesetzlich Wirklichkeiten konstruieren und ihrem Handeln zugrunde legen. Nur wenn das erkannt und in das Verständnis unternehmensinterner wie auch die Systemgrenzen überschreitender Prozesse eingebaut wird, kann die Dynamik und Innovativität erreicht werden, die besonders die europäische Wirtschaft braucht. Gleichzeitig kann nur so, dies ist unsere Überzeugung, das gerade für Europa und Nordamerika so typische Modell weiterentwickelt werden, das von einer relativen strukturellen Homogenität von Wirtschaft, Politik und Kultur ausgeht."

2.2.2.2 Cognitive constructivism in biology

The explanation of social processes is inspired by findings of natural sciences, particularly biological evolution theory. At the core is the concept of autopoiesis, the capacity of systems for endogenously controlled auto (self-)generation, to develop their structure and elements from within. This concept has been shaped by the neurobiologist Maturana at the beginning of the 1970s[54] and later further developed by Maturana and Varela. Maturana refers to the molecular network: "A closed network of molecular productions that recursively produces the same network of molecular productions that produced it and specifies its boundaries, while remaining open to the flow of matter through it, is an autopoietic system, and a molecular autopoietic system is a living system." (Maturana 2002: 8). Those networks specify their boundaries themselves, but are open to metabolic flows through them. Further, Maturana describes molecular autopoietic systems as living systems. Autopoietic systems "… are defined (they create identity) by their own operations." (Neves/ Neves 2006: 14). They (re-)generate themselves in a circular process through reproducing their basic elements with the help of these elements: A cell continually replaces and reproduces its components (cf. Willke 1996: 61). Decisive for the processes that take place within the system, is its current structure; living systems are thus structure-determined systems (structural determinism, cf. Maturana 2002: 15).[55] Autopoietic systems consist of components whose interactions regenerate and realise the relations that produced them and that determine the characteristics of the system. Reproduction processes are based on those components, thus the components of the system have reproductive capacities.[56] Autopoiesis character-

54 Maturana (2002: 8) explains in retrospect: "It was not until 1970 that I chose the word autopoiesis as the name of the organization of living systems as discrete autonomous entities that existed as closed networks of molecular production, claiming that autopoiesis was the necessary and sufficient condition for the constitution of living systems, and that they existed only as long as their autopoietic organization was conserved."

55 Debus (2002: 45) points at these characteristics: "Das, was ein autopoietisches System produziert, ist es selbst, und der Bauplan dafür liegt nicht in der Umwelt des autopoietischen Systems, sondern in seiner eigenen Struktur."

56 As Maturana (1970: 9/10) analyses: "Living systems as they exist on earth today are characterized by exergonic metabolism, growth and internal molecular reproduction, all organized in a closed causal circular process that allows for evolutionary change in the way the circularity is maintained, but not for the loss of the circularity itself. […] This circular organization constitutes a homeostatic system whose function is to produce and maintain this very same circular organization by determining that the *components* that specify it be those whose synthesis or maintenance it secures. Furthermore, this circular organization defines a living system as a unit of interactions and is essential for its maintenance as a unit; that which is not in it is external to it or does not exist. The circular organization in which the *components* that specify it are those whose synthesis or maintenance it secures in a man-

ises living systems and distinguishes them from non-living ones; living systems thus have the capacity of continuous self-creation and reproduction.[57] An autopoietic system has clear boundaries, defined by itself. An entity can only be partly open towards its environment because it has to keep its closeness in order to distinguish itself from the environment.[58] If this operational closeness cannot be maintained, the autopoietic systems cannot exist anymore as living system. These characteristics of autopoiesis and adaptation are leading to the historical process of biological evolution. A cell or an organism controls and governs its own further existence according to immanent operational rules. An external operation of this process is not possible; an external agent can only "… trigger in the living system a structural change determined in it." (Maturana 2002: 24). Accordingly, systems can only trigger structural changes in the medium around them. Living systems thus are considered as autonomous autopoietic entities that adjust their structures according to external stimuli, thus existing through interactions with the medium around them. The living system and the medium co-evolve in the context of their interactions. These interactions, as well as interactions with other systems in the same medium, are described as structural coupling.[59] However, Maturana (2002: 13) argues that autopoietic systems exclusively exist in the molecular domain. This is rooted in his belief that autopoiesis occurs spontaneously, and that reproduction of the same kind of elements as a spontaneous result from their structural dynamics only occurs in the molecular domain (cf. Maturana 2002: 5-25, Neves/ Neves 2006: 4, Willke 1996: 61/62).

Coming back to the issue of perception, the cognitive-biological constructivism integrates the systems view and emphasises reconstruction as pertinent aspect: Perception is conceived to be effected in human brain (rather than by the sense organs), that, in turn, is a closed system (with respect to information) and reconstructs the external

ner such that the product of their functioning is the same functioning organization that produces them, is the living organization." (emphasis taken over from the original text).

57 Since self-creation comprises self-organisation, autopoiesis is broader than self-organisation (cf. Debus 2002: 45).

58 The assumption of closeness differentiates autopoiesis approaches from the former systems theory conceptions that postulated openness of living systems towards their environment. However, the postulate of operational closeness exclusively refers to systems' own reproduction processes; other domains such as energy or information exchange permit and require openness (cf. Willke 1996: 61/62). In his understanding of living systems, Maturana (2002: 10) refers to these characteristics: "… living systems are not the molecules that compose and realize them moment by moment, they are closed networks of molecular productions that exist as singularities in a continuous flow of molecules through them."

59 In this context, cognition, according to Maturana, "… is the capacity that a living system exhibits of operating in dynamic structural congruence with the medium in which it exists." (Maturana 2002: 26).

environment on the base of former information "from within", i.e. based on its internal interactions. The structure of a system effects the perceptions a human has of his/ her environment, is therefore decisive for his/ her representation of reality. The nervous system is conceived as structure determined system which does not compute behaviour of the organism; behaviour is considered as operation of the organism through structural coupling with a changing medium (cf. Knorr Cetina 1997: 133, Maturana 2002: 19).

2.2.2.3 Constructivist systems theory

This autopoiesis concept has been transferred to social systems by Luhmann.[60] The main characteristic of Luhmann's functional-structural system theory approach is the introduction of the environment as reference for system development and analysis; thus, system theory is referred to as theory of systems and their environments. This aspect differentiates Luhmann's approach from the former system theory approaches that focused on system-internal structures and their reproduction. According to Luhmann, the function of system building - the sense of systems - requires relations between the system and its environment with the crucial catalyst for sense building being located external to the system (cf. Willke 1996: 5-10). Focusing on their task to reduce the external world's complexity in order to make it senseful for humans, social systems, according to Luhmann, are not simply the sum of their elements, but defined as differing from their environment: "The system that contains its difference within itself is an autopoietic one, self-referring and operationally closed, defined as such by reducing the complexity of the environment." (Neves/ Neves 2006: 6). Luhmann assumes that social systems are based on communication and on processes of self-organisation; he defines social systems as closed communication systems. Systems reproduce themselves through succeeding communication (cf. Knorr Cetina 1997: 133, Morawa, no year given, Debus 2002: 48ff.). Luhmann thus refers to the self-organisation theories of Maturana and Varela. Social systems are characterised by their own internal operation modus – they have a specific understanding and operation of sense – and can thus be distinguished from other systems.[61] Culture as social system evolves as well as indi-

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60 Maturana did not consider social systems as autopoietic ones, since the components of a firm for instance – the collaborators - are not reproduced through the internal structure of the firm (cf. Debus 2002: 48).

61 The process of self-organisation effects that "… a circular process of components' self production follows, able to make sense of the information coming from the environment and, consequently, able to distinguish itself from the same." (Neves/ Neves 2006: 5). Sense – better: the way of processing sense - also distinguishes psychological from social (autopoietic) systems, which constitute a human being in Luhmann's view: The former's

viduals. Similarities between members of the same social systems are higher than with members of other systems. Systems define their borders in relation to their (complex) environment, they distinguish themselves from their environment, and these borders define the openness and permeability of the system. Rigid systems for instance are comparatively closed because they have only minor exchanges with their environments. This leads to a higher stability and strengths on the one hand, but also to increasing pressure resulting from changing environments on the other hand. Living systems generally are confronted to continuous changes of their environments. The way how the system reacts and adapts to external conditions is related to the internal system processing, and is consequently individual in every system. Systems' internal consistencies are generated through the independent determination of the mode of reaction when facing external influence (cf. Morawa, no year given). Systems are confronted to chaotic evolution of the external world and, in order to maintain themselves, they continuously need to change and adapt themselves. The complexity of the world is referred to as noise. The evolution of those systems requires noise, casual incidents which are new for them and require new ways to treat them, for an order or changing relation of their networked components to be established.[62]

Although the catalyst for system-internal changes is supposed to be located in the environment of a system, the environment itself cannot directly influence system-internal processes. This is due to the assumed limitation and operational closeness of the system, its reference to internal structures, its self-reference.[63] This means that all system operations are (exclusively) internal, and that information generation and selection processes take place within the system. The environment, according to Luhmann, cannot contribute to this process. Operational closeness prevents direct interactions between the system and its environment. A system creates its environment internally and

sense processing is effected by thought and belief and the latter's by communication. Perception is the basic operation of the psychological system, and can only be transferred through communication. Thus, communication in social systems requires perception in psychological systems via structural coupling (cf. Willke 1996: 65, Debus 2002: 51, 54 and 71).

62 This relation has been central in the "order from noise" concept of von Foerster in the 1960s which was later applied by Atlan (1992) in studies of biological systems. Here, the cell was considered as "… an integrated, self-organized process, maintaining a dynamic balance with the environment". Living beings are compared to the flame of a candle e*ntre le cristal et la fumée*, i.e. ""*oscillating between the rigidity of the crystal and the fluidity of the smoke*", presenting emergent properties that can not be reduced neither to rigid qualities nor total fluid ones;…" (Neves/ Neves 2006: 4; emphasis taken over from the original text). Cf. also Luhmann 1994: 3.

63 However, this postulate of self-reference does not exclude external relationships of the system. Crucial is the understanding that external events give incentives for system's internal operations, thus trigger, but do not determine them (cf. Willke 1989: 45).

triggers its environment by own activities. Due to self-reference, system's behaviour retroacts and is the basis for further behaviour. Redundancy is an important feature which is diminished by 'noise' and contributes to the ability of the system to adapt to its specific external environment (cf. Bernard 1990: 215, Neves/ Neves 2006: 4, Luhmann 1994: 3, Morawa, no year given, Debus 2002: 61).

Luhmann transfers these ideas to knowledge generating systems which are supposed to have similar characteristics as described above: They are operationally closed, cannot directly interact with their environment through their (internal) operations, and have to generate information internally. Information processing generates knowledge. These processes take place without an influence of the environment. However, the environment can cause irritation which causes the system to increase its cognitive complexity, thus allowing processing and reacting towards an increased range of information (cf. Luhmann 1994: 4).

2.2.3 Perception geography and behavioural approaches in geography

Up to now, psychological and sociological approaches related to perceptions and subjective representations of reality have been shortly presented. With the exception of early conceptions in psychology, they point at the cognitive character of the perception process. However, spatial consequences have not been discussed yet. The spatial view is integrated by approaches of human geography.

2.2.3.1 Themes, profile and theoretical framework

The following section presents the perception concept in a spatially oriented context. It refers to perception and to behavioural geography, whereas behavioural approaches can be considered broader and as comprising perception conceptions. Perception geography studies space as well as the perception and evaluation of space under cognitive aspects. Individual factors of perceiving humans as well as their attitudes[64] and values have an influencing and filtering effect on humans' perceptions which result in cognitive representations or mental maps. These representations are the base for human behaviour in space. Perception processes, decision-making and the specific relationship between humans and their behaviour in space, i.e. the individual-space relation, is subject of behavioural geography.[65] Consequently, behavioural geographical

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64 Attitudes are treated in section 2.3.

65 Walmsley/ Lewis (1993: 6) speak of "behavioural approaches in human geography" because these approaches rather complement existing geographical branches than being

approaches can be characterised as including perception processes (cf. Albrecht 2002).

Behavioural approaches in human geography emerged in the 1960s. They generally assume interrelations between man and environment, but denying some of the assumptions of former man-environment interaction models, first and foremost that of rational economic behaviour. Behavioural approaches generally analyse the 'how' and 'why' of human behaviour as well as individuals' interpretation of and attribution of meaning to the environment.[66] Behavioural approaches assume that individuals and social groups acquire knowledge about their environment, and this knowledge, in turn, has an impact on their attitudes and (overt) behaviours. Incoming information is filtered according to cultural and social characteristics or according to the places where information recipients live. Perception and behavioural approaches in human geography analyse how this knowledge is gained, processed and which influences it has on behaviour (cf. Knox/ Marston 2001: 276/277, Walmsley/ Lewis 1993: 1 and 68).

Contrary to Walmsley/ Lewis (1993), Gold (1980) speaks of "behavioural geography" which he defines as "… the geographical expression of 'behaviouralism', a general movement which has spread into the social sciences…" (Gold 1980: 3). Behaviouralism takes into account the complexities of behaviour, assuming cognitive, mental processes to acquire, organise and apply knowledge as mediator of human action.[67] Main themes of interest are (i) the way in which humans cope with their (physical and social) environment, and (ii) the factors which influence the interrelationships between mental processes (thought) and action. It is assumed that the decision-making process and spatial behaviour are not proceeding in an identical way: Some decisions are based on complex cognitive processes, some others might be immediate reactions to a stimulus. Behavioural approaches in geography primarily view spatial behaviour patterns resulting from cognitive processes. In this general context, a dual character of space is assumed, opposing the objective environment and the behavioural environment, thus

new or replacing others. Instead, "behavioural geography", according to them, would imply a specific and distinct field in geography.

66 Early behavioural studies investigated overt behaviour and environmental perception, e.g. travel patterns and mental maps. Research topics later shifted to analysing attitudes, decision-making, learning or the meaning of places (cf. Walmsley/ Lewis 1993: 1).

67 Walmsley/ Lewis (1993: 21) focus at the difference between behaviourism and behaviouralism: "The difference between behaviourism and behaviouralism […] is in fact fundamental. The former attempts to reduce behaviour to S-R [stimulus-response; added by the author] bonds whereas the latter emphasizes the significance of predisposing factors (attitudes, beliefs, values) as well as the manner in which individuals make decisions about where to go and what to do within a set of socially generated constraints and intersubjectively shared environmental meanings."

representing the "world of actuality" and the "world of the mind" (cf. Gold 1980: 4). The behavioural environment is the base for humans' decisions and behaviours. Furthermore, it is assumed that individuals not only react or respond to their (physical and social) environments, but they also shape their environment through their action. Thus, a certain spatial behaviour is not necessarily the endpoint of a sequence of events, but may also lead to further action and reaction. Behavioural geographical approaches have connections to other disciplines, first and foremost to psychology (cf. Gold 1980: 3-5).

However, 'perception' is applied slightly differently in psychology and geography (cf. Golledge/ Stimson 1990: 36/37). The notion of perception as it is considered in geography also includes evaluation processes while in the classic psychological sense it is connected to a stimulus. Perception is sometimes confused with the attitude concept (cf. section 2.3) which refers to more durable structures existing without particular stimuli (cf. Golledge/ Stimson 1990: 46).[68] Spatial perception does not only rely on stimuli received via the senses sight, hearing, smell and touch, but also on secondary information from the environment, i.e. information that is not directly and immediately received by the sense organs, but "… culled from the media and through hearsay via communication with fellow human beings. This is **perception**. It concerns the **immediate apprehension** of the environment (stimuli) by one or more of the senses. It occurs because of the presence of an object. It is closely connected with events in the immediate surroundings and is, in general, linked with immediate behaviour." (Golledge/ Stimson (1990: 36/37, emphasis taken over from the original text). Perception differs between two persons according to the information content of the message and to the individual ability to pick up the information. Cognition, on the other hand, refers to the storage and organisation of information in human brain, is not directly related to behaviour. The information is organised in a way to be integrated into structures already available, i.e. knowledge gained through former experience. Cognition thus develops with further incoming information, and cognitive structures have an influence on the type of information which is selected later (perceptual selectivity). Individual's representation of reality thus is influenced by the already available cognitive structure. Contrary to perception, cognition is not necessarily linked to stimuli from the environment or to immediate behaviour; cognition is the medium which links the past to the present (through experience) and which is the base for future projections. Cognition, according to Golledge/ Stimson is then the superordinate term for the whole process reaching from

68 Walmsley/ Lewis (1993: 12) are reluctant to use 'attitudes' for the prediction of behaviour, because attitudes also comprise cognitive and affective besides the behavioural components (cf. section 2.3).

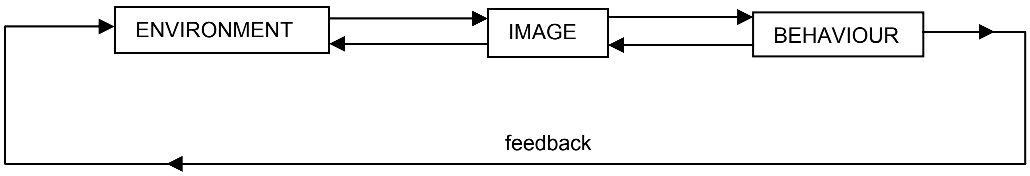
sensation to perception, imagery, retention, recall, reasoning, problem solving and judgements and evaluations (cf. Golledge/ Stimson 1990: 36-38). This is also emphasised by Gold (1980: 20): "Cognition is regarded as a wider term which, *inter alia*, includes perception. Cognition relates to psychological processes whereby human beings obtain, store, use, and operate upon information. It includes sensing, perceiving, remembering, imagining, judging, deciding, and virtually every other type of mental process, and is intimately related to experience and behaviour. Perception, by comparison, is a more specific term. It is the psychological function that enables the individual to convert sensory stimulation into organized and coherent experience. Perception itself is a cognitive process." (emphasis taken over from the original text). Perception has an impact on the development of humans' cognitive structures. Needs and values may exerce an influence on perception, better: on the probability that the respecting stimulus passes the perceptual threshold, i.e. the minimum stimulation of the sense organs in order to notice sensory experiences. Further factors influencing perception are the form and clarity of the perceived object or event, the frequency of exposure to the stimulus, the information source and closeness to the perceiver's action space (cf. Golledge/ Stimson 1990: 40-44). Bailly (1984: 423) explicitly refers to the cognitive processes and to the relations between the perceiving individual and the society that shape the mental environment in which his or her perceptions are embedded: "La géographie de la perception qui a pour objectif de comprendre les liens entre les significations du vécu individuel et l'objectivisation nécessaire des codes utilisés par la société cherche, à partir de notre vécu, à nous éclairer sur les raisons profondes des pratiques individuelles et collectives." (Bailly 1984: 424).

Based on perception psychology, perception geography draws the whole "chain" of perception and behaviour as follows: The individual receives information or stimuli via his or her sense organs and – after a selection process[69] – compares and connects them with the available knowledge and experience which are based on earlier processes of perception or actions. This information processing leads to a (subjective) mental picture of reality which, in turn, influences decisions of the individual. Perception is thus not merely the decoding of a sensory data input, it is a new product in human brain, resulting from the sensory stimuli and from the incoming and feedback activity within the central nervous system, combined with former learning and experience. Thus, the whole process of perception, as understood by perception geography, comprises the absorption of stimuli, their processing and interpretation. Perceptions are highly individual; however, it is assumed that members of a social group have (partly)

69 This process of selection differs between individuals and seems to run unconsciously (cf. Fliedner 1993: 147).

similar perceptions.[70] Human behaviour is assumed to be based on peoples' cognitive representations of their environment, the image (cf. figure 4).[71] The picture gained of the environment is continuously modified through newly incoming information and experience and following learning processes (cf. Gold 1980: 38 and 48, Raffelsiefer 2000: Chapter 3.2, Fliedner 1993: 147/148).

Figure 4: A conventional paradigm of man-environment relationships



Source: Gold 1980: 38.

In differentiating between the 'objective environment' and the 'behavioural environment', behavioural geography relates to the belief of Gestalt theory (cf. page 38) that human behaviour relies on the perceived and less on the objective world. However, behavioural geographical approaches relate the behavioural environment to learning processes and do not assume it to be innate, as Gestalt psychologists believed. Behavioural environments are individual, but they have common traits due to the common neurological mechanisms in humans and due to common socialisation experience (cf. Gold 1980: 11/12, Walmsley/ Lewis 1993: 21).

These basic assumptions of behavioural approaches are also mirrored in the research philosophy. The (positivist) idea of the scientist passively observing an (objective) reality gave way for instance to constructivist approaches to explain humanity – environ-

70 Gould (1974: 186) argues that "… a portion of our viewpoint is quite particular to ourselves, while another part is shared, or held in common, with many of our fellows." Golledge/ Stimson (1990: 41/42) relate this phenomenon to social customs: "When one considers the very complex problem of individual differences and also the complexity of objective reality, one cannot help but wonder about how we can obtain perceptual consistency across large groups of people. […] But, the same stimulus presented to a large number of individuals will result in a similar type of perception across that group. For example, in many cases adults of similar social class and status perceive much the same things because their perceptions are constrained in similar ways by social mores".

71 Gold (1980: 41) describes images as "… a synonym for an individual's organized subjective knowledge of the environment" and defines an image "… as the mental picture that may be called to mind when the object, person, place, or area is not part of current sensory information. The image has visual connotations […] Yet this need not always be the case […] An image is therefore a perception in the absence of an external stimulus, irrespective of the sensory mode in which this perception occurs."

ment interactions and their dynamics.[72] Aspects like values or beliefs came into the focus since they were considered as influential factors of overt behaviour. Reality was no longer considered as given, but as resulting from constant dynamic mind-world interaction. Recent research fields of analytical behavioural approaches comprise for instance cognitive mapping and spatial behaviour, attitudes, learning, consumer behaviour or locational decision-making (cf. Golledge/ Stimson 1990: 8-10). In the context of these general assumptions and conceptions of behavioural geography, Golledge/ Stimson attribute it the following characteristics: (i) Man is considered as "satisfier" instead of "optimiser" as proposed by classical and neo-classical economics. Bounded rationality, alternatives, irrationality, incompleteness and uncertainty are taken into account.[73] (ii) The 'environment' is attributed a renewed understanding: The concept of people's environment widened from the pure physical one to the integration of economic, social, political, legal and further environments leading to an interest "… in the perceptual, cognitive, ideological, philosophical, sociological and other environments that were all part of the dialectical relation between humanity and the realities in which they lived." (Golledge/ Stimson 1990: 4) (iii) Themes in behavioural geography focus on micro-level topics. (iv) These characteristics require new types of analytical research, focussing on individuals and on their subjective evaluation of certain phenomena in differing environments, and new methods of data analysis such as for instance non-parametric tests, multidimensional and multivariate methods to represent phenomena, methods to treat incomplete data sets and new methods to present the data. (v) Finally, the conclusions of analytical work are based on generalisation of the findings; starting from the individual, analysing groups of individuals and searching for possible generalisations (cf. Golledge/ Stimson 1990: 3-5).

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72 With the "quantitative revolution" in the 1950s and 1960s, geographical analytical research focused on objective and observable facts, the representation of reality as a summary of atomistic facts, an emphasis on hypothesis testing, the search for generalisations, and the idea that the scientist (passively) observes objective reality. Representatives of the positivist tradition believe that science should focus on observable phenomena and less on (largely unknowable) subjective properties of the mind. These principles could no longer be held as cognition as important factor between people and their environment have been identified (cf. Golledge/ Stimson 1990: 8, Gold 1980: 13).

73 It is thus assumed that decision-making is realised under uncertainty due to the lack of complete information. This leads to economic decisions to be made under assumptions of other actors' behaviours (cf. Golledge/ Stimson 1990: 46).

2.2.3.2 Mental models and cognitive maps

In order to comprehend complex relations and for instance understanding a stimulus within its context, human mind creates mental models.[74] Mental models are made up for instance by pictures and memories, logical relationships or experiences formerly made and memorised. Newly incoming information is ordered and contextualised by using the already existing information; this new information broadens the existing model. Consequently, mental models are constantly evolving and evoking learning to occur. Since mental models depend on individual experiences, they are highly individual and represent one's view of the external world. Johnson-Laird (1983) argues that mental models are based on (explicit and implicit) inferences[75] and denies consequently a hypothetical mental logic. He states that "… mental models play a central and unifying role in representing objects, states of affairs, sequences of events, the way the world is, and the social and psychological actions of daily life. They enable individuals to make inferences and predictions, to understand phenomena, to decide what action to take and to control its execution, and above all to experience events by proxy; they allow language to be used to create representations comparable to those deriving from direct acquaintance with the world; and they relate words to the world by way of conception and perception." (Johnson-Laird 1983: 397). Though people have the impression that they perceive their environment directly, models of the environment influence what is experienced. Johnson-Laird relates the ability to create mental models to human evolution: "… all our knowledge of the world depends on our ability to construct models of it. Since this ability is a product of natural selection, our knowledge indeed depends on our biological make-up as well as on things-in-themselves." (Johnson-Laird 1983: 402/403).

This conception makes clear that people thus do not behave in direct response to their environment, but to their mental model of it. Besides perceptions, factors like values, attitudes and emotions also have an impact on human behaviour (cf. Golledge/ Stimson 1990: 38, Knox/ Marston 2001: 288/289). The investigation of mental or cognitive

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74 Vandervert explains that "… thought processes construct mental models that are imitative, small-scale computational representations of the external world that retain the external world's relation-structure." (Vandervert 2003: 22, footnote 2, cf. Johnson-Laird 1983). They are the base for decision-making; Patel/ Pavitt (1994: 77) describe them in relation to theory and policy-making: "As is well known, policies and perceptions are influenced not only by events, experience and evidence, but also by mental models moulded in part by the concepts of theorists."

75 Explicit inferences rely to a conscious effort and a voluntary decision whereas implicit inferences do not require efforts or conscious decisions. They are quick and happen often in daily life in processes of understanding and judging (cf. Johnson-Laird 1983: 127).

maps can be described as the "classical" method in perception geography. Here, participants of the study are requested to draw a map based on their mental representation of the given subject; mental maps thus put together information on the spatial environment of individuals; they show peoples' images of the given space (cf. Raffelsiefer 2000: Chapter 3.2.5). Referring to Down and Stea (1974b: 9, emphasis taken over from the original text), "[c]*ognitive mapping is a process composed of a series of psychological transformations by which an individual acquires, codes, stores, recalls and decodes information about the relative locations and attributes of phenomena in his everyday spatial environment.*" A cognitive map is considered as human's model of reality, and as base for spatially oriented behaviour. It is assumed to be quite resistant to changes (cf. Golledge/ Stimson 1990: 70, Downs/ Stea 1974b: 10 and 26).[76]

The first empirical research in this field between psychology and geography has been performed by Lynch and his investigations on inhabitants' images of different cities in 1960. His analysis of the form of cities from the viewpoint of their inhabitants aimed at identifying crucial characteristics for urban planners and architects. He concentrated his work on visual aspects, and observed that every person forms his or her individual picture, but that there is high conformity between the pictures of members of a social group. He is particularly interested in these "group effects" – he calls it "public images" – in order to give city planners and architects some indications concerning their work (cf. Lynch 1960: 6/7).[77]

2.2.3.3 Behaviour, man and environment

Subjective representations of their environment accompany humans during the day; people "… sense, store, record, organise and use bits of information for the ultimate purpose of coping with the everyday task of living." (Golledge/ Stimson 1990: 1) in order to seize their environment. Behavioural approaches in geography assume that environmental information and decision-making precede overt behaviour, however not always as direct influence, but rather as interpretation of the external environment. This aspect has similarities to the constructivist approach (cf. Walmsley/ Lewis 1985: 63).

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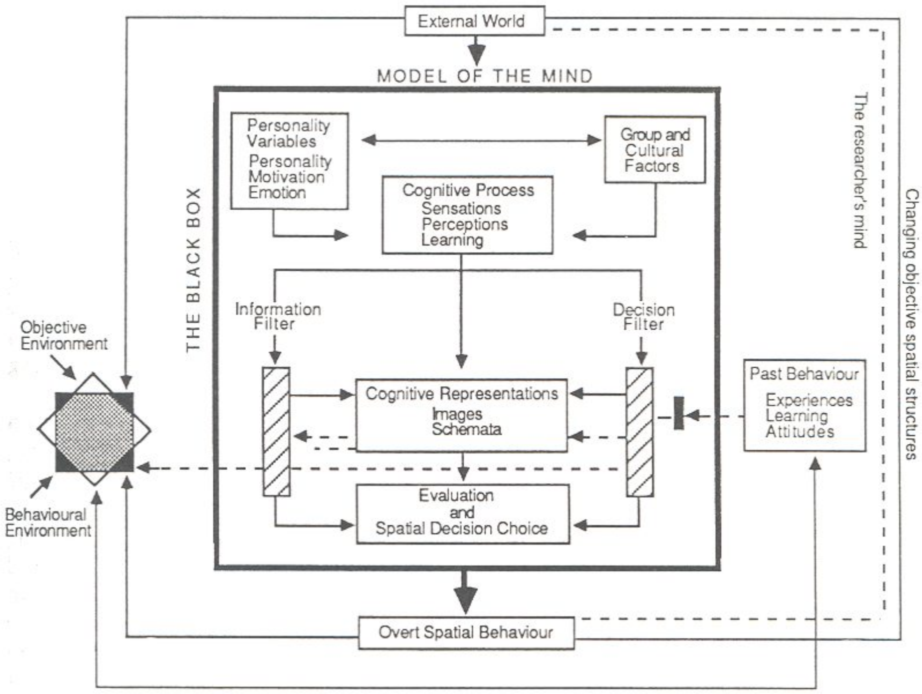
76 These authors emphasise that a cognitive map is not necessarily a map of a cartographic style, rather a map-like representation, a cognitive representation of the environment (Downs/ Stea 1974b: 11).

77 More recent studies in perception geography have for instance been performed in the field of environmental research; a recent study comprises the analysis of comprehension and assessment of "nature" in German nature conservation (Raffelsiefer 2000). Raffelsiefer studies the impact of subjective perception and assessment processes on nature protection (cf. Raffelsiefer 2000: Chapter 1.3).

Figure 5 schematises the notion of spatial behaviour in relation to individuals' perceptions of their environment. The external world is connected with spatial behaviour via peoples' mind models. Golledge/ Stimson (1990: 13) describe the behavioural interface between reality and behaviour as a 'black box' in which people build their image about their environment.

Figure 5: A paradigm of individual behaviour, spatial cognition and overt spatial behaviour



Source: Golledge/ Stimson 1990: 13

Figure 5 shows that the cognitive process of sensing, perceiving and learning is embedded at the same time in personal aspects of the perceiving individual as well as in social aspects of the group the individual belongs to. The paradigm presented in figure 5 differentiates the 'objective' and the 'behavioural' environment, the latter pointing at the subjective representation of reality which is the environment of which the individual is aware, in which he/ she operates and behaves. Objective and 'behavioural' environments partly overlap. The individual gets information from the behavioural environment on the base of which he/ she acts. These actions, in turn, are affecting both the objective and the behavioural environment. On its path from sensation and perception towards subjective cognitive representation, external information is filtered according to personal, cultural and cognitive factors, the filtering process either concerning the way information is gained from the external world or concerning necessary decisions for very important information. These are also based on past experience, on learning processes and on individuals' attitudes. The decision filter may come to the following conclusions: (i) No decision is reached, (ii) the decision is made that more information is needed, (iii) no action is resulting, (iv) a decision is made and an action performed. Past and present environmental information is organised and connected to spatial meaning in schemata; this process is described as cognitive mapping. Schemata organise environmental information resulting from experience whereas images are pictures that imagination can call to human mind.[78] Images and spatial schemata thus mediate (spatial) behaviour. The psychological variables in this whole process are attitudes, emotions, perception, cognition and learning. After the action is performed, the individual monitors his/ her actions and evaluates it with respect to its effectiveness. The results of this process then flow into the 'past experience' category and impact future actions. They can also modify spatial cognition. This whole chain constitutes a highly dynamic process (cf. Golledge/ Stimson 1990: 11 and 13, Gold 1980: 43). However, for instance constraints in human spatial behaviour or feelings are not incorporated in this model (cf. Walmsley/ Lewis 1993: 9).

2.3 Attitudes

2.3.1 Perception and attitude

The preceding sections showed that perceptions indicate how persons interpret messages from the external environment received by the senses, and how this information about the external environment is ordered and given a meaning. The way this information is interpreted may differ between individuals and is influenced by individual beliefs, values and attitudes towards an object of the external environment (cf. also figure 5). Attitudes, values and norms depend on the respective social and cultural environment, are thus a social construct. They can be understood as (unobservable) mental sets or filters which manage emotions, knowledge, opinions and behaviour[79] (cf. Fliedner

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78 According to Gold (1980: 41-43), images are associated to imagination and thus deliver the base for conceptions of places rarely or never visited, whereas schemata are rather related to the everyday environment (cf. Gold 1980: 41-43).

79 Golledge/ Stimson (1990: 46, emphasis taken over from the original text) distinguish attitudes from perception and describe the former as a "… relatively permanent structure which may hold in the absence of any particular stimulus. Attitude, therefore, can be regarded as a **learned predisposition** to respond to a situation in a consistent way." A similar definition provide Fishbein/ Ajzen (1975: 15) who describe attitudes as "… a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object." Thus, attitude is supposed to be learned, leading to action (behaviour) and being comparatively consistent in time. Attitudes can be considered as predisposition for

1993: 146, Rusch 1994: 315). Attitudes are built in relation to social objects: "An *attitude* is the evaluation or affect associated with a *social object*. […] Social objects are such things as people (for example, friends or political candidates), categories of people (such as racial and ethnic groups), or abstract concepts (such as abortion rights or God)." (Greenwald 1990: 254, emphasis taken over from the original text). People experience certain cognitions and affects concerning a given object, and assign certain categories to those objects in order to evaluate them.[80] Attitudes develop on affect, cognition and conation (cf. figure 6), i.e. referring to feelings and emotions about the environment (affect), involving perceiving, knowing and thinking which generates the individual's knowledge about the environment, object or event (cognition), and involving acting, doing, thus having an impact on the environment (conation) (cf. Fishbein/ Ajzen 1975: 12, Petty et al. 1997: 613, Golledge/ Stimson 1990: 49, Crano/ Prislin 2006: 347). Measurable independent variables ("stimuli") are in this framework individuals, situations, social issues, social groups, etc. (cf. Gold 1980: 24).[81]

Gold (1980: 24/25) describes attitudes as superordinate to concepts such as belief, bias, doctrine, faith, ideology, judgement, opinion, stereotype or value. Values – the personal or social preferences of a certain mode of conduct over other modes – are a means of forming types of information connected to certain attributes. If the type membership is identified, characteristics of the whole type is transferred to the individual item.

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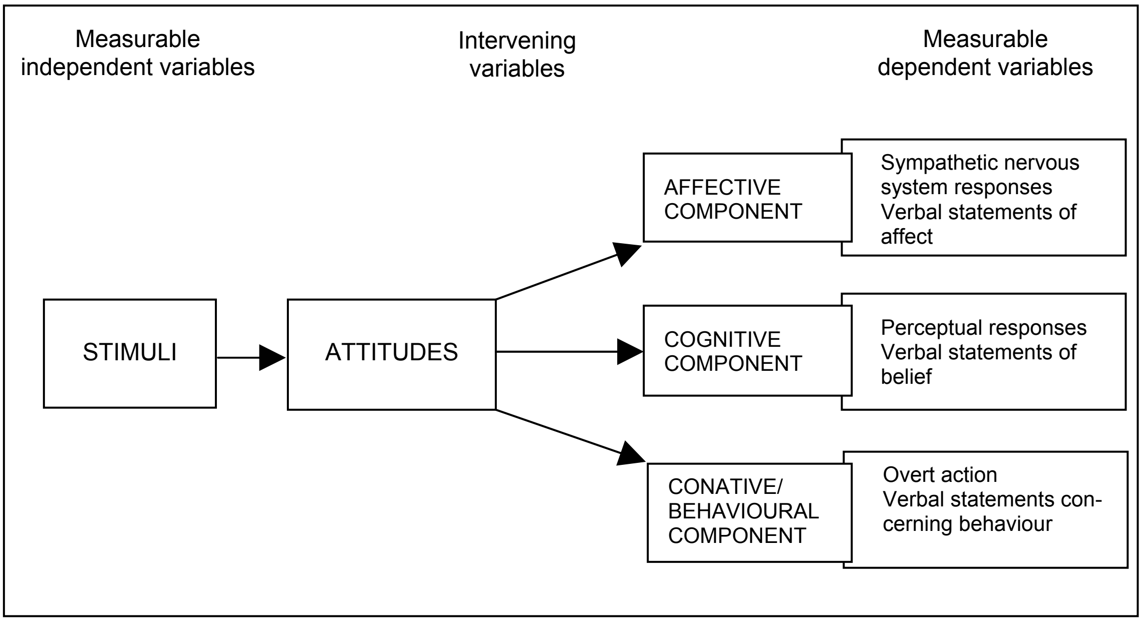
an individual's reaction (cf. Gold 1980: 23). However, the relationship between attitude and behaviour is controversely discussed (cf. also page 50).

80 As Ajzen (2001: 28) expresses it: An attitude "[…] represents a summary evaluation of a psychological object captured in such attribute dimensions as good-bad, harmful-beneficial, pleasant-unpleasant, and likable-dislikeable […]". Cf. also Petty et al. 1997: 611.

81 Golledge/ Stimson (1990: 49) argue that the three components should be considered as interacting.

Figure 6: The three components of attitude



Source: Golledge/ Stimson 1990: 50

2.3.2 Persuasion and attitude change

Attitudes, attitude changes and attitude-behaviour relationships are crucial topics in social psychology. The formation of attitudes, as well as the processes of attitude change – due to persuasion – and its results do not follow the same pattern, as Crano/ Prislin (2006: 347) state. Crucial for the formation of attitudes is the degree of conscious acceptance or rejection of the object in question whereas attitude changes are assumed to be realised due to source effects, to the message, its content and cognitive load, and to dissonance aspects (dissonance theory, see below). However, cognitive responses to a persuasive message do not necessarily induce direct attitude change, but may also impact thought processes (cf. Crano/ Prislin 2006: 348-352). There are several theoretical approaches to understand the change of individuals' attitudes. Classical models of attitude change assume changes in message recipients' attitudes as a result of the presentation and processing of a message. The changed attitude, in turn, may have an impact on behaviour. This general process of reception of a message, change in attitude and (maybe) change of behaviour is conceived in dual-process models such as the elaboration likelihood model of Petty and Cacioppo (1986). This model considers the consequences of a persuasive message on the message recipient and focuses on the recipient's attitude towards the topic of the given message. The core of the model is the conception of two types of processing or elaboration of a message,[82] a central and a peripheral route as opposite ends of an "elaboration-likelihood continuum" which ranges "… from no thought about the issue-relevant information presented to complete elaboration of every argument, and complete integration of these elaborations into the person's attitude schema." (Petty/ Cacioppo 1986: 129). The central route of elaboration mainly refers to the content of the message whereas the peripheral route points at indications beyond the pure arguments, such as for instance characteristics of the person forwarding the message. Processes of the central route type lead to distinct examination of the arguments presented; consequently attitude change depends on the recipient's cognitive reaction to the message. Peripheral route processes are less related to cognition and the arguments of the message, but rather refer to the message source (e.g. trustworthiness or attractiveness), the way the message is forwarded (i.e. repetition), or general judgements such as belief in expert opinions. In this case, "… when either motivation or ability to process issue-relevant arguments is low, attitudes may be changed by associating an issue position with various affective cues, or people may attempt to form a reasonable opinion position by making an inference about the likely correctness or desirability of a particular attitude position based on cues such as message discrepancy, one's own behavior, and the characteristics of the message source." (Petty/ Cacioppo 1986: 130). According to the theoretical basis, the need for cognition, or the preference for thinking, is individual and innate. The likelihood of elaboration, influenced by the individual's ability and motivation of cognitive processing, determines if the central or the peripheral route is followed. Motivation and ability are related to individual and to situational factors, influencing the direction of thinking (objective vs. biased) such as perceived relevance, need for cognition[83] or the personal responsibility for message evaluation, and /or the extent of information processing, e.g. external distraction, repetition of the message, comprehensibility of the message (cf. Petty/ Cacioppo 1986, Lien 2001, and Petty et al. 1997:

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82 'Elaboration' in this context means: "… the extent to which a person thinks about the issue-relevant arguments contained in a message. When conditions foster people's motivation and ability to engage in issue-relevant thinking, the "elaboration likelihood" is said to be high. This means that people are likely to attend to the appeal; attempt to access relevant associations, images, and experiences from memory; scrutinize and elaborate upon the externally provided message arguments in light of the associations available from memory; draw inferences about the merits of the arguments for a recommendation based upon their analyses; and consequently derive an overall evaluation of, or attitude toward, the recommendation." (Petty/ Cacioppo 1986: 128). High elaboration is associated to higher cognitive resources. Elaboration may take place comparatively objectively – in this case, the arguments and their strength are crucial – or rather biased and shaped by the initial attitude of the recipient (cf. Petty/ Cacioppo 1986: 128).

83 People with a high need for cognition are in favour of cognitive tasks (cf. Petty/ Cacioppo 1986: 150-152).

616ff., differentiating their overview on theories and results of applied research according to central and peripheral routes).[84]

Summarising, the crucial factor in this process is the individual's willingness, ability and motivation to think about the message content. If the message is based on a good and convincing argumentation, it is supposed to persuade. If, in the other case, the recipient does not process the message content, he/ she is supposed to concentrate on auxiliary features, on "peripheral cues", for instance consider the source of the message or general, heuristic statements. Thus, central in those models are the source of the message and its content, as well as motivation and ability for message processing (cf. Crano/ Prislin 2006: 348). Petty et al. (1997: 627ff.) attribute persuasion to source factors (such as credibility), recipient factors (self-esteem, prior knowledge, etc.), and context factors (for instance contextually induced mood). A further influencing effect on persuasion is attributed to the strength of attitudes; strong attitudes being associated to comparative stability over time, to resistance to persuasion and to high degree of prediction of behaviour (cf. Ajzen 2001: 37 and Crano/ Prislin 2006: 354ff. for research results on attitude strength).

Attitudes may not only influence behaviour, but may also be a consequence of it (cf. Crano/ Prislin 2006: 350). This assumption is inherent in the dissonance theory by Leon Festinger (1957) and further studies on this base. Festinger's dissonance theory postulates a value and belief consistency of people. Incompatible cognitions or knowledge elements including attitude, emotion, belief or behaviour are supposed to cause (internal) conflicts. This can happen when new insights contradict the own individual opinion or newly gained information does not conform to decisions already made. According to the cognitive dissonance theory, peoples' minds seek to eliminate this internal conflict through new thoughts or beliefs or through change of existing ones in order to reduce the conflict or dissonance between cognitions. This is supposed to leading to attitude changes (cf. Petty et al. 1997: 619, Abbott 2003). Contrary to these approaches, the self-perception theory developed by Bem in the 1960s, postulates that people's observation of their own behaviour forms their attitudes (i.e. people observe their own behaviour and conclude which attitudes must have formed them). Thus, self-perception theory postulates that people infer their attitudes on the base of their behaviour as an external observer would do. Bem (1972: 2) summarises the main characteristics of the self-perception theory as follows: "*Individuals come to "know" their own attitudes, emotions, and other internal states partially by inferring them from observa-*

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84 The elaboration likelihood model (ELM) has been widely applied in consumer research, cf. for instance Lien (2001).

tions of their own overt behavior and/ or the circumstances in which this behavior occurs. Thus, to the extent that internal cues are weak, ambiguous, or uninterpretable, the individual is functionally in the same position as an outside observer, an observer who must necessarily rely upon those same external cues to infer the individual's inner states." (emphasis taken over from the original text).[85]

2.3.3 Attitudes and behaviour

Additionally to attitude formation and change, the relation between attitude and behaviour is a crucial research topic in basic and applied research: "Because attitudes predict behavior, they are considered the crown jewel of social psychology." (Crano/ Prislin 2006: 360). Central models in this field are the theory of reasoned action and the theory of planned behaviour.

Fishbein/ Ajzen (1975: 12) distinguish between the intention of a behaviour, i.e. the (verbal) indication of the way to behave and the (actual) behaviour itself, thus arriving at a classification of four categories (instead of three as in figure 6): "affect (feelings, evaluations), cognition (opinions, beliefs), conation (behavioral intentions), and behavior (observed overt acts)." (Fishbein/ Ajzen 1975: 12). Attitude specifically is related to the evaluation of an object whereas the information this person has about the object is represented by beliefs; beliefs referring to cognition. Individual attitudes are to a high extent based on social learning from individual's environment. Learning leads to a consistent general pattern of evaluation with respect to a certain object. Fishbein/ Ajzen (1975: 15) define attitude as general predisposition leading to certain intentions, but not necessarily predefining a specific behaviour. However, attitude is neither static nor one-dimensional. Attitudes may change and do not necessarily replace old attitudes. The model of dual attitudes postulates the simultaneous existence of an implicit and an explicit attitude towards a specific object, the first being unconscious but having an impact on peoples' behaviours (cf. Wilson et al. 2000 in Ajzen 2001: 29). Multiple attitudes can be shown in cases where the same object is differently evaluated in different contexts. These "multiple context-dependent attitudes toward social targets" are consulted to explain attitude-behaviour discrepancies (cf. Ajzen 2001: 29).

According to the theory of reasoned action (Fishbein/ Ajzen 1975, Ajzen/ Fishbein 1980), intention is the main predictor for behaviour. Intention is influenced by attitudes towards the behaviour in question - feelings and assessments of the individual about

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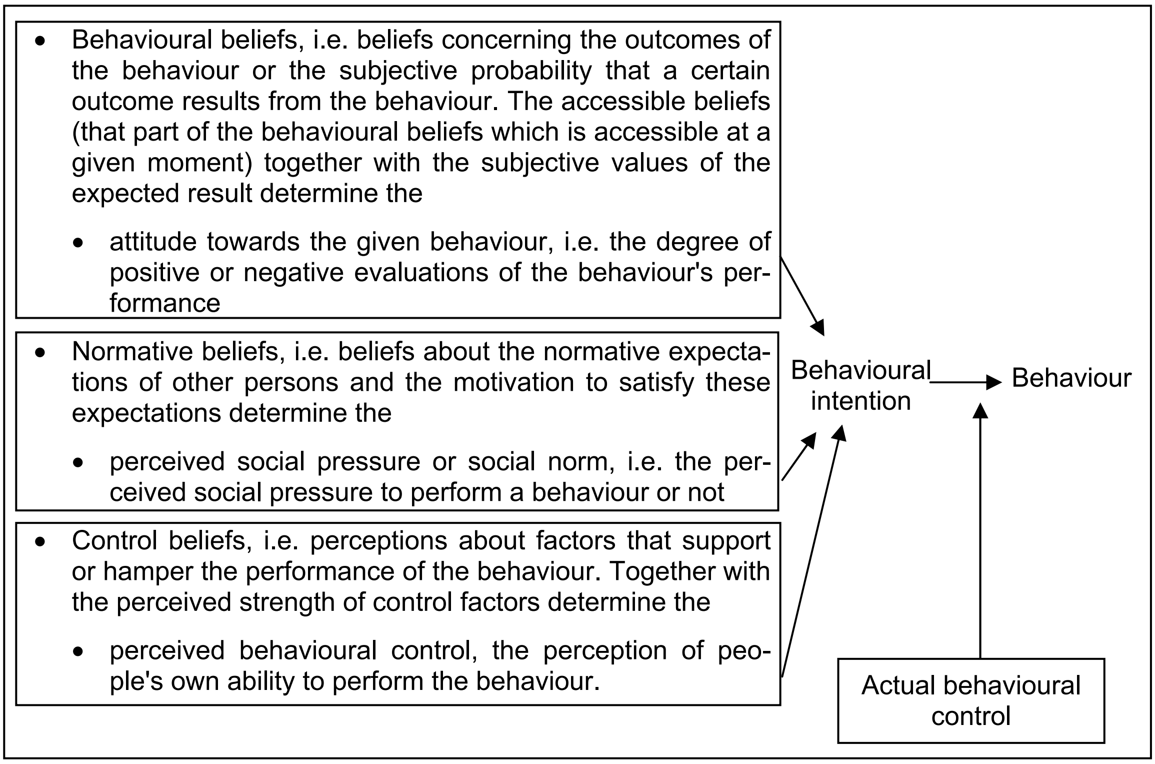
85 Crano/ Prislin (2006) and Petty et al. (1997), among others, give detailed overviews of research results and theoretical developments of models concerning persuasion and attitude change. A special focus on cognition and persuasion give Eagly and Chaiken (1984).

the performance of the behaviour and desirability of these consequences - and subjective norms about the behaviour (individual perception about the assessment of important persons towards the performance of the behaviour and motivation to comply with the wishes of the reference person). The theory of reasoned action is based on the assumption of rational human beings. Fishbein/ Ajzen assume that people consider the implications of their actions before they decide how to behave (reasoned contrary to automatic behaviour) (cf. Fishbein/ Ajzen 1980: 5). According to this theory, a person's intention is made up of the personal factor (the individual's attitude towards the behaviour), and the social influence (or the subjective norm, i.e. the person's perception of the social pressures on him). Based on these determinants, the theory assumes that an individual intends to perform a behaviour in the case he/ she evaluates it positively and he/ she believes that important other persons think he/ she should perform it. Attitudes lead to a set of intentions, each of which refers to a specific behaviour, that mirror a certain amount of affect towards the object considered. A person's attitude towards a selected object can be derived from the pattern of his/ her object-related actions (cf. Fishbein/ Ajzen 1975: 15).

Based on empirical evidence which did not prove close links between attitude and behaviour, Ajzen/ Fishbein (1980: 27) suggest in their approach "… that appropriate measures of attitude are strongly related to action. […] we take the position that attitudes toward an object can predict only the overall pattern of behavior; they are of little value if we are interested in predicting and understanding some particular action with respect to the object. To predict a single behavior we have to assess the person's attitude toward the behavior and not his attitude toward the target at which the behavior is directed. In other words, according to our approach any behavioral criterion can be predicted from attitude-be it a single action or a pattern of behavior-provided that the measure of attitude corresponds to the measure of behavior." Fishbein/ Ajzen (1975: 16) do not assume a direct relationship between attitude and behaviour related to a given object, but instead consider a person's intention to realise behaviour as link between attitude and behaviour.

Summarising, according to this approach, behaviour is influenced by behavioural intentions that, in turn, are determined by the person's attitude towards the behaviour and his/ her subjective norm (cf. Fishbein/ Ajzen 1975: 16). The theory of planned behaviour, developed by Icek Ajzen, is an extension of the theory of reasoned action. Figure 7 shows the basic elements of this theory on attitude and behaviour. It assumes that human action is guided by behavioural, normative and control beliefs.

Figure 7: Conception of the theory of planned behaviour



Source: Adapted from "TpB Diagram" on Ajzen's presentation at http://www.people.umass.edu/aizen/tpb.diag.html#null-link

The step between intention and behaviour is mediated by the actual behavioural control, the extent of the available skills, resources, etc. in order to act, to perform the given behaviour. Behavioural, normative and control belief are not independent from each other (cf. Ajzen 2001: 43, Crano/ Prislin 2006: 361).

Greenwald (1990: 256ff.) suggests an alternative solution to the attitude-behaviour problem - i.e. weak correlations between attitude and behaviour measures - by introducing unconscious cognitive processes and implicit memory. He gives some examples for strong indirect attitude effects: (i) The halo effect (if a certain positive or negative attitude towards a person already exists, new attitudes are formed in the same positive or negative direction), (ii) the similarity-attraction effect (people with similar attitudes rather have an attracting effect than those with differing attitudes), (iii) the cognitive response effect (cues that show agreement with the individual's attitudes lead to object liking – this is a relative of the similarity-attraction effect referring to objects). Possible explanations of the indirect attitude effects are "… that attitudes operate unconsciously, and that unconsciously mediated effects are easily disrupted when attention is directed to the action." (Greenwald 1990: 259). Furthermore, unconscious attitudes can deviate from conscious ones (attitudinal dissociations), and different attitudes towards an object can compete in their influence (cf. Greenwald 1990: 259).

2.4 Mood

The following section is devoted to another aspect that has been mentioned by Drucker (1985, see page 35), namely mood. Kaufmann (2003) analyses the relation between mood and creativity, and the effect of emotional states on creativity and problem-solving in the frame of the innovation process.[86] Mood as an affective state can be understood either as the "background" of peoples' experiences and evaluations or in the forefront of people's attention: "Moods are seen to be pervasive and global and have the capability to influence a broad range of thought processes and behaviors." (Kaufmann 2003: 191).[87] Research in the 1990s generally concluded a positive relationship between positive mood states and creative problem-solving.[88] However, the results of further analyses lead Kaufmann to assume a more differentiated picture of the mood-creativity question, stating that negative mood may rather lead to novel problem solving processes than to pursuing traditional modes of solution finding because negative mood may lead to 'creative tension' which incites people to reject the status quo and to engage in finding novel solutions.[89] On the contrary, positive mood may indicate a satisfactory state of the task environment and make people lead to be satisfied with solutions at lower levels of creative performance; mood thus generates the mental frame of background within which a specific strategic proceeding is chosen (cf. Kaufmann 2003: 195-197, George/ Zhou 2002: 689).

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86 According to Kaufmann (2003: 191), the whole conception of innovation consists of (i) originality (related to new ideas), (ii) creativity (additionally requiring value or usefulness), (iii) invention (requiring objectivity of novelty, i.e. novelty must be broader than only novel for the inventor), and (iv) innovation which also requires that the novel idea can be realised. Each of those steps is necessary, but not sufficient for the following one. In his research on mood effects, Kaufmann concentrates on the creativity part. A similar differentiation between creativity and innovation is given by Anderson et el. (2004: 148/149): Innovation requires the "intentional introduction and application" (West and Farr 1990: 9, in Anderson et al. 2004: 148). While creativity is related to idea generation, innovation additionally includes implementation, furthermore intended benefits of the new idea. Innovation is assumed to be new in the surveyed unit.

87 Shalley et al. (2004: 945) point at the transient and short-term character of mood: "Moods are pervasive generalized affective states that are relatively transient in nature, are experienced over the short run, fluctuate, and may be affected by contextual factors […]".

88 Shalley et al. (2004: 945) for instance argue that positive mood leads to increasing cognitive processes in individuals. This facilitates creative thinking and problem solving. Positive mood fosters associations between stimuli and even influences the relationship between contextual factors and creativity. However, the arguments for the relationships between negative mood and creativity (see below) are accredited (cf. Shalley et al. 945/946).

89 From Runco's (1994, 1999) arguments "... that 'tension' and 'dissatisfaction' appear to be important prerequisites for creative problem-solving", Kaufmann concludes negative mood – 'creative tension' relationship leading people rather to reject the status quo and to engage in finding novel solutions (Kaufmann 2003: 195).

Similar questions are discussed by George/ Zhou (2002), referring to creativity in the workplace. According to them, positive mood makes people believe they are in a satisfying situation and thus do not incite them to high efforts in order to search for new solutions.[90] On the contrary, "[t]o the extent that the work context emphasizes and rewards creative performance, individuals in negative moods may push themselves to come up with novel and useful ideas because their negative moods cause them to be more critical and discerning. As a result, such individuals strive to come up with suggestions that are truly new and useful." (George/ Zhou 2002: 687). Similar to Kaufmann, George/ Zhou argue that negative mood may have a signalling effect for needed changes and motivate individuals to engage in new ideas for improving the status quo. In the process of generating new, creative ideas, people have to decide when their creative efforts are sufficient, mainly through their own perceptions of their work. Here, people's mood state is crucial, and negative mood may indicate that further work has to be done. But these effects only occur if (i) people are rewarded for creative ideas and (ii) if people are aware of their moods and feelings. If the latter is not the case, then, according to George/Zhou, mood is not used as input in evaluating peoples' creative efforts which may lead to positive relationships to creativity. Similar effects are expected if creative performance is not appreciated; i.e. if creativity is not an objective for people, mood is not used as input for creative performance (cf. George/ Zhou 2002: 687-690).[91]

Kaufmann supplements this view on mood and its functions by relating it to internal characteristics of individuals; referring to the concept of self-efficacy, i.e. the belief in one's capabilities to achieve given attainments: "Thus, we postulate that positive mood will lead to enhanced confidence in one's own ability to solve the problem at hand, and thus promote a higher level of self-efficacy. Conversely, negative mood is thought to lower confidence, promote pessimism, increase susceptibility to fear of failure and thus decrease the individual's level of self-efficacy." (Kaufmann 2003: 197).

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90 George/ Zhou measure positive and negative mood with the Positive and Negative Affect Scale (PANAS) which contains 10 markers of positive (e.g. excited, enthusiastic, proud) and of negative (e.g. distressed, scared, nervous) moods respectively. People are asked to indicate their feelings during the past week. Perceived recognition and rewards for creative performance and clarity of feelings are measured on the basis of individual's agreements or disagreements of certain statements concerning these topics (cf. George/ Zhou 2002: 691).

91 From their analyses, they conclude that "… we do not mean to imply that organizations should seek to foster negative moods in their members and dampen positive moods to encourage creativity. Rather, we strove to identify the conditions under which naturally occurring negative affect might be a kind of energizing force […]. We fully acknowledge that under other conditions, positive mood may promote, and negative mood may inhibit, creativity; ..." (George/ Zhou 2002: 694).

Based on his thorough literature analysis and own research, Kaufmann develops a theory of the influence of mood on different states of the problem-solving process in differentiating between (i) problem perception, (ii) solution requirements, (iii) process and (iv) strategy[92] and the respective effects of different mood states (Kaufmann 2003: 197ff.):

(i) in the stage of problem perception, the classification of a given problem as opportunity or threat (the valence of the problem) is decisive since it has an impact on individuals' information processing procedures. According to this view, individuals defining a problem as opportunity rather tend to have a stronger belief in their own problem solving ability than the cues indicating a threat attitude which, in turn, implies a rather pessimistic view on own problem solving abilities. Kaufmann (2003: 198) assumes that "... positive mood should promote a frame of mind that is conducive to perceiving a problem as an opportunity, whereas negative mood should increase the likelihood of perceiving the problem as a threat."

(ii) based on the hypotheses that positive mood rather leads to a satisfying and negative mood to an optimising solution strategy, negative mood is rather conducive to finding an ingenious solution than positive mood. Consequently, negative mood leads to higher requirements concerning the quality of the solution for a given problem than positive mood.[93]

(iii) here the level and breadth of information processing in the solution finding process is addressed. It is postulated that positive mood leads to broader information processing than negative mood, but also to a more superficial processing. On the contrary, "... negative mood leads to more constricted but deeper processing." (Kaufmann 2003: 199)

(iv) differentiating between heuristic-intuitive (based on simplification) and systematic, analytic strategies (more costly), the strategy pursued is also linked to the confidence in problem solving ability (and to the structure of the given task). It is concluded that positive mood rather leads to heuristic, short-cut strategies whereas "... negative mood should lead to more cautious, analytic and systematic methods of dealing with the task at hand." (Kaufmann 2003: 199).

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92 Additionally to theses stages, task constraint is added as external variable which might moderate mood effect. This is due to yet unanswered questions concerning the share of performance related to the task to be solved that can really be attributed to mood (cf. Kaufmann 2003: 199/200).

93 Kaufmann (2003: 199) adds that the availability of feedback processes on solution finding may have a significant impact on the postulated relationships. The findings presented above refer to a situation without feedback processes. In the other case, positive mood can also lead to higher quality solutions when feedback indicates the non-appropriateness of the solution reached so far.

Kaufmann (2003: 200/201) concludes by stating that according to his findings and contradictory to the "mainstream position", critical thinking in the creativity process – considered as an necessary, but not sufficient condition for innovation – rather seems to be facilitated by negative than by positive mood.

Summarising, there is no unambiguous relation between mood and creativity. Some researchers doubt positive relationship between mood and creativity, and argue that negative mood rather indicates (affective) states of tension or dissatisfaction. These tend to be related to the ability to find new and creative solutions. However, as George/ Zhou (2002) showed, this relationship is only valid under certain conditions: If creative performance is communicated as overall objective within the organisation, and if people are aware of their mood states.

2.5 Perception, attitudes and (spatial) behaviour: Concluding remarks

This section aimed at giving an overview of research on perception in psychology, sociology, and the application of those concepts to spatial issues. It showed that research on the effects of external stimuli has a fairly long tradition, starting with Fechners and Wundt's psychophysical experiments, being further developed and treated under cognitive aspects, and being adapted to spatial and behavioural questions. Besides the effort to trace the different lines of research which are supposed to be pertinent for the empirical analysis of perception and innovation in Alsace and Baden, the preceding chapter indicated that there are similar basic assumptions to the perception issue. However, the different disciplines slightly differ in their application of the perception terminology. Psychology understands perception as environmental stimuli impinging on human sense organs, whereas perception geography seems to rely on a broader concept of perception including information processing, cognitive processes, as well as decision and behaviour (cf. Walmsley/ Lewis 1993: 68/69). Downs/ Stea (1974b: 13, emphasis taken over from the original text) already in the 1970s state these differences: "… perception has been used in a variety of ways: to experimental psychologists, it involves the awareness of stimuli through the physiological excitation of sensory receptors; to some social psychologists, it implies both the recognition of social objects present in one's immediate sensory field *and* the impressions formed of persons or groups experienced at an earlier time. To many geographers, perception is an all-encompassing term for the sum total of perceptions, memories, attitudes, preferences, and other psychological factors which contribute to the formation of what might better be called environmental *cognition*." However, Walmsley/ Lewis (1985: 64) do not consider perception and cognition as fundamentally dichotomous, and argue that cognition in this context involves perception. Both are realised in a context shaped by individual's experience, belief, values, attitudes and personality. Cognition is thus more general "… and includes perception as well as thinking, problem solving, and the organization of information and ideas." (Downs/ Stea 1974b: 14). Kaplan (1974: 70), as a result, pleads for using the term 'cognitive representation'. The more general terms of 'spatial cognition' and 'cognitive representation' are used by development psychology while the notion of 'cognitive mapping' stems from research on environmental behaviour (cf. Hart/ Moore 1974: 248). However, perceptions are always understood in relation to the subjective representations of peoples' environments. A crucial position in the different approaches receives the underlying conception of Gestalt theory. Evolutionary elements and constructivist thinking have been integrated in geographical approaches of perception and behaviour. The relation of firms and their environments in the context of these approaches can be understood as a "system" located in its environment, being in continuous change. The firm perceives these changes, and realises adaptive processes through internal reproduction processes. These processes are of crucial importance for the survival of the system. Adaptation processes to environmental changes have been described as "sense-making" or "chaos reduction". On this base, the firm (considered as system) acts and behaves; its behaviour taking place in its "behavioural environment". This behavioural environment is specific to the firm, but is assumed to overlap with other firms in the same social environment.

While perceptions in the "classical" psychological sense are related to a moment and an impulse from the environment, attitudes are rather longer lasting and circumscribe the general background in which perceptions take place. Attitudes are non-observable mental filters of knowledge, opinion, emotions and behaviour, and, contrary to perceptions, are supposed to contain affective or emotional components. Attitudes are assumed to be influenced by the social and cultural environment, are thus described as social constructs. Social psychology assumes attitudes to be related to behaviour, and Ajzen and Fishbein suggest in their theory of reasoned action and the theory of planned behaviour that attitudes and behaviours are mediated by behavioural intentions. Diverse approaches exist concerning attitude change, related to the message, the message sender and the message receiver. The overview of mood research and the relation between mood and creativity gave an indication about a short-term affective human state on creativity. Though there are different arguments concerning the influence of mood on creativity, the results of recent research seem to indicate an inverse relationship, i.e. a connection of negative mood to higher levels of creativity. This is due to the assumption that positive mood rather indicates a satisfying situation than negative mood which leads people to interpret their situation as problematic. This increases peoples' efforts to conceive creative solutions.

The manifestation of behaviour and its influencing elements is investigated in behavioural sciences. Behavioural geographical approaches adopt an evolutionary perspective, in differing in their basic assumptions from neo-classical notions of rational actors, complete information and optimal behaviour. Furthermore, behavioural approaches assume that firms have different abilities to use information (cf. Boschma/ Lambooy 1999: 414). Basic in the behavioural approach in geography is the supposition that human behaviour in space is influenced by spatial perception. This approach distinguishes between the behavioural and the objective environment. It is assumed that human beings' representations of their environments are basic for their behaviours, which, in turn, have an impact on the environment: "The behavioural geographer recognizes that man shapes as well as responds to his environment, and that man and environment are dynamically interrelated. Man is viewed as a motivated social being, whose decisions and actions are mediated by his cognition of the spatial environment." (Gold 1980: 242). Spatial behaviour is in the first place analysed on the individual level, i.e. considering individual attitudes, values and norms. These, however, are assumed to depend on the respective social and cultural environment (cf. Fliedner 1993: 146).

Theoretical approaches of perception have shown that the individual and his environment are in continuous interaction, and receive external information. However, not the whole spectrum of available information reaches the human brain, leading to the phenomenon that "…, man sees only what he wants to see." (Walmsley/ Lewis 1985: 64). This information is classified in human brains and combined according to cognitive structures already available from former experience and learning processes, and later builds peoples' subjective representations of the environment. These representations are referred to as mental maps, images, cognitive representations or schemata.[94] More generally, the term 'subjective representation' has also been used here. While behavioural approaches in geography differentiate between objective and behavioural environment, (radical) constructivist approaches hypothesise that human reality is completely constructed. However, approaches from different scientific disciplines agree that the process of reality representation (or construction) is connected to perceptive and cognitive processes. Their result, human's subjective representation of reality, delivers the framework for human decision-making and action. The basic ideas and concepts of the theoretical approaches seem to point in the same direction: Individual human beings as well as firms (better: their representatives) have a certain view of their environ-

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94 Discussing these different terms, Walmsley/ Lewis plead for the use of 'schemata': "The end product of the act of perception and cognition has been given a variety of labels: mental map; image; cognitive representation; schemata. The idea of 'mental map' is […] really nothing more than a metaphor, while the notion of an 'image' conjures up mental pictures, and the term 'cognitive representation' is rather vague and all embracing. As a result the idea of schemata as frameworks for coding and structuring environmental information is probably the most useful concept in helping to understand the way in which information processing and spatial decision-making influence overt behaviour." (Walmsley/ Lewis 1985: 64).

ment. This view is influenced by individual and by socio-cultural factors, leading to the assumption that reality representations have an individual, but also a social character. This means that every human has his/ her individual view or representation, but – due to socio-cultural impact factors as well as communication structures – those representations resemble among members of the same social group: "Yet, each person's conceptualized geography is not necessarily unique. Because we share a verbal language to communicate with each other and otherwise share a common **society**, we tend to have similar geographical notions and to make similar geographic decisions." (Jakle et al. 1985: 2, emphasis taken over from the original text).

The constructivist systems perspective points at self-organisation processes and the high pertinence of system-internal communication.[95] Systems have a coherent internal structure which is capable to reproduce itself on the base of its own components. Internal consistency constitutes the system boundaries. System changes are reactions to environmental changes. Human beings are considered as operationally close (autopoietic) psychological systems. Their neural systems constitute consciousness on the base of the organisational structure of the neural system. The external world is represented in a relational form. According to this viewpoint, environmental events (or stimuli) initiate neural relations which then create a certain association or presentation. Thus, the construction of reality, according to this standpoint, is taking place in human brain, is assumed to be a cognitive process. However, the effects of the initiated neural relations cannot be determined in advance (cf. Willke 1996: 63).

The preceding chapter allows formulating some indications for the analysis of firms, their innovation activities and their environments. Firms are located in a specific environment, their regional context. According to the regional innovation system approach, firms build a sub-system within the regional innovation system. As such they are related to further actors of the innovation system, embedded in specific socio-economic and cultural framework conditions and experience influences from beyond the regional system's border. The choice of this conceptual framework for the empirical analysis also answers the critique uttered with respect to behavioural approaches in geography, namely the fact that "… social phenomena are explained purely in terms of the mental characteristics of individuals. This is particularly important because one of the most telling criticisms yet made of behavioural approaches in geography is that they frequently view an individual as *homo psychologicus* and tend to treat environmental behaviour as a one-dimensional phenomenon to the extent that the economic, social, and political considerations that act concomitantly with environmental influences are fre-

95 This is supported by Jakle et al. (1985: 3): "Our environment is given meaning through communication; nothing has meaning apart from the communication process."

quently overlooked" (Walmsley/ Lewis 1993. 15, emphasis taken over from the original text). With respect to innovation, research and technology transfer institutions, co-operation partners like clients, competitors, and other firms are decisive elements of the environment. Firms and their representatives perceive their environment and have a certain subjective picture of it in which their decisions are rooted and their actions are embedded. In this context, the notion of selective attention or perception seems to be important since firms will only be able to perceive, thus to know, those parts of their environment that they "want to know". This relates to the assumption that firm representatives only know about things if they have a certain relation to it, if they are "searching for them" in their environment. Behavioural approaches in geography analyse human behaviour in space, initially for instance consumer behaviour or migration. Regionally oriented spatial behaviour of innovating firms would mean for instance a search for innovation-related knowledge sources in the immediate environment. However, the 'region' is treated in a further function here, it represents the (diverging) socio-cultural background of the sample firms in the empirical analysis, thus referring to the assumption that subjective representations of the environment (the 'behavioural environment') are more similar between actors with a similar socio-cultural background than compared to actors with different contexts.

Generally, the following analysis tends to rather consider perception than attitude, however referring to perception in a broader meaning. These concepts seem to be partly overlapping: According to figure 6, perceptions are the measure for the cognitive component of attitude. In line with this reference to cognition, perception is interpreted in the cognitive sense, leading to firm representatives' evaluations of certain aspects in their regional environment in relation to their firms' innovation activities. Consequently, perception is not reduced to the pure meaning of a stimulus being transferred and interpreted. Attitudes in this context would be interpreted in a broader sense, for instance firm representatives' general opinion concerning the importance of innovation. But, as Golledge/ Stimson (1990: 46, emphasis taken over from the original text) assert: "Regardless of the exact definition chosen, it appears that perception involves an interaction or transaction between an individual and an environment. […] While in the classic sense perceptions are regarded as flexible and transitory phenomena which occur only in the presence of the stimulus, […] in the discipline of geography the concept has been interpreted in a broader context with a distinct evaluative component. In many cases, the term **perception** has been confused with the concept of **attitude**, which is seen to be a relatively permanent structure which may hold in the absence of any particular stimulus." Clearly, the following analysis concerns interactions between firms, i.e. their representatives, and their environment, and an evaluation component, thus seems to be in line with the geographic interpretation of the perception concept. It contains a cognitive component and is not merely restricted to the immediate response to a stimulus.

3 Innovation, perception and the region: Synoptic view, policy-related indications and introduction to the empirical analysis

This chapter aims at synthesising the main elements presented so far and to introduce the empirical analysis of perception and innovation of firms in two different regional settings.

3.1 Innovation, perception and the region: A synthesis trial and some policy indications

The first chapter approached the innovation-region relation from the view of the firm and its internal innovation activities, from the perspective of proximity between actors, and from the regional perspective, i.e. the manifestation of production and innovation in a territorial setting. Chapter 2 then discussed the notion of perception in different scientific disciplines and the issue of reality representation or construction. Further, the attitude concept, as well as recent findings in mood research have been presented.

The different theoretical approaches and conceptions related to the understanding of innovation differ in their consideration of the impact of territory. The linear model understands innovation in sequential phases and does not consider feedback processes. The chain-linked model of innovation refers to exchanges within the firm, but also with external partners, and thus contains an implicit reference to firm location, i.e. of space. Kline/ Rosenberg also point at innovating firms' economic and social environments and thus consider innovation as an embedded process (Kline/ Rosenberg 1986: 304). The current understanding of innovation as complex and interrelated, thus social process (cf. Lundvall 1992b: 1, Koschatzky 2001: 35, European Commission 2000) owes a high part of its understanding to the chain-linked innovation conception. Crucial ingredient for successful innovation is knowledge.[96] Research on knowledge as the crucial input for innovation focuses on the pertinence of tacit, implicit knowledge[97] and therefore

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96 Nonaka et al. (2000) describe knowledge creation as firms' crucial function, leading to constant evolution processes of firms and people. New knowledge is generated by processes of knowledge conversion, i.e. interactions and transformations between tacit and codified knowledge (cf. Nonaka et al., 2000: 10). Nonaka/ Toyama (2005: 430) indicate their understanding of knowledge-creating firms' environment which, according to them, "… is not an abstract world which is a subject of analysis for modern science, but a phenomenological 'life-world' to live in and experience as a reality…". Cowan/ Foray (1997) point at the process of knowledge codification and diffusion in the economy.

97 Cf. for instance the famous statement of Polanyi (1997: 136) that "we can know more than we can tell." Senker (1995: 426) describes tacit knowledge as "heuristic, subjective and internalised" - thus related to the knowledge creator - which is "… not easy to communicate

points at the importance of face-to-face contacts and proximity relations for the transfer of tacit knowledge. According to Maillat/ Kébir (1999: 437), the more a production regime refers to tacit knowledge, the more it is localised, the more this knowledge is specific for the territory and the less it can be transferred to other regions. This view can be considered as being in line with Autio's (1998) characterisation of the regional innovation system as being rather tacit than the innovation system on the national scale (cf. page 16f.).

'Industrial districts' and 'innovative milieus' focus on the intrinsic vigour of the local setting to support communication, interaction, co-operation, and innovation. Apart from Italian regions, districts have for instance been identified in Germany (Baden-Württemberg, the greater Stuttgart area) and France (e.g. Jura). Since cultural and social factors, traditions and institutions play an important role, the transfer and reproduction potential of districts and milieus is quite limited, and it is difficult to set them up with the aid of public policy (cf. for instance Fromhold-Eisebith 1999: 172/173).[98] However, some of the constituting elements – face-to-face contacts, possibilities for exchange, etc. – have been adapted to regional and innovation policy measures.[99] Comparable is the situation for learning regions: Some of the elements can be supported by political measures, for instance through incentives for life-long learning.[100] The great

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and is learned through practical examples, experience and practice." Contrary to tacit knowledge, codified or articulated knowledge "… is transmittable in formal, systematic language." (Senker 1995: 426). Tacit and codified knowledge parts are assumed to be complementary (cf. Senker 1995).

98 However, Fromhold-Eisebith (1999: 173/174) argues that regional policy may lay the base for the generation of an innovative milieu and suggests distinct measures as the registration of existing milieus including non-innovative ones, the establishment of a "regional task force", an executive committee to conceive innovation supporting measures, and measures to stimulate creativity and innovation in the milieu.

99 Innovation policy is defined as "set of policy action to raise the quantity and efficiency of innovative activities, whereby "innovative activities" refers to the creation, adaptation and adoption of new or improved products, processes, or services." (European Commission 2000: 9). Innovation policy thus is directed to the whole innovative process, from idea generation to market introduction of the innovative product. It concerns scientific, technological, economic, organisational, and social aspects. Technology policy, though often used synonymously with innovation policy, is less broad and concentrates on the scientific-technological sphere. On the local level, technology policy is directed towards the specific local conditions; its instruments can thus be better adjusted to the situation of local firms (cf. Hilpert 2001: 74/75, Koschatzky 2001: 302ff. concerning instruments, competencies and regional levels of technology and innovation policies). Hassink (1996: 287) distinguishes three groups of regional technology policy in order to support firms' innovativeness: (i) technological aid schemes for the financial support of regional firms, (ii) the support of technology transfer infrastructure, and (iii) technology centres for the support of business start-ups.

100 In Germany, the "*Lernende Regionen*" (learning regions) programme of the Federal Ministry for Education and Research and the federal states focuses on the initiation of networks

advantage of this concept is the openness towards different development modes and strategies (cf. also Butzin 2000: 159 ff.), and the focus attributed to learning competences can be useful for "lagging behind regions", too.[101] Nevertheless, it has to be mentioned that the transformation into a learning region may be a long-term process since the basic principles of the whole system – production and education structures, as well as mentalities, behaviours, rules and norms, etc. – are affected.

The importance of learning is basic in policy conceptions for the "learning economy" (cf. Lundvall/ Johnson 1994: 37ff., or Lorenzen 2001: 171-178 concerning learning policies on a localised level). According to these conceptions, policy intervention should be designed to support learning - including (creative) forgetting (cf. Johnson 1992: 29) – and knowledge production and exchange, learning capabilities, interactive learning, and access to knowledge, as well as "learning-friendly" environments for individuals and firms. Furthermore, external links that bring new knowledge to the region are considered pertinent (cf. also Asheim/ Cooke 1998: 229). The creativity aspect of individuals is emphased by Florida and his talent-oriented approach. Hansen et al. (2005) relate this focus to the specific knowledge bases used in different industries, assuming that different knowledge bases depend on different talent types and consequently refer to different policy measures. Talents, according to them, have the highest importance in industries which rather rely on codified than on tacit knowledge, whereby scientific knowledge is of high importance. Examples are genetics, biotechnology or information technology. From a political point of view, attracting talents can be supported through conducive administrative measures, granting project funding to research institutes, and providing conditions to make international talents "feel at home" (Hansen et al. 2005: 10-13). Besides knowledge, learning and creativity, communication is considered pertinent for the success of innovation systems (cf. Freeman 1992: 181, European Commission 2000: 14). This is also congruent with Luhmann's system approach that comprehends communication as basic prerequisite for a system to maintain and reproduce its functions. Communication is an essential part in interaction-based approaches, and also receives crucial importance in perception approaches, since individuals and their environments are connected via communication.

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between educational institutions and the demand side, relating schools and educational institutions, firms, employment offices, economic support, municipalities, chambers of trade and industry and others. The main goal of the initiative is oriented towards life-long learning. Cf. http://www.bmbf.de/de/414.php, http://www.lernende-regionen.info/dlr/index.php.

101 This does not mean that a lagging behind region will surpass high-tech regions just by adopting the principles of a learning region, but that it may qualify for innovation processes and shift towards an individual development by transforming into a learning region. See also Muller 1999.

The systemic view that characterises innovation is also required for innovation policy: Policy support should consider the different facets of knowledge generation and innovation (cf. European Commission 2000: 20). While after-war policies generally had a strong focus on science support – thus mirroring the linear science-pushed conception of innovation[102] – more recent policy conceptions are encompassing further fields such as education, basic and applied research, or innovation financing. Policies are furthermore focusing on networking relationships between different actors, and have an increasingly regional focus. Here, the regional innovation system concept is widely used as analytical framework for the investigation of innovation processes and for the formulation of policy implications. On the European level, for instance, diverse support programmes for innovation and technology transfer have been supported on a regional scale.[103] They are competition-based and aim at bringing together regional actors in order to raise awareness for innovation issues and to develop a common regional strategy (cf. for instance Koschatzky 2001: 7/8, Morgan/ Nauwelaers 1999, Landabaso et al. 2001, Landabaso et al. 1999). Competition-based technology and/or innovation-related initiatives on a regional scale are implemented both in France and in Germany (cf. chapter 4).

The examination of perceptions added a subjective element to the approaches of innovation and the territory. The link between perception and innovation has already been discussed by Drucker (1985: 95):[104] "Whether sociologists or economists can explain the perceptional phenomenon is irrelevant. It remains a fact. Very often it cannot be quantified; or rather, by the time it can be quantified, it is too late to serve as an opportunity for innovation. But it is not exotic or intangible. It is concrete: it can be defined, tested, and above all exploited." Tang (2006) focuses on firms' innovation activities in relation to firms' perceptions of competition and finds a "complex relationship between competition and innovation." (Tang 2006: 74ff.). On the individual level, links between

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102 For instance the support of scientific development and of large research institutions in important technological fields (cf. chapter 4 for some background information on Alsace and Baden). The underlying concept is related to the notion of knowledge as a public good which is assumed not to be fully appropriable by the knowledge creator. This leads to the "free-rider" problematic and the sub-optimal knowledge production within the economy. Consequently, the government is required to provide an appropriate amount of research (cf. Amin/ Cohendet 2004: 141).

103 These are for instance the Regional Technology Plan (RTP), the Regional Innovation Strategy (RIS), the Regional Innovation and Technology Transfer Strategies and Infrastructures (RITTS) programmes, RISI (Regional Information Society Initiatives), TRIPS (Trans-Regional Innovation Projects) or RIS-NAC (Regional Innovation Strategies in Newly Associated Countries). See also http://www.innovating-regions.org/.

104 However in the context of changes in consumer perceptions as innovative capabilities for firms, see page 35.

creativity as a precondition for innovation and perception have been elaborated by Vandervert and his working memory / cerebellar theory of innovation (cf. Vandervert 2003; see also page 41). Learning processes in working memory and the perceptual-cognitive functions in human cerebellum lead to creativity and innovation capabilities; innovation and perception are thus assumed to be related through cognitive processes, knowledge, learning and experience.[105] Constructivist and system-oriented approaches focus on the (autopoietic) evolution of firm (systems) in relation to their environment. The constructivist perspective links the observer and the observed, since the observer creates his/her individual reality based on selective perceptions from the complex environment. Autopoietic reproduction and social evolution result in the generation of structurally coupled social sub-systems such as policy, religion, arts, economy, science and law, characterised by specific codes of communication. Changes result from triggering and structural coupling (cf. Debus 2002: 35/36 and 55/56). According to this view, the different sub-systems – in the case of innovation for instance the science, the economic and the political sub-systems – can only trigger each other through communication. This would mean that policy cannot influence innovation activities in firms directly, but can 'trigger' firms' activities and give incentives to foster their innovation efforts.

Evolutionary economic theory provides the general conceptual framework in which innovation processes in their territorial context are analysed. The focus is on dynamics, process and transformation, and – more precisely – on knowledge, learning and evolution in uncertain environments. Key concepts of evolutionary theory are variety, replication and selection. Additionally, space is attributed central importance within the evolutionary framework: The local 'milieu' is crucial in technology development and in mediation of economic actors' uncertainty (cf. Camagni 1991a: 212). The evolutionary and dynamic character of innovative processes is basic in the innovation system conception: In their investigation of diverse European regional innovation contexts at the beginning of the 1990s and the 2000s, Cooke et al. detect an increasing trend towards systemic innovation on the regional scale (cf. Cooke 2004: 2). The evolutionary principles are investigated with respect to regional (technology) policy by Lambooy/ Boschma (2001). Crucial are economic actors' strategies to adapt to changing structures, as well as dynamic interactions between economic actors and the selection environment. However, due to human decisions and actions, the 'selection of the fittest' principle diverges from biology. Consequently, regional development cannot be con-

105 Senker (1995: 427) emphasises this aspect when distinguishing knowledge from skills: "Knowledge implies understanding. The acquisition of knowledge is a perceptual, cognitive process".

ceived as a linear process with changes in one variable resulting in predictable changes of the outcome. Technology policy aims at stimulating development, diffusion of new variety or innovation, which can be achieved through efficient selection mechanisms and the support of adaptation to changing structures. Essential is the support of interrelations between the diverse parts of the regional innovation-related structure, and the reference to existing conditions and capabilities. Policy in an evolutionary context is generally characterised by adaptation instead of optimisation, trial-and-error, an experimental character, and to non-predictability due to chance effects (cf. Lambooy/ Boschma 2001: 114 and 117-128).

Hilpert (2001) integrates the 'regional darwinism' and the autopoiesis dimensions, stating that leading innovation locations are selected in interregional competition according to the 'survival of the fittest' principle ('regional darwinism'), related to successful developmental approaches and best practice strategies. He identifies characteristic patterns in successful high-tech regions: (i) Regional policy planning, (ii) spatial self-organisation (autopoiesis), and (iii) (evolutionary) selection processes. He derives from his analysis that the most successful regions were able to synchronise governmental framework conditions, science and economy. Self-organising systems are characterised by instability, nonlinearity, fractal structures and chaos, and are able to create order through the process of self-organisation. Successful self-organising systems practice learning, experience instability and master structural breaks ('creative chaos', cf. Hilpert 2001: 76/77). Decisions are not based on rational choice by *homo oeconomics*, but by subjectivity and individual dispositions, i.e. by decisions resulting from individual situations. This refers to the general understanding of self-organisation as a result of 'selective attention' and subjective preferences, and the constitution of interactions through perception and evaluation. 'Learning regions' are understood as regional systems of networked actors that succeed in mastering structural change (cf. Hilpert 2001: 77/78). On this basis, Hilpert (2001: 79ff.) develops the concept of 'experimental imitation' for regional technology policy, i.e. an oscillation between imitation of other successful examples and experimental introduction of (innovative) policy elements in relation to the development phases of the regional system. Evaluations, feed-back processes and reorientations are the main components of recursive strategies. Summarising, regions that succeed in harmonising the different (self-organising) sub-systems which are pertinent for innovation – such as economy, policy, law and regulation, education and qualification – and thus achieving their co-evolution (through structural coupling) seem to be well prepared to play an important role in the interregional competition for innovation and high-technology locations.

3.2 Definition of the field of analysis

The general argumentation of the empirical analysis is rooted in the regional innovation system approach. The conceptual framework seems appropriate to perform an applied empirical analysis of perception and innovation in two different regions, though being conscious that not every region can be characterised as a coherent innovation system *per se*. Perception approaches in psychology and in geography focus first and foremost on individual human beings, thus the micro level. In the context of firms and their environments treated here, individuals are considered as members of the whole social system "firm" and of the social and economic sphere of the spatial entity where the firm is located. The region is the spatial manifestation of a socio-cultural setting that is characterised by a common history, by comparatively stable (formal and informal) institutions and common values and norms. The members of a (social) group are assumed to have their individual subjective representations of their environment – of innovation-related actors, organisations, institutes, as well as the general innovation atmosphere and the economic and political framework conditions – which resemble among the members of the same social group and distinguish them from members of other groups. These subjective representations are assumed to relate on firm representatives' perceptions of environmental characteristics, perception understood here in a cognitive sense, thus encompassing the physiological process of stimulus reception and absorption, and including information transfer and processing. The environment is thus assumed to be constructed and to shape the territorial context in which behaviour takes place ('behavioural environment').

The approaches concerning innovation on a regional level would suggest characteristic perception patterns rooted in the cultural and social context. This would imply that firms and their representatives act and react in their (constructed) behavioural environment, and that due to similar frameworks and communication between regional actors, those environments are similar among members of the same regional context. If it is further assumed that innovation activities display certain patterns or structures on a regional level – based on the assumption of the social character of innovation, thus of the embeddedness of innovative activities in the context in which it takes place - it can be concluded that specific innovation patterns are associated to specific perception patterns in a given territory. According to the system perspective shortly presented in section 2.2.2.3, firms can be understood as (i) displaying the capability for self-reproduction based on their internal components, and (ii) evolving in their internal structures as a result from adaptation processes to environmental changes. Following this argumentation, it can be assumed that firms – as well as regional systems – generally develop along established patterns, and evolve through adaptation to new conditions of their environments.[106] This also implies that firms' evolutive patterns and thus their behaviours are comparatively stable. Firm-internal changes, according to these arguments, could be conceived as reactions towards changes in the external environment. Research on perception topics and their relation to (spatial) behaviour assumes relationships between perception and behaviour in space. However, it is assumed here that these relationships are less simple and not direct stimulus-response relationships, but that perceptions rather lead to the generation or construction of a subjective representation of the environment (the 'behavioural environment') in which (innovation) behaviour takes place. On the contrary, when it comes to the analysis of behaviour, attitudes – which are rather longer-lasting than perceptions and less connected to a stimulus – have been indicated as having an impact on action, however via the intentional element, as Ajzen and Fishbein (1975, 1980) and Ajzen (2001) have shown. In addition to the behavioural component, attitudes are also composed of an affective and a cognitive component. Finally, mood – a rather short-term affective state – is supposed to have an impact on creativity, though there are different arguments concerning the direction of interrelation. Recent research has shown an inverse relationship in that negative affective states lead to higher efforts in problem-solving than positive mood (cf. Kaufmann 2003, George/ Zhou 2002). These analyses have been performed on the level of individuals. However, if the cautious assumption can be made that those findings can be transferred to the regional level, this could indicate associations between rather critical positions for instance through a less positive opinion concerning the innovation atmosphere and higher levels of creativity.

Perceptions are measured through firm representatives' evaluations of specific characteristics of the regional environment, thus including the evaluative component (cf. page 72). These assessments, however, are not treated as independent variables explaining regional innovation performance in a regression model or similar procedures. Instead, the analysis aims at investigating the existence of associations between perceptions and innovation characteristics – here measured as innovation input of the firms – which might characterise firms in the two surveyed regions. For Walmsley/ Lewis (1993: 69, referring to Downs 1976: 74), "… the environment is not seen just as another variable to be thrown into a multiple regression model but rather as the *raison d'être* of a whole class of behaviour…" (emphasis taken over from the original text). Perception is considered as continuous confrontation of the individual with the external environment

[106] Innovation researchers argue here in terms of technological and regional trajectories (cf. for instance Dosi 1988: 223ff., Nelson/ Winter 1977: 101ff., as well as Braczyk/ Heidenreich 1998: 415ff.).

leading to steady learning processes. These "mental interchanges" may lead to modified assessments of regional innovation-influencing factors. In constructivist terminology, the systems (firm representatives and firms) react to changes in the environment. These may incite the system to evolve. It can be assumed that these evolutive processes lead to diverging representations of the environment by firms.

The (regional) environment of firms is assumed to have a double function: It is the socio-cultural background that shapes individual perceptions, cognitive processes and behaviour. At the same time, firms' actions also influence the environment. This means that the environment shapes the 'decision and action space' of systems, and is also modified through actions of the systems. From this argumentation follows that every region has its specific interrelations leading to different patterns of perception. It seems thus consequential that different territorial environments lead to different patterns of perception. Due to selective perception, i.e. the focus on factors that seem to be important for a firm and its innovation activities, perceptions are assumed to mirror the specific innovation patterns in the region. It is expected that innovators only have a distinct evaluation concerning the features which are of relevance for them.[107] The study design allows to refer to innovation surveys at two different points in time. It focuses on the opinion of representatives of small and medium-sized manufacturing and knowledge-intensive business service (KIBS) firms in two regions in close geographical proximity but belonging to different national contexts: Alsace and Baden. The investigation of both manufacturing and business service firms aims at displaying a significant part of the whole business sector in the region. Moreover, as diverse studies have shown, KIBS are not only innovative as such, but additionally mediate innovation activities in manufacturing firms (KIBS as "co-innovators") and thus have an important function in the development of competences and the regional innovation landscape (cf. for instance Muller 2001: 35ff., Muller/ Zenker 2001: 1502-1506, Strambach 2001: 60ff, Lambooy/ Boschma 2001: 126).[108]

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107 On the other hand, outstanding organisations like research institutes contribute to a positive view of the regions even though the individual innovator might not co-operate with them.

108 This is also indicated by the European Commission in a recent communication, also emphasising the role services may play in "non high-tech" regions: "Not only does the service sector account for more than two thirds of GDP and employment, but there are also many possible synergies with industrial innovation. Since much service innovation is primarily linked to the business model rather than to developing new technologies, it is often relatively accessible to less technologically developed regions." (Commission of the European Communities 2006).

The focus on perception-oriented aspects aims at continuing innovation research performed in the surveyed neighbouring regions of Alsace and Baden (cf. for instance Muller 2001, Muller et al. 2001, Muller/ Zenker 2001, Héraud et al. 2000, Koschatzky 2000b, Koschatzky 1998a) with many similarities, but also differences. So the analysis on perceptions highlights an additional viewpoint on innovation aspects on both sides of the Rhine. Alsace is an administrative unit, one of the French *régions*, whereas Baden is part of the *Land* Baden-Württemberg. Baden has been chosen as region of analysis because its structure as well as history differs from that of Württemberg so that Baden has been considered as being rather comparable to Alsace than Baden-Württemberg as a whole. The size in terms of population further favours Baden as a comparative unit of analysis to Alsace. Finally, Baden and Württemberg have been fusioned after World War II to become the current federal state of Baden-Württemberg. Since Baden formerly was an independent *Land* (cf. also chapter 4) and since the approach chosen here refers to the social, cultural and historical setting, it is assumed that Baden is an appropriate spatial level of analysis.

3.3 Research questions

The regions of Alsace and Baden are understood as spatial environments of innovating firms. These environments host innovation consulting and innovation support through various actors also located here. Furthermore, the regions also represent the socio-cultural, political and economic framework for firms' innovation activities. The following analysis argues in the context of the regional innovation system approach (cf. section 1.2.5), supplementing it through the understanding of regions as 'behavioural environments' (cf. section 2.2.3), i.e. the 'region' as people see and understand it, and that is the context of their (spatially oriented) behaviour. Summarising, from a conceptual point of view, the perceptions perspective is complementing approaches on innovation and the region.

Perception and the generation of a subjective representation of the environment are supposed to rely on continuous "mental interchanges" between a given perceiver and his/ her environment. The socio-cultural environment of perceiving individuals represents the general framework conditions for individuals' cognitive processes, leading to individual 'behavioural environments', but with higher overlappings between people with similar social backgrounds. This points at the question how different types of firms and their representatives in different regions view their respective environments:

- Can the 'subjective environments' – indicated by firm representatives' assessments concerning the selected innovation-related regional aspects – of actors in different regions clearly be distinguished from each other? Or are the selected aspects rather diffuse, thus receive similar ratings from firms located in the sample regions?

- How do firms of different types, i.e. of the manufacturing and business service sector, assess their environments? Are firms' assessments of the same region rather similar or can evaluations rather be distinguished according to firms' type of activity, i.e. do "region-specific behavioural environments" outperform "type-specific behavioural environments" or *vice versa*?
- A further question concerns possible associations between firms' subjective representations of their environments and their innovation behaviours: Are these characteristics related, i.e. do firms' evaluations of their environment show specific patterns related to their innovation characteristics or do the answers of firm representatives show a rather diffuse, unstructured picture? Is it possible to identify perception- and innovation-related associations of the sample firms, i.e. do Alsatian sample firms compared to Baden ones have characteristic and region-specific innovation features and perception patterns and *vice versa*?
- How do perceptions and innovation behaviours evolve in time? Evolutionary approaches would rather suggest that firms develop along existing paths. Perception research, on the other hand, focuses on cognitive processes in human brains, leading to continuous adaptations and thus new mental conditions for incoming stimuli. This could argue for perception changes in time. Will it thus be possible to detect changing patterns of innovation and perception between two points in time?

The intergration of the perception perspective in the innovation topic could have implications for the study of innovation processes and for innovation policy. Firms' images concerning their regions mirror their representations, i.e. the way how external conditions are absorbed and processed, and how they are 'matched' with internal processes. Thus, knowledge on perceptions can be considered as means to get information about internal innovation activities in firms, as mediating the regional framework conditions and internal innovation activities of regional firms. Additionally, the analysis aims at delivering indications about innovation behaviours of different firm types in different regions. If the analysis shows differences between innovation characteristics and perceptions of the sub-samples, this might have an impact for innovation research and policy, in the sense that different firm types and/ or regional backgrounds show different indications for innovation support.

The analysis relies on three 'perception variables', two of them being related to specific aspects of the regional conditions with respect to firms' innovation activities: Research and technology as well as the workforce. The former refers to the generation and provision of research results and technological knowledge in the region, while the latter focuses on human capital, thus on knowledge, creativity and 'talent'. The third perception variable, i.e. the regional innovation climate, is more general and summarises the overall frame of the innovation conditions in the region. The innovation climate is assumed to be determined by the role and acceptance of innovation in the region, public support for innovation and the importance of innovation as felt by regional firms. In a cautious interpretation, this variable also aims at giving indications about the general "innovation atmosphere" in the region. A complete innovation-related image of the region would comprise more than these three aspects. But for the (explorative) analysis of possible associations between innovation and perception, those three selected variables have considered most relevant. The region is integrated in the analysis in its double function: First as the immediate environment and location of the sample firms, and second referring to the importance of regional sources for innovation-related information. This first function leads to the understanding of the (regional) 'behavioural environment' in terms of the innovation conditions in the surveyed regions. Innovation behaviours finally are measured in terms of firms' expenditures for research and development as innovation preparing tasks, and the share of employees working in R&D. Innovation input is assumed to indicate firms' intention for innovative behaviour, in terms of their efforts to engage in innovation. Since innovative activities and innovation expenditures are correlated (cf. Koschatzky 1999: 742), innovation inputs can point at firms' innovation activities. As indicated above, this study is designed to contrast firms' innovation input and assessments at two points in time.

Summarising and from a structural point of view, the empirical investigation is designed along three axes: (i) The assessment of selected regional innovation-related factors aims at providing indications concerning firm representatives' perceptions of their regional environment, (ii) firms' innovation input characteristics (measured in terms of their expenses for research and development or innovation projects, as well as their staff working in those fields) are supposed to reveal some aspects of firms' innovation behaviours and (iii) the two surveyed regions – located in close (geographical) proximity, but in different national contexts – are representing the spatial component, firms' 'home bases' and the regional framework conditions of the analysis.

In order to gain some indications about the regional framework conditions for innovation, the following chapter gives an overview of the regions of Alsace and Baden before the empirical analysis of perception and innovation is presented.

4 The surveyed regions of Alsace and Baden

4.1 Introductory remarks

The following chapter has the objective to give an introduction into the economic structures and innovation-related aspects in the two surveyed regions, and at presenting the general framework conditions under which the sample firms perform their innovation projects. Since – according to the innovation system approach (cf. section 1.2.5) – firm innovation is understood to be embedded in the regional and national contexts, the following sections also provide background information about the national innovation systems in France and Germany. The regional institutional set-up presented afterwards is based on the conception that different institutions fulfil specific functions within a (more or less coherent) innovation system. This relies on the concept of 'Institutions of Technological Infrastructure' (ITI), i.e. legal entities located in the region and being in charge of the management of the common knowledge base, the support of interactions between firms and the provision of expertise.[109] They comprise technology transfer agencies, R&D funding institutions, innovation consulting organisations, as well as public research institutes and certain private firms that execute the functions of an ITI. ITI thus produce scientific and technological knowledge, educate, provide and diffuse information and demonstrate new knowledge and applications. They promote the engagement of innovative actors in networks, and provide financial resources to innovators. They may also be in charge of training, i.e. of teaching in specific fields, in consulting, in validating technologies, in protecting intellectual property rights, or in providing external resources for innovative agents (cf. Koschatzky et al. 1996: 2-6, Bureth/ Héraud 2001: 69, and Héraud et al. 2000: 15/16). The succeeding analysis follows thus a functional approach, i.e. ITI are not addressed as a given type of institution, but related to the functions that are fulfilled (cf. Bureth/ Héraud 2001: 79). Figure 8 schematically illustrates the functions of an ITI. Those institutions can directly address actors of the regional scene, for instance firms. They can further start their activities at relationships between the knowledge-producing and -using actors or at relationships between firms in order to induce or strengthen networks.

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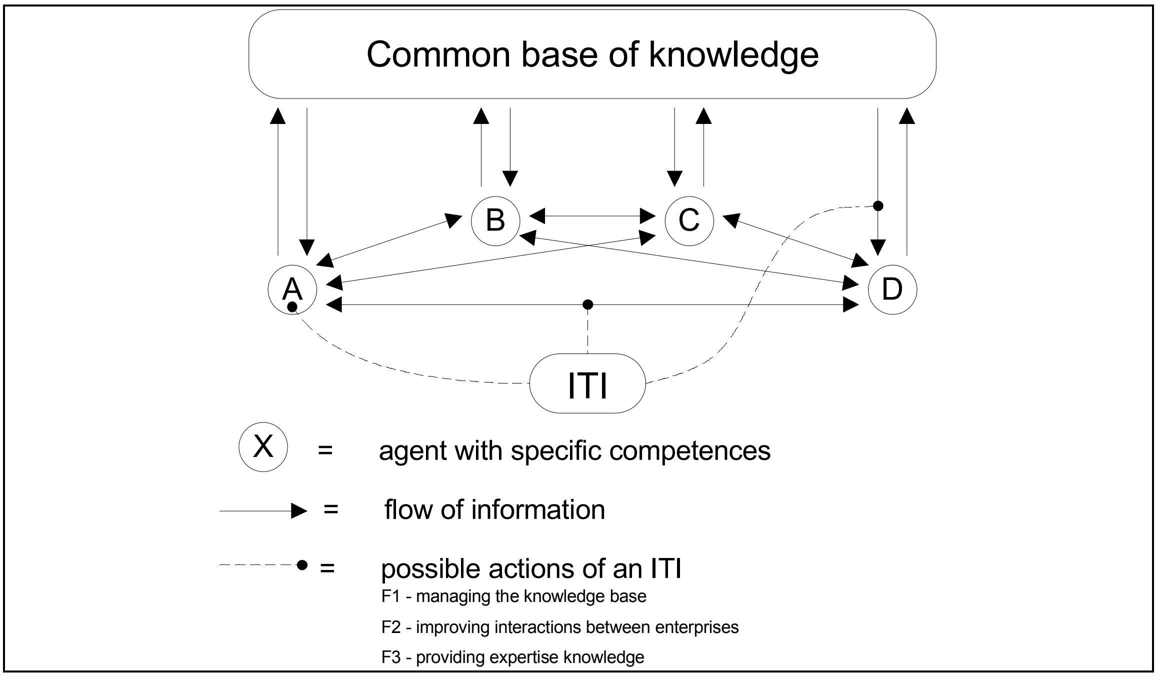
109 This conception has been developed in a feasibility study on Institutions of Technological Infrastructure carried out by Fraunhofer ISI and *Bureau d'Economie Théorique et Appliquée* (BETA, Université Louis Pasteur Strasbourg) on behalf of Eurostat (cf. Koschatzky et al. 1996).

Figure 8: Institutions of technological infrastructure (ITI): Schematic representation of possible activities



Source: Koschatzky et al. 1996: 4

The function "Managing the knowledge base" comprises the production of scientific and technological knowledge, education, information provision, and demonstration. Examples are research institutes that generate new scientific and technological knowledge, higher education organisations, the provision of information in databases, synthesis publications, as well as demonstration activities, e.g. for testing products and processes. The second function, "Improving interactions between enterprises", encompasses the support of networks between innovative actors, i.e. by organising meetings, fairs and exhibitions, as well as services with respect to finance provisions. Finally, the third function, "Providing expertise knowledge", refers to training in specific competencies, to the provision of consulting services, validation of technology, protecting innovative actions through patents, copyrights, etc., and to the supply of financial resources (cf. Bureth/ Héraud 2001: 83/84).

From a regional point of view, the empirical investigation refers to the *Région* Alsace on the French side, whereas the Baden surveyed region comprises the *Raumordnungsregionen*[110] Mittlerer Oberrhein, Südlicher Oberrhein and Schwarzwald-Baar-Heuberg,

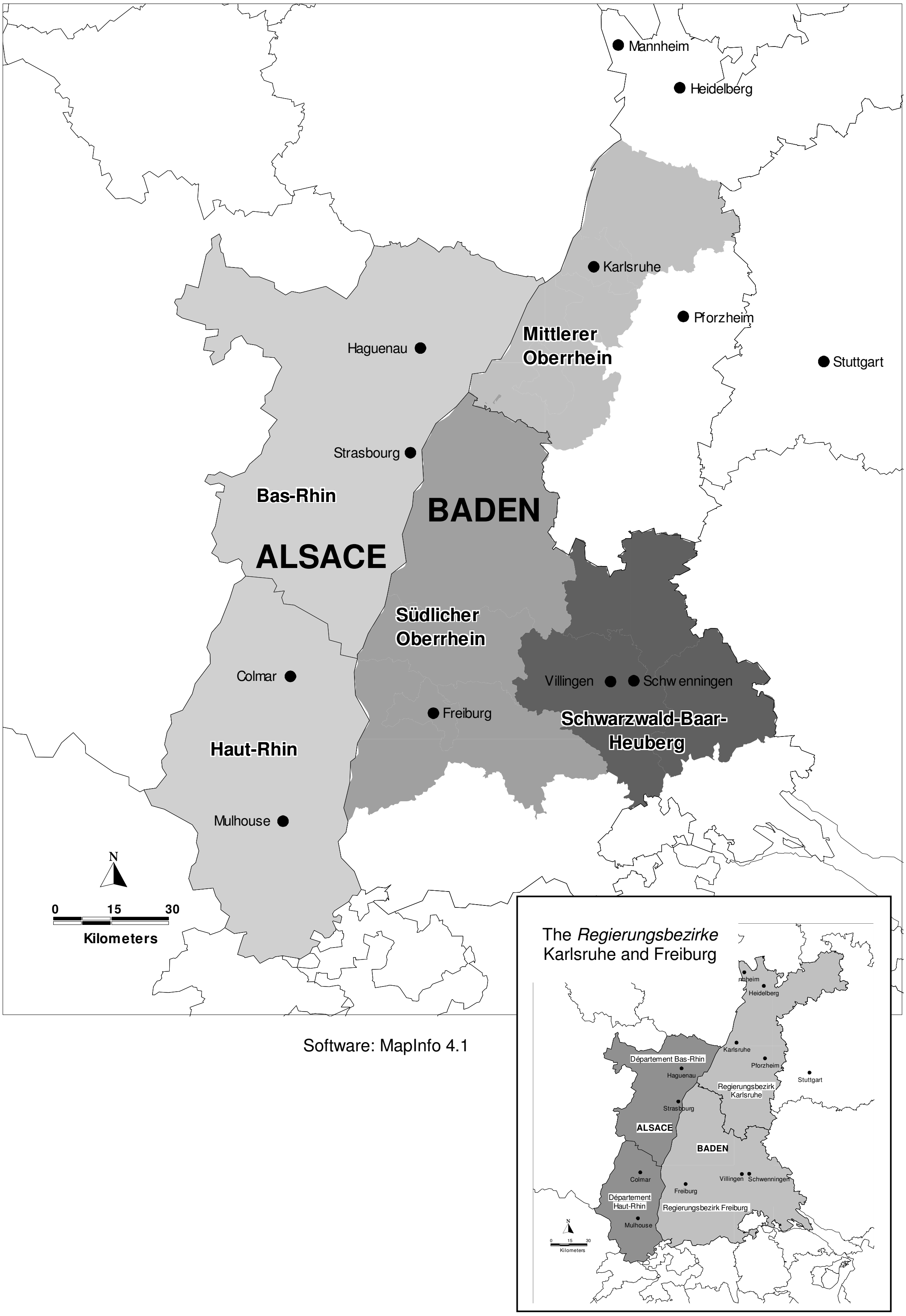
110 The 97 German *Raumordnungsregionen* are units for regional analysis and planning, thus not administrative units. They are placed between the 439 administrative units or *Kreise*

these *Raumordnungsregionen* being identical to the districts of the chambers of commerce Karlsruhe, Freiburg and Villingen-Schwenningen (cf. figure 9). The following presentation of the Baden surveyed region refers to data related to the *Raumordnungsregionen*, for instance provided by the *Bundesamt für Bauwesen und Raumordnung*, the Federal Statistical Office and the Statistical Offices of the states (INKAR database), or to regional statistics. Contrary to the surveyed region of Baden, Alsace is an administrative region on the NUTS2[111] level of the European nomenclature which is consequently one of the regional units of the Eurostat regio database. Comparable supranational data can only partly be used since *Raumordnungsregionen* as panning units are not represented in the Eurostat regio database.

(from which are 323 rural districts or *Landkreise*, and 116 urban districts or *Stadtkreise*) and the government regions or *Regierungsbezirke*. *Regierungsbezirke* are sub-divisions in the federal states of Baden-Württemberg, Bavaria, Hesse, North Rhine-Westphalia and Saxony.

111 NUTS: *Nomenclature des Unités Territoriales Statistiques*, cf. http://ec.europa.eu/comm/Eurostat/ramon/nuts/introduction_regions_en.html. In Germany, the NUTS2 level corresponds to *Regierungsbezirke* which are larger territorial entities than *Raumordnungsregionen*. The Baden surveyed region is covered by the *Regierungsbezirke* Karlsruhe and Freiburg which additionally include Heidelberg and Mannheim for instance (cf. figure 9).

Figure 9: The surveyed regions of Alsace and Baden



Software: MapInfo 4.1

4.2 The region of Alsace

4.2.1 Introduction

Alsace is one of the 22 (metropolitan) French regions, with historical roots in France and Germany, an European orientation with European institutions located in Strasbourg[112] and a strong cultural identity. It has a north-south orientation and is limited by the Rhine in the eastern and by the Vosges mountains in the western part. Due to its fertile soils, agriculture (particularly tobacco and maize) and viticulture played and still play a distinct role in the region's economic structure. However, Alsace is an industrial region with an above-national share of the workforce employed in industry and construction (cf. section 4.2.2). Alsace borders Germany in the northern and western, and Switzerland in the southern part. This geographical situation of Alsace as a border region is reflected in a considerable share of cross-border commuters: In 1999, Alsace had 69,830 cross border workers in Germany and Switzerland (9.3 % of the active workforce).

The region consists of the two *départements* Bas-Rhin in the north and Haut-Rhin in the south (cf. figure 9). Its capital is Strasbourg. With its 1.79 million inhabitants (2003),[113] 2.98 % of the French population live in the Alsatian region. The region's population density (216 inhabitants/ km^2) is twice as high as the French average and – after Île-de-France and Nord-Pas-de-Calais – on third position of the whole country. Alsace is a wealthy region (GDP/ inhabitant in 2003: € 24,694.5 compared to € 25,650.2 in total France)[114] with the commerce having a considerable contribution to the GDP. In the second quarter of 2006, the regional unemployment rate was 8.3 % (national average: 9.0 %), compared to 5.3 % at the beginning of 2001[115] (cf. Goetz 2003, INSEE Alsace, no year given, Chambre de Commerce et d'Industrie de Strasbourg et du Bas-Rhin 2005, Ledig 2005. See also section 4.2.5).[116]

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112 Cf. http://www.strasbourg-europe.com/en/.

113 Data source: Eurostat, regio database (retrieved on 31 July 2006).

114 For comparison: The Alsatian GDP/ inhabitant in 1995 was € 21,211.8, and € 20,214.6 in total France. Data source: Eurostat, regio database (retrieved on 31 July 2006). Thus, in 1995, the Alsatian GDP/ inhabitant was higher than the national value, contrary to 2003.

115 Cf. http://www.insee.fr/fr/ffc/chifcle_fiche.asp?ref_id=CMRSOS03311&tab_id=476. Cf. also Ledig 2005.

116 Cf. also http://www.insee.fr/fr/insee_regions/alsace/zoom/alsaceenlignes.htm.

4.2.2 Socio-economic structure of Alsace

4.2.2.1 Industrial structure: Manufacturing and service sectors

Alsace is a diversified industrial region with a tradition in chemical and textile sectors dating back to the 18th century. The mechanical industry developed on the base of these sectors. In the 19th century, both *départements* underwent a process of industrialisation. Though industrial establishments are located throughout the whole *région*, some large economic centres can be identified: Mulhouse with its manufacturing tradition (important industries have been potash, textiles, metals, chemicals and plastics, publishing and breweries), Colmar with a high share of foreign – particularly Japanese – investment, and the Strasbourg/ Haguenau/ Molsheim triangle in which more than a quarter of the regional employment in the manufacturing sector is concentrated and that recently witnessed an increase in tertiary employment. The broad industrial structure is considered advantageous; none of the sectoral fields employs more than 15 % of the workforce. Regional strengths are in the agro-food, mechanical, electrical, automotive, chemical and pharmaceutical sectors;[117] finance and insurances as well as tourism are the most important tertiary fields of activity (cf. Direction régionale du commerce extérieur 2006: 2, Wackermann 2000: 45).

The enterprise structure consists of SMEs which are mainly active in medium technology fields on the one hand, and of branch plants of multinational firms with their headquarters outside the region and production sites in Alsace on the other hand.[118] The importance of foreign firms is also reflected in the export-import ratio which exceeded 100 % in 2004.[119] The share of independent SMEs is below the national average. Regional SMEs have a good performance and constitute an important share of the firm

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117 The most important contribution to the regional value added is created by the automobile industry, food processing, mechanical engineering and chemicals (cf. http://forum.europa.eu.int/irc/dsis/regportraits/info/data/en/fr42_eco.htm).

118 In 2001, 35.4 % of industrial firms had foreign interests, employing 46.1 % of the industrial workforce (compared to 20.6 % of firms and 32.0 % of the workforce in France). More than 50 % of foreign firms are German origin; these are particularly located in Bas-Rhin. More than 90 % of the regional firms are SMEs with their head offices in Alsace, but since most of them are parts of multinational groups, their decision-making autonomy is limited (cf. Chambre de Commerce et d'Industrie de Strasbourg et du Bas-Rhin 2005, http://forum.europa.eu.int/irc/dsis/regportraits/info/data/en/fr42_eco.htm, Direction régionale du commerce extérieur 2006: 3).

119 This ratio is based on export values of € 23,773 million and imports of € 22,823 million in 2004. For comparison: The ratio for France was 97.6 %, i.e. imports in 2004 exceeded the export value (cf. Chambre de Commerce et d'Industrie de Strasbourg et du Bas-Rhin 2005). A high share of Alsatian products is imported by EU countries with Germany being the most important import-export partner (cf. Wackermann 2000: 51/52).

landscape. At the beginning of the 2000s, the rate of industrial firm foundations in Alsace was below the national average, but Alsatian firms had a comparatively high survival rate in the second half of the 1990s. But at the beginning of 2005, the number of firm foundations in France and particularly in Alsace decreased (cf. Muller et al. 2001: 67/68, Bach/ Héraud 2003, Région Alsace 2004, Direction régionale du commerce extérieur 2006: 3, Léglise 2001, Région Alsace 2006: 41).

Table 1 shows the share of the active population in the primary, secondary and tertiary sectors.[120] Between 1995 and 2003, the share of persons employed in agriculture and forestry as well as in industry decreased while at the same time the share of employees in the service sector increased both in Alsace and in France as a whole. However, it becomes obvious that Alsace has a higher industrial specialisation compared to the national average, and a comparatively lower share of persons working in the service sector.[121]

Table 1: Employment structure 1995 and 2003 in France and in Alsace

Territorial unit	Share (%) of employment in:*					
	Agriculture, forestry		Industry and construction		Services	
	1995	2003	1995	2003	1995	2003
France	4.55	3.50	25.37	22.71	70.08	73.79
Alsace	2.38	2.02	32.57	28.81	65.05	69.17

Data source: Eurostat, Regio database (retrieved on 01.08.2006), own calculations

*: The classification of branches relies on NACE Rev. 1.1. The sectors are divided into (i) agriculture, hunting, forestry, fishing, (ii) industry (including energy), mining and quarrying, manufacturing, electricity, gas and water supply, and (iii) financial intermediation, real estate, renting and business activities, other service activities, public administration and defence, compulsory social security, education, health and social work, other community, social and personal service activities, and private households with employed persons (cf. Eurostat 2006: 69).

Between the beginning of the 1990s and the 2000s, the contribution of service value added to the regional GDP increased, however having a rather lower-ranking position when compared to other French regions: In 2001, Alsace occupied the 14th position among French regions. Service firms, particularly business services, are mainly located in the urban areas, especially in Strasbourg, but also in Colmar and Mulhouse. Those

120 Percentages have been calculated on the base of absolute figures.

121 The manufacturing sectors contribute with 23 % to the regional GDP and with 22 % to regional employment (cf. Région Alsace 2006: 13). There is still potential for further development, particularly concerning business-related services (cf. Direction régionale du commerce extérieur 2006: 3).

locations provide qualified workforce, proximity to clients, favourable infrastructure conditions and an appropriate institutional, economic and cultural framework. Activities related to information and communication technologies do not have a particularly high importance in Alsace; these are rather concentrated in Paris. Île-de-France is an important location for business services, particularly for computer-related, business support and advertising service firms. On the contrary, services related to tourism (hotels, restaurants) and to individual services, are well presented in Alsace. An important contribution to regional wealth is realised by commerce (cf. Rimlinger 2003: 16).[122] A high share of service firms is based in Alsace, and only 20 % of the service workforce is employed by firms with headquarters outside Alsace. Nearly half of Alsatian service firms are characterised as individual operations whereas 49 % are associations (cf. Rimlinger 2003: 17). Summarising, the Alsatian service sector provides a considerable share of employment in the region, but the share of tertiary employment is below the national average. Knowledge-intensive business service firms, which are considered important in the innovation context, are rather moderately presented in the region.

4.2.2.2 Research profile

Alsace has a very strong profile in science and fundamental research. It hosts four universities with 65,000 students and has nine engineering schools. Alsace is the third important scientific pole in France with 3,000 engineers, 2,200 researchers, 126 research centres and 2,500 PhD students. Alsace has a good position in the national context concerning scientific publications: In 2001, 4.1 % of French publications originated in Alsace, which corresponds to the 6th rang among the French regions. However, when referring to the population and with respect to the French value (France=100), Alsace is on second position with 142 scientific publications/ capita (Île-de-France: 206). Related to scientific fields, the highest share of publications is obtained in chemistry, followed by fundamental biology (cf. OST 2004: 381 and 384. See also Ledig 2005, Goetz 2003).[123] The density of researchers in public institutes per 10,000 inhabitants is comparable to the national average: 11.9 versus 11.7 for the

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122 Cf. also http://www.insee.fr/fr/insee_regions/alsace/zoom/alsaceenlignes.htm.

123 Alsatian research organisations are also integrated in international research networks. Strasbourg hosts the *Pharmacopée européenne*, assuring quality standards in medicament production, the *Fondation Européenne de la Science* that supports scientific research in twenty countries, *Frontières Humaines* in Strasbourg which fosters high-level research in brain sciences and molecular biology and the International Space University ISU in Illkirch for research and formation in space issues. Further institutions located in Alsace are for instance the *Institut Franco-Allemand de Recherche en Environnement*, as well as international activities of the *Université Louis Pasteur* (cf. http://www.region-alsace.fr/fr/investir/recherche/matgrise.htm).

whole country (2001, cf. OST 2004: 367).[124] Concerning the number of accorded PhD degrees/ 100,000 inhabitants, Alsace is at second position in France (22.7) after Île-de-France (31.9) (2001, cf. OST 2004: 363). 5.2 % of the French researchers in the *Centre National de la Recherche Scientifique* (CNRS)[125] institutes are working in Alsace. In full-time equivalent, CNRS employees represent 18.5 % of the scientific personnel in Alsace and 35 % of the public research personnel in 2001-2002.[126] Life sciences (454 from 1,344 researchers) and chemical sciences (334 from 1,344 researchers) are the most important scientific fields, and also account for the highest amount of co-operations with industry (in terms of number of contracts and the contract sums) (cf. CNRS Alsace 2005: 4 and 13).

4.2.2.3 Research and development

The region's focus is (public, university-based) fundamental research; the production of technological knowledge and the rate of breakthrough innovations are rather modest, and the business sector's R&D expenses[127] remain below 1 % of the regional GDP (cf. Muller et al. 2001: 67, Bach/ Héraud 2003 and table 2).

Table 2: R&D expenses 1995 and 2003 by business enterprise, government, higher education and private non-profit sectors in Alsace and France (% of gross domestic product)

Territorial unit	Total intramural R&D expenditure (% of GDP) in									
	All institutional sectors		Business enterprise sector		Government sector		Higher education sector		Private non-profit sector	
	1995	2003	1995	2003	1995	2003	1995	2003	1995	2003
France	2.29	2.18	1.39	1.37	0.48	0.36	0.38	0.42	0.03	0.03
Alsace	1.06	1.57	0.69	0.87	0.06	0.06	0.31	0.64	no data	no data

Data source: Eurostat, Regio database (retrieved on 11.08.2006)

124 However, the number of total researchers/ 10.000 inhabitants is below the French average: 21.6 versus 25.8 in France as a whole (2001), cf. OST 2004: 365. See also table 3.

125 Further information concerning the CNRS are given in section 4.2.3.

126 CNRS research expenditures in Alsace count for 20 % of the total regional research expenses and 39 % of the public research expenditures. According to CNRS Alsace (2005: 8), these shares are highest in France.

127 The R&D definition refers to the Frascati Manual (cf. OECD 2002, see page 8). R&D expenditures refer to the total investment in order to realise research and development, including employment, material and capital expenses. The "Higher education sector" refers to universities, colleges of technology and other institutes of post-secondary education, as well as "… all research institutes, experimental stations and clinics operating under the direct control, administrated by or associated with higher education establishments" (cf. Eurostat 2006: 117).

Table 2 shows that the R&D expenditure in Alsace increased between 1995 and 2003, but still remains below 2 % and below the national reference value. The main share is spent in the business enterprise sector, followed by higher education, but not exceeding 1 % of the regional gross product in both years considered here. In an intraregional perspective in 2001, the report of the Observatoire des Sciences et des Techniques (OST 2004: 337) displays that 1.9 % of the French R&D expenditure is spent in Alsace (compared to 44.5 % spent in Île-de-France). From the repartition within France, OST (2004: 342/343) concludes that institutes of the CNRS are more present in Alsace than higher education institutes which indicates the high importance of public research in Alsace. In the business sector field, the highest shares of R&D expenses in 2001 have been spent by large firms with more than 2,000 employees (36.9 %), and small firms with less than 250 employees (32.6 %). Firms in the size class between 500 and 1,999 persons employed had a share of 21.5 % while the firm class 250 – 499 employees showed the lowest R&D share with 9.1 % (cf. OST 2004: 349).

The share of R&D personnel[128] in relation to the total employment in 2001 was below 2 % both in Alsace and in France with below-average shares of Alsace in the business enterprise sector. The highest share of R&D personnel is working in the higher education sector which points at the regional competence in fundamental research (cf. table 3).

Table 3: R&D personnel 2001 by business enterprise, government, higher education and private non-profit sectors in Alsace and France (% of total employment)

Territorial unit	Total R&D personnel (% of employment) in				
	All institutional sectors	Business enterprise sector	Government sector	Higher education sector	Private non-profit sector
France	1.64	0.82	0.21	0.58	0.04
Alsace	1.43	0.55	0.07	0.81	no data

Data source: Eurostat, Regio database (retrieved on 11.08.2006)

128 Eurostat (2006: 117) defines R&D personnel as "… all persons employed directly on R&D sectors plus any supplying direct services to R&D such as manager, administrative staff and office staff." (cf. Eurostat 2006: 117). The reference value – employed persons – refers to "… all persons aged 15 and over who during the reference week worked at least one hour for pay or profit, or were temporarily absent from such work. Family workers are included." (Eurostat 2006: 18). On the contrary, the definition of "economically active population" or "labour force" comprises employed and unemployed persons (cf. Eurostat 2006: 18).

4.2.2.4 Patent applications

Table 4 shows the number of patent applications to the European Patent Office between 1995 and 2000 (absolute values) and the annual average,[129] as well as the number of patent applications per million inhabitants in 1995 and 2002, comparing the Alsatian figures with the French values. This compilation shows that French patent activities concentrate on the operation and transport field, electricity, human necessities, chemistry and physics. With the exception of physics, the region of Alsace has similar specialisations, measured in terms of patent applications to the European Patent Office. Looking at the patent applications referring to the inhabitants (patent intensities), the good position of Alsatian patent applications becomes obvious: Except in physics and electricity (and mechanical engineering in 1995), the Alsatian values are above the national ones. In 2002, especially the operations and transporting as well as the chemistry patent classes are very strong in Alsace, outperforming the French values. The figures reflect the high importance of the vehicle construction and chemical/ life science fields in Alsace. On third position are patent applications in human necessities; this reflects the importance of the agro-food sector in the region. Textiles, paper and fixed construction do not have an important position in patent applications, neither in Alsace nor in the whole country. In a comparative analysis of regional patent applications to the European Patent Office with respect to the regional population in 2001, Alsace occupies the third position after Île-de-France and Rhône-Alpes (in relation to the French value) (cf. OST 2004: 386).

129 Annual averages have been calculated in order to account for potential random fluctuations in single year values.

Table 4: French and Alsatian patent applications to the European Patent Office 1995-2000 (absolute figures) and in 1995 and 2002 (per million inhabitants)

International Patent Classification*	Patent applications to the European Patent Office							
	1995-2000 (absolute figures)				per million inhabitants			
	France		Alsace		France		Alsace	
	Total	Annual average	Total	Annual average	1995	2002	1995	2002
Human necessities	7,317.4	1,219.6	256.5	42.8	16.70	24.24	20.81	32.27
Performing operations, transporting	8,300.8	1,383.5	257.5	43.0	18.92	27.26	19.53	43.02
Chemistry, metallurgy	6,599.9	1,100.0	346.1	57.7	16.31	20.19	24.98	40.80
Textiles, paper	553.1	92.2	70.2	11.7	1.60	1.81	5.45	6.95
Fixed constructions	1,781.1	296.8	126.4	21.1	4.26	5.26	8.38	7.36
Mechanical engineering; lighting; heating; weapons; blasting	3,983.7	664.0	72.3	12.1	10.14	12.68	2.83	13.08
Physics	6,297.2	1,049.5	93.2	15.5	13.28	25.30	4.75	17.91
Electricity	7,646.6	1,274.4	185.5	30.9	15.69	27.41	11.35	22.24
Total	**42,479.7**	**7,079.9**	**1,408.1**	**234.7**				

Data source: Eurostat, Regio database (retrieved on 11.08.2006), own calculations

*: The sections of the International Patent Classification refer to:

A. Human necessities: This sections refers for instance to agriculture, forestry, hunting, fishing, food and food production, tobacco, clothes and wearing, jewellery, furniture, medical or veterinary science, life-saving, fire-fighting, sports and games, etc.

B. Performing operations, transporting comprises for instance physical and chemical processes and apparatus, cleaning, hand and machine tools, working referring to wood, plastics, cement, clay, stone, paper, printing, furthermore vehicles, railways, ships, aircraft, as well as micro-structural technology and nanotechnology, etc.

C. Chemistry, metallurgy: Comprises organic and inorganic chemistry, biochemistry, metallurgy, crystal growth, among others.

D. The section 'textiles, papers' comprises for instance spinning, yarns, weaving, sewing, treatment of textiles, paper-making, cellulose production.

E. Fixed constructions: This section refers for instance to the construction of roads, railways, bridges, hydraulic engineering, water supply, building, drilling and mining.

F. Mechanical engineering; lighting; heating; weapons; blasting: Referring to machines or engines, engineering elements or units, lighting, steam generation, combustion apparatus, heating, drying, furnaces, weapons, etc.

G. Physics includes for instance measuring, testing, optics, photography, horology, controlling, computing, signalling, information storage, musical instruments, nuclear physics, nuclear engineering, etc.

H. refers to electric elements, electric power, electronic circuitry, electric communication technique, etc. (cf. Eurostat 2006: 126-130).

4.2.3 Framework for innovation in Alsace: The French innovation system

4.2.3.1 General characteristics and evolution

Profound transformation, coupled with new actors, new regulations and new frameworks as well as new ways of implementing priorities characterised the French innovation system during the 1980s and 1990s which beforehand was related to the strong involvement of the State and the interventionist character of the innovation system ("technological Colbertism", cf. Larédo/ Mustar 2001). High emphasis was given to *grands programmes* encompassing the civil and defence sectors and aiming at technological developments and at national independence in specific fields (such as the nuclear, space, aeronautics, telecommunications or defence sectors). Public support strongly focused on large companies active in high technology fields with the aim to achieve a leading position of France in research and innovation. SMEs, on the other hand, were modestly involved in research activities. The most important actor in basic research was the *Centre National de la Recherche Scientifique* (CNRS)[130] whereas higher education was the mission of universities and of *Grandes Ecoles*, high schools that qualify future managers, civil servants and engineers. Research demand of government departments and public authorities was answered by mission-oriented public research institutes[131] (government laboratories). Co-operations between industry and

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130 The CNRS emanated from the *Caisse Nationale des Sciences* (National Office of Science) in 1939. CNRS institutes' main missions are the conduction of research, the production of knowledge and scientific information. CNRS institutes are involved in all scientific fields as well as in interdisciplinary programmes. This research organisation introduced the model of full-time research personnel in France compared to university researchers who are also in charge of teaching activities (cf. Mustar/ Larédo 2002: 60 and Larédo/ Mustar 2001: 459). CNRS belongs to the EPST (public institutes for science and technology, see below). The CNRS nowadays employs around 25,000 persons (among them around 11,000 researchers) and is the largest public research institute of France and of Europe (cf. European Commission 2005b: 3, http://www2.cnrs.fr/en/8.htm).

131 Mission-oriented public research institutes have been established after World War II as specific research structures to answer research questions of different government departments. French mission-oriented research organisations comprise, among others, the *Institut National de la Recherche Agronomique* (INRA), created in 1946, CEMAGREF (*Institut de recherche pour l'ingénierie de l'agriculture et de l'environnement*) in agricultural and environmental research, the *Centre National d'Etudes Vétérinaires et Alimentaires* CNEVA (now part of the *Agence Française de la Sécurité Sanitaire des Aliments* AFSSA), the *Institut Spécialisé de Technologie des Pêches Maritimes* ISTPM (later IFREMER, *Institut Français de Recherche pour l'Exploitation de la Mer*) for fishery research, the *Institut de Recherche pour le Développement* IRD for research on colonial issues, later on developing countries, or the *Centre d'Études et de Recherches sur les Qualifications* CEREQ for employment and qualifications research (cf. Larédo/ Mustar 2001: 461ff.).

(public) researchers were rather rare, leading to a gap between the French universities and the production system (cf. Mustar/ Larédo 2002: 55-57, Chesnais 1993: 192/193, Quéré 1999: 6-11).

This view of the French national innovation system does not coincide with the current situation, as Larédo/ Mustar (2001) and Mustar/ Larédo (2002) argue. They document that the French innovation and research system has undergone important changes since the beginning of the 1980s,[132] and that two new governance levels have occurred besides the national one: The European and the regional ones, with the 1982 Decentralisation Act (see below) in France and the launching of the first Community Framework Programme in 1984. Mustar/ Larédo (2002: 57ff.) document the loss of importance of large programmes in the nuclear, civil aviation, computer and electronics and telecommunications sectors until the 1990s, an exception being the space programme.[133] Furthermore, the differentiation between universities and the CNRS has been replaced by a stronger interrelation between both institutional forms; consequently, the majority of CNRS units are currently *unités mixtes* between CNRS and

[132] The authors ascribe the beginning of the 1980s as the turning point due to changes in Government and Presidential policy orientation, emerging discussions on research policy, the organisation of Research Conferences on National and Regional levels, and the creation of the Ministry of Research and Technology. The 1982 *Loi d'orientation et de programmation de la recherche et du développement technologique* which modified the research infrastructure, concerned legal changes, as well as organisational changes in research organisations, aimed at supporting industrial competitiveness, the SME sector and research activities in firms; and the integration of public resources for civil research in the Civil Budget for Technological Research and Development aimed at prioritising research activities. These measures included the transformation of research institutes' legal status from *Établissement Public à caractère Administratif* (EPA) to *Établissement Public à caractère Scientifique et Technologique* (EPST), leading to the transformation of employees' status into civil servants and thus the introduction of the competitive examination system for recruitment and career development. Furthermore, contractual research relations between different actors and organisations as well as the establishment of valorisation services in research institutions, an active patent policy, and the support of firm foundations by researchers have been a consequence of the 1982 Research Act. In the meantime, regional and European research programmes gained importance in granting financial support for research projects (cf. Mustar/ Larédo 2002: 56, footnote 1, Larédo/ Mustar 2001: 464-467, and Vavakova 2006: 445/446).

[133] However, public support for space technologies is similarly organised in other western countries. Concerning the other technology fields, some of the former large programmes phased out such as the Telecoms programme due to the privatisation of France Télécom. Others, like civil aeronautics, still exist, but in a less important manner. In parallel, technology-oriented institutions modified their orientations. Thus, the centralised state interventions in research implemented after World War II have largely disappeared (cf. Mustar/ Larédo 2002: 59, Larédo/ Mustar 2001: 456-459).

universities.[134] In addition, *Grandes Ecoles* are to an increasing extent involved in research activities. Policy measures were conceived to support co-operations between (publicly funded) research institutes and firms, thus valorisation of research results and their application gained importance (cf. Mustar/ Larédo 2002: 60/61, Larédo/ Mustar 2001: 460/461, Vavakova 2006: 445/446, Quéré 1999: 11.) Summarising, "[c]urrent reality is an overlapping between the universities, the CNRS and the grandes écoles. Higher education is playing an increasingly central role in the public research system." (Mustar/ Larédo 2002: 61). The mission-oriented research institutes have also undergone changes, for instance a stronger involvement in research projects on a contractual basis. Technology transfer and valorisation of research gained importance, and relationships between research institutes and with industry increased. Based on the 1999 *Loi sur l'innovation et la recherche pour favoriser la création d'entreprise de technologies innovantes*, intermediary institutions for the diffusion of knowledge have been established,[135] and firm foundations by researchers were supported.[136] Further measures such as the establishment of incubators, support of innovative activities in SMEs and a national competition for start-up firms[137] witness the changes of the French research system (cf. Mustar/ Larédo 2002: 61-63). Thus, with its focus on interactions between academia and the business sector, the 1999 Innovation Act introduced cultural changes, witnessed by a project and evaluation culture and a more innovation-friendly environment in administration (cf. European Commission 2005b: iii). Industrial research activities, finally, have also undergone changes. Formerly, a limited number of large firms basically benefited from public support while SMEs hardly engaged in research and innovation. As Mustar and Larédo (2002: 63-67) show, during the 1980s and 1990s, SMEs were increasingly engaged in research efforts. Finally, links between public and private research have been further developed, leading to new forms of rela-

134 The universities define their research objectives in contracts of four-year-duration with the Ministry in charge of research and the public science and technology institute participating in *unités mixtes* (cf. European Commission 2005b: 3).

135 For instance *Réseaux de recherche et d'innovations technologiques* (RRIT, cf. page 109) associating teams from public research institutions and industry in technology-based projects, *plateformes technologiques* aiming at fostering technology transfer in SMEs, or CRITT (cf. page 103 and page 111 (cf. Vavakova 2006: 453/454).

136 In order to support innovative start-up creation, state funds were made available, and a venture capital as well as a 'primer' fund (*fond d'amorçage*) have been set up (cf. Vavakova 2006: 454).

137 Particularly in biotechnology, information and communication technologies, education, multimedia, automation and mechanics, and environmental, quality and security technologies (cf. Vavakova 2006: 455). Details concerning the competition 2006 can be found on the website of the Ministry for Higher Education and Research: http://www.recherche.gouv.fr/technologie/concours/2006/index.htm.

tionship between public and private laboratories. Diffusion-oriented measures for the support of SMEs have been launched. Among these are the ATOUT[138] procedure of the Ministry of Industry, and the European initiative EUREKA focussing at market-oriented R&D co-operation projects between technology firms and research institutes in high-tech fields. A further measure is the initiative *technologies clés*, a call for tender for projects in selected key technologies (cf. Mustar/ Larédo 2002: 66). Generally, the State function changed from direct and financial interventions to a "… role of strategic impetus and anticipation, of evaluation of past actions and of the promotion of public debate to promote "common visions" between innovation actors." (Mustar/ Larédo 2002: 71).

4.2.3.2 The Regional Level

In parallel, the Decentralisation Act attributed new competencies to the French regional level:[139] The regional administration is under the responsibility of the *Conseil Régional* whose members are elected by the regional population for a period of six years. In the area of innovation policy, this Council can establish centres for innovation and technology transfer, technological centres and can grant enterprise support. The process of deconcentration, on the other hand, points at the transfer of central competencies to the regional level, for instance by establishing regional agencies that represent the nation state in the regions: "La décentralisation vise à donner aux collectivités locales des compétences propres, distinctes de celles de l'État, à faire élire leurs autorités par la population et à assurer ainsi un meilleur équilibre des pouvoirs sur l'ensemble du territoire. La décentralisation rapproche le processus de décision des citoyens, favorisant l'émergence d'une démocratie de proximité. La déconcentration est une notion bien distincte ; elle vise à améliorer l'efficacité de l'action de l'État en transférant certaines attributions de l'échelon administratif central aux fonctionnaires locaux, c'est à dire aux

138 ATOUT merges different procedures created in the 1980s: micro-electronic components, computer aided design and manufacture, advanced design, new material. ATOUT is managed by the regional services of the Ministry in charge of Industry (cf. Mustar/ Larédo 2002: 65).

139 Article 1 of the law envisages that "… les communes, les départements et les régions s'administrent librement par des conseils élus" and determines that "des lois détermineront la répartition des compétences entre les communes, les départements, les régions et l'Etat, ainsi que la répartition des ressources publiques résultant de nouvelles règles de la fiscalité locale et de transferts de crédits de l'Etat aux collectivités locales, l'organisation des régions, les garanties statutaires accordées aux personnels des collectivités locales, le mode d'élection et le statut des élus, ainsi que les modalités de la coopération entre communes, départements et régions, et le développement de la participation des citoyens à la vie locale." (Assemblée Nationale 2005). The historical development of the decentralisation process is explained by Larédo/ Mustar (2001: 474ff.).

préfets, aux directeurs départementaux des services de l'État ou à leurs subordonnés." (Assemblée Nationale 2005). This means that deconcentration is realised through the attribution of increased competencies to the *préfet* who represents the French State in the regions. The *préfet* is delegated from the central Government and is directly representing the *Premier Ministre* and the Ministers.[140]

Both competence levels – the regional representation of the nation state and the elected regional administration – are responsible for the elaboration of regional *Contrats de Projet Etat-Région* (CPER; former *Contrats de Plan Etat-Région*), the planning instrument for regional infrastructure and development.[141] CPER are arrangements between the Government and the regions which determine financial transfers of the state to the regions and fix common projects to be realised at the regional level. In the frame of these contracts and among other chapters like for example physical infrastructure, education and training or social programmes, regions are involved in science and technology policies and can negotiate their budget for R&D and innovation issues[142] (cf. Larédo/ Mustar 2001: 474, Vavakova 2006: 457, footnote 57, European Commission 2005b: 9).[143] A further measure under the CPER is CORTECHS (*Convention de recherche pour techniciens supérieurs*), a partnership between a young technician, a SME and a competence centre (e.g. a research institute, a university, engineer school or a further education organism, or a technology transfer agency) in a common devel-

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140 Cf. http://www.alsace.pref.gouv.fr/etat/prefet.php concerning the *région* Alsace.

141 *Contrats de projets* focus for instance at economic development, employment, as well as regional competitiveness, social and territorial cohesion, sustainability, etc. Regions are "interlocutrices privilégiées de l'Etat" that can conclude additional arrangements with infraregional collectivities such as *départements* (cf. http://www.senat.fr/rap/r05-337/r05-33719.html).

142 Fields concerning for instance the physical infrastructure or social programmes are under the responsibility of the *départements* and the *région*. CPER in the period 2000-2006 were directed at synergies between public research and higher education, competitiveness and excellence clusters, technology transfer and equipments. Concerning the regional dimension, the Alsatian contract focuses at the creation of employment, at knowledge-related resources such as science, technology and information and communication technologies, at quality of life and natural resources, at agriculture and environment, at transport infrastructure, and at the European dimension of the region (cf. http://www.alsace.pref.gouv.fr/dossiers/documents/cper.pdf). CPER 2000-2006 have a territorial dimension: "Le volet territorial constitue l'une des innovations majeures des contrats de plan 2000-2006." (Entreprises Territoires et Développement 2003). Specifically, this refers for instance to networks between towns, agglomerations, etc. and their spatial planning policies which are integrated in the state-region contract framework (cf. Entreprises Territoires et Développement 2003). The fifth generation of CPER are conceived for the period of 2007-2013.

143 See also http://www.assemblee-nationale.fr/histoire/decentralisation.asp, http://www.alsace.pref.gouv.fr/etat/etat.php, http://www.region-alsace.fr/js/cadre_rub.htm?rub=01&ss_rub=1.

opment project. This partnership is co-financed by the region (cf. Vavakova 2006: 454, Goetz 2003, European Commission 2005b: 53).[144]

The *Agence Nationale de Valorisation de la Recherche* ANVAR (or *Agence Française de l'Innovation*) is with its regional delegations an example for deconcentration of a central institution in the field of innovation support. ANVAR has been created in 1974 with the objective to promote the exploitation of public research results. Its action had a 'top-down' character; Chesnais (1993: 205) describes it as "… a fairly classical type of agency for technology transfer from government and university research laboratories to industry." During the time, ANVAR has increasingly focused on SME[145] support and became more 'bottom-up' oriented. ANVAR's missions enlarged, including loans for innovation projects, SME contracts with research societies, as well as the recruitment of PhD students and researchers by SMEs (cf. Mustar/ Larédo 2002: 65, footnote 16). The delegations located in proximity to regional firms entirely managed ANVAR's tasks since 1996; the Paris headquarter provides backbone services. In 2005, the innovation agency has been merged with the *Banque du développement des PME* to the OSEO group (see below) (cf. European Commission 2005b: 41/42). OSEO's current mission is the support "… par l'aide à l'innovation, les prises de risque liées au développement de programmes d'innovation et de transfert de technologie auprès des porteurs de projets, laboratoires, créateurs d'entreprises et PME" (cf. http://www.oseo.fr/mieux_connaitre_oseo/metiers_filieres/innovation).

Further regional agencies of national institutions are for instance the *Direction Régionale de l'Industrie, de la Recherche et de l'Environnement* (DRIRE) and the *Délégation Régionale à la Recherche et à la Technologie* (DRRT). The Regional Divisions for Industry, Research and Environment DRIRE are in charge of several state services for technical and regulatory control of industrial activities. DRIRE activities fall into the field of environmental protection, automobiles, metrology, pressure instruments, nuclear safety, energy, mines, and since 1975 the development of SMEs. Thus, it is responsible for the implementation of the policies of the Ministry in charge of economic development, financial affairs and industry. Concerning industrial development, DRIRE observes the evolution of the industrial fabric in the region and supports competitiveness of regional SMEs. Specifically, DRIRE supports firms in the administrative procedures to receive support for improving existing or introducing new activities, for instance the

144 Cf. also http://www.technologie.gouv.fr/technologie/mesur/aides/cortec.htm.

145 According to the French SME definition: Companies with less than 2,000 employees not affiliated to companies with more than 2,000 staff members (cf. European Commission 2005b: 9).

introduction of information and communication technologies (cf. Muller et al. 2001: 71/72, European Commission 2005b: 5).[146] The regional delegations of research and technology, DRRT, fulfil State missions in the fields of research, technology, innovation, diffusion of scientific and technical culture, in the regions. Under their responsibility is the implementation of measures launched by the Ministry in charge of Research as well as general co-ordination tasks. DRRT regional representatives work in a concerted way with DRIRE as well as with representatives of the Ministry of Education and the state services in charge of regional issues (*Secrétariat Général pour les Affaires Régionales des Préfectures de Région* SGAR)[147] in order to integrate research and industry on the regional scale. In their function as "link" between the ministry and the regional levels, they diffuse information, support regional *pôles technologiques*,[148] organise knowledge diffusion and technology transfer, and communicate governmental visions into the regions. Generally, the regional representative of DRRT is also involved in the CPER procedure and thus has a voice in the negotiation about regional strategies concerning science, technology and innovation (cf. Muller et al. 2001: 72, European Commission 2005b: 9/10).[149]

Regions were thus attributed the responsibility to engage in stimulation of the technological development of regional SMEs. This development led to new regional institutional structures such as the region-specific *Centres Régionaux d'Innovation et de Transfert de Technologie* (CRITT)[150] or advisory committees on science and technology in the Regional Councils. CRITT belong to the interface structure between public

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146 Cf. also http://www.drire.gouv.fr/alsace/di/missions.htm.

147 SGAR is also in charge of co-ordinating regional aid from the Structural Funds in the *préfectures* (cf. European Commission 2005b: 10).

148 The emergence of *pôles d'excellence* has been formulated as one goal of French innovation policy. An excellence cluster is defined as a concentration of actors in geographical proximity and related to a specific technology. Actors may comprise public and private research centres, leading technology firms, a net of SMEs and education organisations. Alsace, for instance, has five *pôles technologiques*: in biotechnology ("BioValley"), in optoelectronics ("RhenaPhotonics"), in information and communication technologies ("e-alsace", "Teleregion"), and in environmental technologies ("EcoRhena"). Cf. http://www.industrie.gouv.fr/enjeux/pol_innov.htm, http://www.ada-alsace.com/dn/dn_nouvelles_technologies/action_ADA_technologie.html.

149 See also the DRRT Internet presentation: http://www.recherche.gouv.fr/drrt/drrt.htm as well as http://cordis.europa.eu/france/fr/org_reg1.htm.

150 The institution of CRITT has been created in 1982. CRITT are "… joint venture organizations with private and public (mainly regional) financial participation and the job of enhancing regional innovation-related networks between laboratories, firms, and local governments. They can be specialized (as in Alsace in the area of new materials) or general." (Chesnais 1993: 211).

research and regional firms and aim at supporting innovation and technological development in SMEs. There are two kinds of CRITT: (i) *CRITT prestataire* with a clear technological focus, directed towards the technological needs of SMEs, and (ii) *CRITT interface* that aim at raising awareness in firms, through '*Conseillers en développement technologique*' (CDT). Both are co-financed in the context of the CPER, the former partly through fees from client firms. Some *CRITT prestataire* are labelled '*Centre de ressources technologiques*' (CRT) to emphasise their service quality (cf. European Commission 2005b: 31 and 34).

Measures for innovation support on the regional level have been framed by nation-wide organised programmes and initiatives such the tax incentive for research activities *Crédit d'Impôt Recherche* which was introduced in 1983[151] (cf. Vavakova 2006: 445/446). Further measures focusing at innovation activities in SMEs and at employment of young researchers are the CIFRE, CORTECHS (managed in the frame of the CPER, see above) and DRT (Diplôme de recherche technologique) schemes,[152] as well as the "*Aide au recrutement pour l'innovation dans les PME*" for hiring R&D personnel for innovation projects. These measures contribute to the mobility of students and graduates in SMEs, to co-operations between competence centres and SMEs via the innovation project and the qualification of the graduate (cf. European Commission 2005b: 53). *Les Fonds communs de placement dans l'Innovation* FCPI – tax incentives for private persons investing in innovative enterprises not quoted at the stock exchange – aim at the stimulation of private capital for small and medium-sized enterprises. In the same time period, a privatisation process of national firms and an opening towards foreign direct investment (FDI) took place which led France being an important FDI recipient in the 1990s (cf. Vavakova 2006: 449).

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151 In the frame of this arrangement, firms are reimbursed half of the increase in their R&D expenditure, R&D being broader defined than in the Frascati Manual. It has a special focus on SMEs and had an important contribution to the development of SMEs' research activities (cf. Mustar/ Larédo 2002: 65).

152 As CORTECHS, CIFRE (*Convention industrielle de formation par la recherche*) builds a partnership between a young person, a SME and an education facility, co-financed by the region. It addresses a three-year stay of a doctorate in an enterprise with the aim of a doctoral thesis in the frame of a development project of that enterprise. The DRT (*Diplôme de Recherche Technologique*), is a diploma of technological research (cf. Vavakova 2006: 454, Quéré 1999: 10, Mustar/ Larédo 2002: 65, footnote 14, Goetz 2003, http://www.technologie.gouv.fr/technologie/mesur/aides/cifre.htm, http://www.technologie.gouv.fr/technologie/mesur/aides/innovpme.htm).

4.2.3.3 Recent trends in French innovation policy

Since the beginning of the 2000s, French innovation policy focuses at the foundation and development of innovative enterprises, including firm foundations by researchers. Further measures consider public-private partnerships, industrial research and young researchers' integration in firms, as mentioned above (cf. European Commission 2005b: i). Currently, the main goals of French innovation policy are directed towards competitiveness – in line with the European orientation since the beginning of the 2000s – growth and employment as well as towards bridging public and private research, at industrial innovation activities and towards the development of high-tech SMEs.[153] Further efforts are necessary in order to achieve three percent of the GDP directed towards R&D – from which two thirds shall be funded by industry – by 2010 (cf. European Commission 2005b: i-iii). Government responsibilities for French innovation policy are taken by the Ministry in charge of research (*Ministère délégué à l'Enseignement supérieur et à la Recherche*), particularly the *Direction de la Recherche*, and the Ministry in charge of industry (*Ministère de l'Economie, des Finances et de l'Industrie*), especially the *Direction de la Technologie*. The *Direction Générale des Entreprises* (DGE)[154] within the Ministry in charge of industry – a merger of the former *Direction Générale de l'industrie, des technologies de l'information et des postes* and the *Direction de l'action régionale et des PMI* in 2004 – is directed towards more efficient support measures for firms and the support of innovation and competitiveness. DGE is responsible for regulation and co-ordinates the Regional Divisions for Industry, Research and Environment (DRIRE). Another important institutional development is the merger of the innovation agency ANVAR with the SME development bank *Banque du développement* des PME (BDPME) to the OSEO group in 2005 (see above). OSEO, a holding with public status referring to the Ministry for Economy, Finance and Industry, and the Ministry for Higher Education and Research, has the mission to provide assistance and financial support to SMEs in crucial stages of their development, i.e. in the start-up, innovation, development and buy out phases. Within the OSEO group, OSEO anvar is in charge of innovation support and funding in the fields of technology transfer

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153 The Minister for Research and New Technologies as well as the Minister for Industry formulate the goal to further develop innovation in France, more precisely the increasing use of R&D in French firms because "... **il y a urgence : bien que l'innovation soit la clé de notre avenir économique, notre pays est en retard ;** il souffre d'une trop faible coopération entre les entreprises et le monde de la recherche ; nos industries et nos laboratoires sont insuffisamment soutenues par la collectivité dans leurs efforts de recherche et d'innovation." (Ministère délégué à la Recherche et aux Nouvelles Technologies, et Ministère de l'Économie, des Finances et de l'Industrie (no year given); emphasis taken over from the original text).

154 Cf. http://www.industrie.gouv.fr/portail/une/index_esse.html.

and innovative technology-based projects, thus in a concerted action improving public support for SMEs and, on the other hand, support of the development of innovative firms.[155] The OSEO regional network is present in all French regions and has the vision to accompany and thus to support entrepreneurs, to network SMEs and to foster their activities, especially in risky phases (cf. European Commission 2005b: 5 and 29).[156]

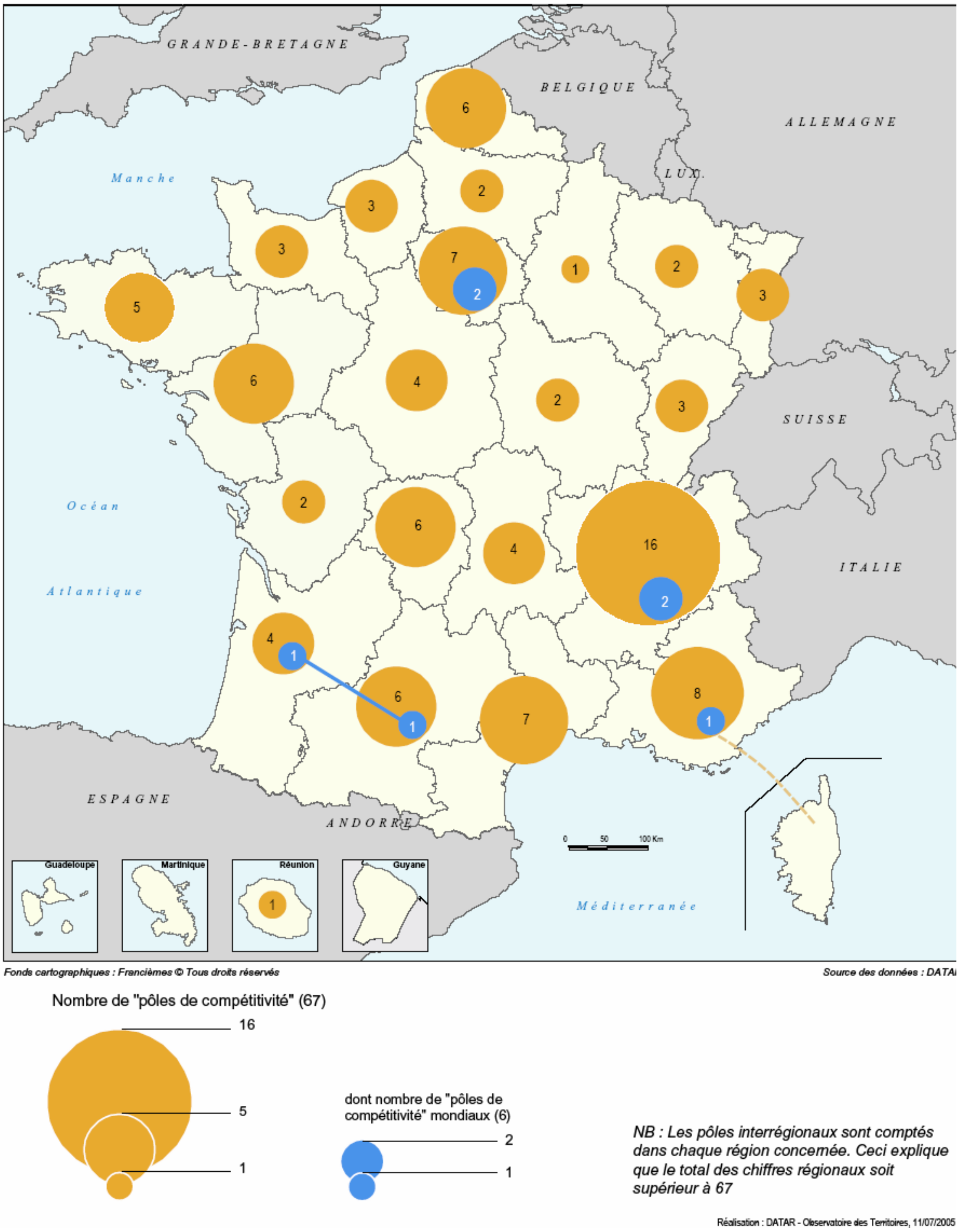
The most important recent innovation policy development was the *pôles de compétitivité* measure, launched in September 2004. The initiative aims at strengthening the competitiveness of the French economy by the development of synergies between research institutes, firms and education organisations in a given geographical space. Active partnerships between the cluster members are supposed to contribute to foster synergies of the sector or technology underlying the cluster. Cluster members are eligible for direct aid, tax incentives and privileges for accessing funding sources. From more than 100 proposals, 67 competitiveness clusters have been selected in 2005 (cf. figure 10), from which are six high-level ones labelled *pôles de compétitivité mondiaux* and ten *pôles de compétitivité à vocation mondiale*. The six *pôles mondiaux* are in Provence Alpes – Côte d'Azur, Grand Lyon, 2 in Paris, Grenoble – Isère, Midi-Pyrenées and Aquitaine, whereas the *pôles à vocation mondiale* are in the region of Paris, 2 in Bretagne, in Champagne-Ardenne and Picardie, Alsace, Provence – Alpes - Côte d'Azur, Haute and Basse Normandie, Nord – Pas de Calais, Lyon Rhône-Alpes, Anjou-Loire (cf. European Commission 2005b: i-ii, 10 and 34/35, Ministère de l'Economie, des Finances et de l'Industrie 2006a, Ministère de l'Economie, des Finances et de l'Industrie 2006b: 5, Brunet, no year given: 7).[157]

155 OSEO bdpme is responsible for funding investments with banks whereas OSEO sofaris, a OSEO bdpme subsidiary, guarantees fundings of banks and equity capital investors. Finally, OSEO services, an economical group of interest between OSEO and the *Caisse des Dépôts*, performs study and provides on-line services to SMEs (cf. http://www.oseo.fr/oseo/groupe/english_version).

156 See also http://www.oseo.fr/tous_nos_services/l_offre_oseo/contrat_de_developpement_innovation, http://www.oseo.fr/oseo/groupe/english_version, http://www.oseo.fr/oseo/groupe/mission, http://www.oseo.fr/oseo/filiales_metiers/oseo_anvar, http://www.oseo.fr/oseo/groupe/offre, http://www.oseo.fr/oseo/groupe/organisation.

157 Cf. also http://trendchart.cordis.lu/tc_country_list.cfm?ID=5. The programme is described at http://www.competitivite.gouv.fr/ or http://www.industrie.gouv.fr/portail/politiques/index_polecompet.html. An overview of the *pôles* is given at http://www.competitivite.gouv.fr/rubrique.php3?id_rubrique=36.

Figure 10: The French competitiveness clusters



Available at: http://www.competitivite.gouv.fr/IMG/pdf/carte_poles_competitivite.pdf (18.10.2006).

The *Loi de Programme pour la Recherche* 2006 has recently been voted as new orientation law for Research in France. It has three principal axes: The balanced development of the whole research system (basic and applied research), the development of interfaces and co-operation between actors, and a development based on a global and long-term strategy. The law has thus defined six objectives: (i) To strengthen state capacities in the fields of strategic orientation and priority setting, by the establishment of a *Haut Conseil de la Science et la Technologie* (HCST), and research debates in the *Conseil Supérieur de la Recherche et la Technologie*; through the adjustment of regional, national and European policies: Establishment of *pôles de compétitivité* (see above), and *Pôles de Recherche et d'Enseignement Supérieur* (PRES); and the support of research projects, realised through the *Agence Nationale de la Recherche* (ANR, see below) and the *Agence d'Innovation Industrielle* (AII, see below); (ii) to implement a system of research evaluation through the *Agence d'Evaluation de la Recherche* (AER), (iii) the bundling of efforts and facilitation of co-operation between different research actors. Among others, the creation of campus recherche, regional coordination and the alleviation of administrative procedures, as well as the creation of *Réseaux Thématiques de Recherche Avancée* (RTRA, see below) fall under this category; (iv) an increased attractivity of scientific careers, (v) the intensification of innovation dynamics, by bringing together public and private research. This is envisaged through the support of *Jeunes Entreprises Innovantes*[158] and the support of private research activities; and (vi) an increased integration of the French system in the European Research Area (cf. Brunet, no year given: 6/7).[159]

In this context, the Prime Minister recently launched the *Réseaux Thématiques de Recherche Avancée* (RTRA) measure, an initiative to foster competitiveness through cooperation. Those networks of the scientific community, selected according to their excellence and quality of the scientific project, receive financial aid from the State. The overall objective of the French Government is to support the emergence of high-level scientific networks that have an international reputation. A *réseau* thus associates high-level researchers working for a common scientific goal. At the 'centre' of this network are research institutes in close geographical proximity. Thirteen networks have been selected by the Government, located at first place in Île-de-France, further in Rhône-Alpes, in the south of France (Midi-Pyrenées and Languedoc-Roussillon) and one *réseau* in Strasbourg. A further network in social and human sciences associates institutes in Lyon, Aix-Marseille, Nantes and Paris.[160]

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158 The *Jeune Entreprise Innovante* status (JEI) makes young firms eligible for tax credits to compensate for their R&D investments and thus facilitates their first years of development (cf. European Commission 2005b: 42).

159 Cf. also http://www.pactepourlarecherche.fr/.

160 Cf. http://www.recherche.gouv.fr/discours/2006/rtra.htm, http://www.recherche.gouv.fr/lopr/rtra/index.htm, http://www.pactepourlarecherche.fr/presse/2006/dprtra091006.pdf.

Some institutional changes characterise current policy support for the whole innovation process. The *Agence Nationale de la Recherche* (ANR)[161] is in charge of supporting fundamental and applied research efforts. Its mission is to connect public and private sectors and to support technology transfer. Projects embedded in the *pôles de compétitivité* concept are supported by the *Fonds de Compétitivité des Entreprises* (FCE) managed by the Ministry for Industrial Affairs. The *Agence de l'Innovation Industrielle* (AII)[162] co-finances together with enterprises large R&D industrial programmes. Finally, OSEO-anvar supports innovation activities via direct firm contacts, particularly with SMEs (cf. Ministère de l'Economie, des Finances et de l'Industrie 2006b: 4). Innovation support is granted for instance through the support of innovative firm foundations, seed-capital funds, the national competition for the creation of technology-based firms, or fiscal and financial incentives. Additionally, public research-company partnerships are supported, for instance by interfaces such as the *Réseaux de Recherche et d'Innovation Technologiques* (RRITs),[163] the *Centres Nationaux de Recherche Technologique* CNRT, technological research teams or CRITT (cf. European Commission 2005b: 30-32).

Concluding, the French innovation system and its innovation policy in the 1970s and 1980s has been characterised as interventionist and nationally oriented ("technological Colbertism", Larédo/ Mustar 2001, Héraud 2004: 3), following a linear (supply-side) orientation and being characterised by state involvement in the development of science, technology and subsidies for firms characterised as "*champions nationaux*". Since the beginning of the 1980s, the innovation system and the general orientation of policies developed towards a network orientation and "bottom-up" philosophy. French policy moved "… from a mission-oriented philosophy embodied in the French "Grands Programmes" to a much broader system of incentives schemes which aims at favouring the diffusion of technological innovation to a broader range of companies involved in the production system, and especially to SMEs." (Quéré 1999: 19). Policy now rather conceives the framework for firms' competitiveness, is thus less direct and targeted as

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161 *The Agence Nationale de la Recherche* has been founded in 2005 with the mission to attribute financial support for research projects. Financial contribution is attributed after a competition procedure and evaluation. Support can be granted to research institutes and to firms (cf. http://www.agence-nationale-recherche.fr/Agence).

162 Cf. http://www.aii.fr/srt/aii/home. The establishment of this institution has been one recommendations of the 'Beffa report' on new orientations of French industrial policy (cf. Beffa 2005: 17-31, 47-60, see also European Commission 2005b: 27/28).

163 RRITs associate public organisation research teams, SMEs and industrial groups in joint projects. The Ministry in charge of research as well as sectoral Ministries provide funding (cf. European Commission 2005b: 30).

before, and has a competitive character with recent measures such as the *Pôles de Compétitivité* concept or the *Réseaux Thématiques de Recherche Avancée* that aim at fostering competitiveness through bundling of regional forces (cf. Quéré 1999: 11, Mustar/ Larédo 2002: 66/67).

Similarly, with the decentralisation process, the regions as new governance level gained importance. Here, the emphasis on endogenous development replaced planning and the equilibration orientation: "Yet over the 1990s more powers have devolved slowly to the regions to promote, support and finance new start-ups and linkages between research and the enterprise sector." (Vavakova 2006: 461).[164] However, the French innovation system is still characterised by a concentration of research activities in the Paris region of Île-de-France (cf. Héraud 2004: 6).[165] In addition to the national and the regional levels, the European level gained importance during the last decades. Consequently, research and innovation issues are subject of policies on these three levels: "Globally, the new rationale of research policy tends to be a multi-level governance mechanism between EU, member states and sub-national entities, in a context of complex competition. Even in a country like France, with a long-standing tradition of central state planning of public investments, an increasing part of the funding of science, education, training and technology transfer is subject of negotiation between all levels of public governance (state regions, cities)." (Héraud 2004: 3).

4.2.4 Institutional structure related to innovation in Alsace

As explained above, the following part relies on the concept of Institutions of Technological Infrastructure (ITI, cf. page 85f.) and their three principal functions of (i) managing the knowledge base, (ii) improving interactions between firms, and (iii) knowledge provision through expertise and training.

The first function, and partly the third one, is fulfilled by the regional universities: The *Université Louis Pasteur*, the *Université Marc Bloch*, and the *Université Robert Schuman* in Strasbourg, as well as the *Université de Haute Alsace* Mulhouse-Colmar[166] and the CNRS institutes in Alsace. Further research institutes are the INSERM (*Institut Na-*

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164 Thus, regions "… focus their interventions on the creation of networks of regional innovation actors." (Mustar/ Larédo 2002: 69).

165 OST (2004: 337) analyses that Île-de-France and Rhône-Alpes account for more than 50 % of internal public and private R&D expenses in 2001, from which 44.5 % are spent in Île-de-France.

166 Cf. http://www-ulp.u-strasbg.fr/, http://u2.u-strasbg.fr/ici/UMB/site/, http://www-urs.u-strasbg.fr/, http://www.uha.fr/.

tional de la Santé et de la Recherche Médicale) centres in Alsace (Strasbourg and Illkirch) and the INRA (*Institut National de la Recherche Agronomique*) in Colmar.[167] Furthermore, qualification and education functions are carried out by the *Ecoles d'ingénieurs*, *Ecoles de commerce*, the *Instituts Universitaires de Technologie* and by *lycées techniques*. The second function, improving interactions between enterprises – which is often combined with the provision of knowledge (function 3) – is fulfilled by several services of the national state with their regional delegations, such as OSEO anvar, DRIRE Alsace[168] and DRRT. The local definition and implementation of research and innovation policies is performed in the frame of the *Contrats de Projet Etat-Région* (CPER) procedure. Interrelating actors of regional innovation policy, *Réseaux de Développement Technologique* (RDT)[169] associate the actors of technology transfer and industrial development in informal networks. In Alsace, the members of the *Réseau Technologique d'Alsace* (RTA)[170] help regional firms to identify and formulate their technological needs and bring them in contact with competence centres, facilitate firms' access to public support and accompany their technology implementation phase. In Alsace, the network is organised by *Alsace Technologie*, an association established in 1995 on the initiative of the *Région Alsace*. Its activities focus on the transfer of technologies from technical and research institutions to regional firms as well as giving incentives to firms to develop innovative capacities and their competitiveness (cf. European Commission 2005b: 31, Muller et al. 2001: 73).[171] The *Direction de la Recherche, de l'Enseignement Supérieur et du Transfert de Technologie de la Région Alsace* (DREST) of the *Conseil Régional d'Alsace*, founded in 2000, has the aim to implement research, higher education and technology transfer policies on the regional level. This mission includes for instance the support of students, research projects or technology transfer and innovation in firms as well as common R&D projects between research laboratories and firms. The transfer of competencies is fostered through CORTECHS (see above) and PRISME[172] programmes and post-doctoral stays.[173] CRITT and *Pla-*

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167 Cf. http://www.inserm.fr/, http://www.colmar.inra.fr.

168 See also the Internet presentation of DRIRE Alsace: http://www.alsace.drire.gouv.fr/.

169 Website: http://www.rdt-france.org/rdt/rdt-alsace.htm.

170 Cf. http://www.alsace-technologie.org/content/rta_presentation.htm.

171 Cf. also http://www.alsace-technologie.org/index.html, http://www.alsace-technologie.org/content/rta_presentation.htm.

172 PRISME brings together a SME, a trainee and an education institution. The region contributes through subventions for the SME and the education institution and a reimbursement of the trainee (cf. Goetz 2003).

te-Formes Technologiques[174] belong to the technology transfer structure of the region. Alsace has six CRITT prestataires: IREPA Laser (CRT, Industrial laser demonstration), HOLO3 (Vibratory analysis, constraint measurements, dimensional measurements), CETIM CERMAT (CRT; metallic and alloy materials, polymers), AERIAL (CRT; agro-food, ionisation), MATÉRIAUX (CRT, materials, polymers), and RITTMO (organic material, fertiliser).[175] In the frame of the policy in favour of firm foundations, the incubator SEMIA (*Science, Entreprise et Marché, Incubateur d'Alsace*) was established at the *Université Louis Pasteur* in 2000 (cf. Muller et al. 2001: 73, Goetz 2003).[176]

General regional economic support and territorial marketing is the mission of the *Agence de Développement de l'Alsace* (ADA).[177] ADA provides services for firms that plan to invest in Alsace or to seek entry on international markets. ADA's mission also comprises partnership building, support of technological innovation and new technologies as well as cross-border co-operations in the Upper Rhine area. In order to foster international relations, ADA is also present in Germany, Canada, China, the United Kingdom, Japan, Poland, Russia, Ukraine and the US.[178] The three regional chambers of commerce, located in Strasbourg, Mulhouse and Colmar and a further one representing the whole region, support firms' development and offer them information, but are not exclusively concentrated on innovation.[179] The region hosts one of the French Innovation Relay Centres which aim at support the transfer of innovative technologies

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173 In this case, a firm is associated to a PhD graduate and a public laboratory. The regional contribution is 50 % of the graduate's salary and a subvention of the laboratory (cf. Goetz 2003).

174 Introduced in 2000, these structures focus on the qualification aspect and the use of national education resources for regional SMEs. They integrate education institutions including universities, CRITT and engineering schools into a network and enable access to education and research organisations. Alsace has six *plate-formes technologiques*: *Production et Usinage à Grande Vitesse* in Haguenau, *métrologie* in Saint-Louis, *Hydraulique* in Obernai, *Plasturgie* (Saverne), *Textile* (Mulhouse) and *Crash-test matériel ferroviaire* in Reichshoffen (cf. Goetz 2003, Ledig 2005, European Commission 2005b: 31, 34).

175 Cf. http://www.recherche.gouv.fr/technologie/critt/listecritt.xls and Ledig 2005.

176 Following the 1999 law, incubators have been established on a regional level, mostly located at research institutes, universities or engineer schools (cf. Vavakova 2006: 458).

177 There are also development agencies for the two départements: ADIRA (*Association pour le Développement du Bas-Rhin*) in Bas-Rhin (cf. http://www.adira.com/index2.html) and CAHR (*Comité d'Action du Haut-Rhin*) in Haut-Rhin (cf. http://www.alsace-cahr.com/).

178 Cf. http://www.ada-alsace.com/, http://www.ada-alsace.com/dn/dn_cooperation/institutions_organisations.html, http://www.ada-alsace.com/dn/dn_reseau_mondial/, http://www.ada-alsace.com/dn/dn_aide_implantation_alsace/.

179 http://www.strasbourg.cci.fr/, http://www.mulhouse.cci.fr/, http://www.colmar.cci.fr/, http://www.alsace.cci.fr/flash/default.htm.

to and from companies or research laboratories throughout Europe.[180] The Alsatian Centre "IRC Grand-Est" is jointly managed by the *Chambre Régional de Commerce et d'Industrie d'Alsace* and OSEO anvar. Alsatian science parks are the *Technopole de Haute Alsace* and the *Technopole* at Illkirch (cf. Muller et al. 2001: 74/75).

The high quality of Alsatian science is reflected in the *Réseau Thématique de Recherche Avancée en Chimie* (*Centre International de Recherche Avancée en Chimie à Strasbourg*, C.I.R.A.C.S.). The network goals are new developments in chemistry and the interfaces to other disciplines. The interface of this networks avec biology is related to the *Pôle d'Innovation Thérapeutique à vocation mondiale*, connected to the Life Science Network BioValley (see below). The goal of this competitiveness cluster is to create an European excellence cluster in therapeutic innovations in Alsace. To reach this goal, public and private regional actors in the medical domain, which also belong to the category *pôle technologique*, shall be brought together. Existing strengths on which the *pôle* is based are the high scientific excellence with international reputation, existing biotechnological firms, exchange relations between actors, the qualified workforce, and the concentration of actors in a limited geographical space. The actor network is already co-ordinated by Alsace BioValley, and the network can rely on the support of territorial collectivities. Challenges are the strengthening of public-private partnerships, as well as the densification of the industrial fabric. In addition to the "therapeutic innovations" cluster, Alsace is involved in the cluster "vehicles of the future" with Franche-Comté and "natural fibers" with Lorraine (cf. http://www.pactepourlarecherche.fr/presse/2006/listepmrtra.pdf, BioValley 2004a: 6 and 24-26).[181]

The regional core competencies in biotechnology, life sciences and chemistry are incorporated in the BioValley initiative bringing together French, German and Swiss partners in order to establish a Biotechnology Centre in the Upper Rhine Area, comprising scientific institutions, companies in the biotechnological and biomedical sectors, regional SMEs as well as international scientific institutions linked to the universities of the area. The extension of this initiative into three national contexts creates a large pool of potential co-operation partners as well as a large potential for knowledge creation and diffusion. The specific characteristics of the respective national biotechnology/ biomedicine fields are thus associated: The Swiss product industry with big pharma-

180 Innovation Relay Centres have been established by the European Commission in 1995 in order to promote technology transfer and partnerships, particularly between SMEs (cf. http://irc.cordis.lu/home.cfm).

181 Cf. also http://www.alsace-biovalley.com/dn_pole_competitivite, http://www.vehiculedufutur.com, http://www.oseo.fr/recherche_technologie/opportunites_et_conseils/nos_conseils/les_poles_de_competitivite.

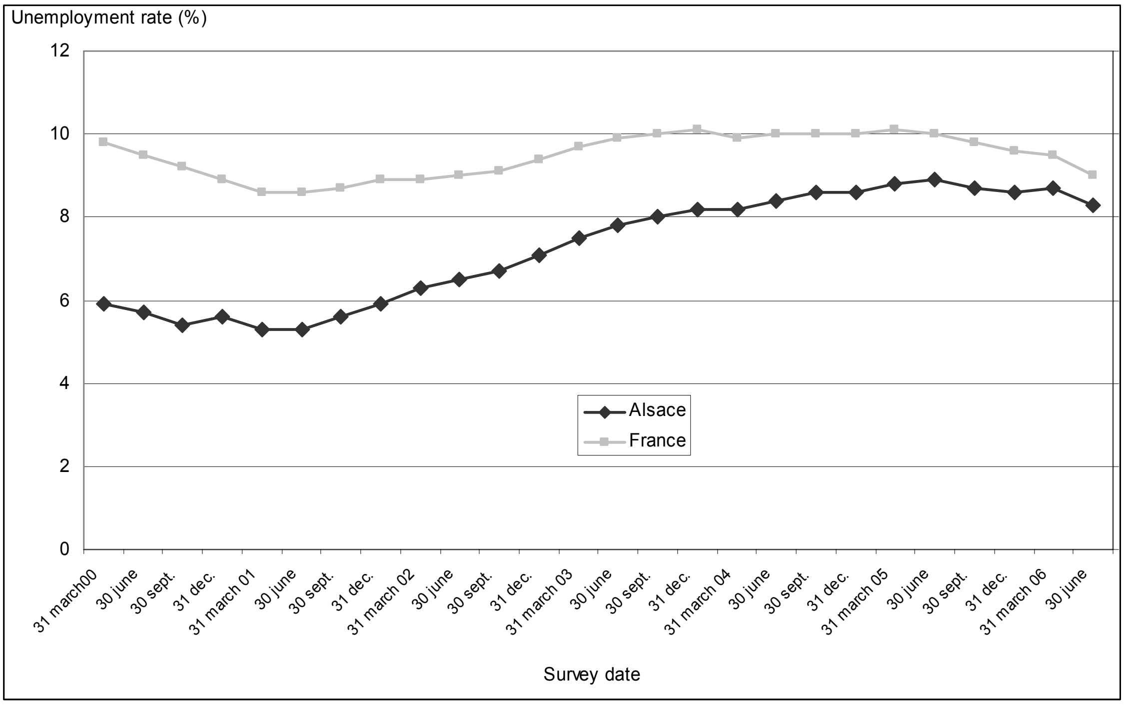
ceutical companies, the German small biotech service companies, and the French supplier industry. Overall objectives are the competitiveness of biotechnological firms, new firm foundations and thus employment creation as well as the creation of an attractive location for biotechnology. BioValley was launched in 1996 and is funded by the Regional Council, the Department of Lower Rhine, the Urban Community of Strasbourg and the European InterReg II and III programmes. It is managed by a national organisation in each of the member countries plus additionally one central association across the three countries involved. (cf. http://www.biovalley.com/, Capgemini 2004: 4, BioValley 2004b).

4.2.5 Innovation policy in Alsace

As indicated in sections 4.2.1 and 4.2.2, the region of Alsace is associated with prosperity, above-average industrial employment, comparatively moderate unemployment rates, considerable shares of firms with external decision units, a good patent performance, and high scientific competence. However, at the beginning of the 2000s, Alsace was confronted to increasing unemployment rates: It evolved from 5.3 % at the beginning of 2001 to 7.8 % in June 2003 and 8.3 % in June 2006 (cf. figure 11, INSEE data). This increase was higher than for France as a whole; however being still below the national rate.[182]

182 The regional authorities characterise the situation at the beginning of the 2000s as follows: "… l'économie régionale alsacienne se trouve, quant à elle, au travers des mutations accélérées et souvent brutales de son tissu industriel, face à un véritable tournant." (Région Alsace 2003: 1).

Figure 11: Development of unemployment rates in Alsace and in France 2000-2006



Data source: INSEE: http://www.indices.insee.fr/bsweb/servlet/bsweb?action=BS_SERIE&BS_IDBANK=045937075&BS_IDARBO=0202020 0000000, http://www.indices.insee.fr/bsweb/servlet/bsweb?action=BS_SERIE&BS_IDBANK=046178161&BS_IDARBO=0203000 0000000 (21.10.2006)

Since 2001, the former attractive location factors which incited foreign firms to locate in the region, thus bringing employment, income and regional wealth, have diminished. Currently, the Alsatian location has to compete with countries in Central and Eastern Europe and with emerging Asian locations for foreign direct investment. Since industrial employment and exports are to a high extent relying on large firms with their headquarters outside the region (Germany, USA, other French regions, Japan),[183] the region seems to be rather characterised by industrial production and incremental innovation than by (radical) innovation and high technology. Industrial restructuring is hampered

183 433 firms with foreign capital employ 71,700 persons (43 % of the industrial workforce; the national value being 29 %) and realised in 2001 48 % of the regional turnover, 56 % of regional investment and 70 % of regional exports (cf. Région Alsace 2006: 15, footnote 8). Cf. Kleinschmager (1999a: 118-120) for a detailed description of the economic situation and the transborder relation of Alsace in the 1990s. He explains that French investments in the region have been rather rare, and that Alsace has never been favoured by French regional planning. Thus, regional agencies for industrial development engaged in attracting foreign investors. Cf. also Kleinschmager 1999b: 3/4.

by the below-average firm foundation dynamics compared to the national level. Even though the service sector has a considerable contribution to the regional GDP and to employment, it is underrepresented in Alsace compared to the national level (cf. table 1). Additionally, service sector activities are not evenly distributed within the region, but are concentrated in the larger agglomerations, particularly Strasbourg where especially business related service firms are located. The situation on the labour market may become difficult since the region has a positive demographic development – including immigration from other French regions – with a comparatively young population (cf. also Wackermann 2000: 50). Additionally, a part of the workforce formerly employed in the neighbouring border regions, have lost their workplaces due to the difficult economic situations in Switzerland and in Germany. As table 2 shows, research and development activities of firms located in Alsace, though increasing, are however below the national average, and contract and applied research institutions are under-represented in the region. Regional SMEs appear rather reluctant concerning research and development activities. The main obstacles to innovation are lack of financial means and of qualified staff. In this situation, public actors see their role in the creation of an innovative regional environment and the support of external co-operation activities of SMEs. In 2005, the *Région Alsace* has launched an initiative to support research and development activities in regional firms, research institutes, and collaborative R&D projects between business and research fields (cf. Région Alsace 2003: 2/3, Région Alsace 2006: 13ff., Ledig 2005).[184]

Due to these changes in the Alsatian economic situation, innovation, technology and start-up firms have a high priority in the regional strategy. Innovation and R&D are seen as "fers de lance de la compétitivité industrielle" (Région Alsace 2006: 6-8) based on the scientific and technological potentials of the region. This should be realised by fostering synergies between qualification, research, technology transfer, and firms in order to create a fertile environment for firms' innovation activities (cf. Région Alsace 2006: 6).[185] In this context, the *Fonds Régional de Financement Initial* (FRFI) and OSEO anvar are attributed a central role. Start-ups in life sciences, chemistry, materials and information and communication technologies are granted financial and logistic support

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184 The conditions for R&D support are described in the document "La Région Alsace s'engage en faveur de l'innovation", downloadable at http://www.region-alsace.fr/fr/outils/appels_projets/innovation/appel_projet_RD.pdf.

185 In order to stimulate and support innovation activities in regional firms, the *Région Alsace* launched a call for tenders in February 2006 for regional co-operations between firms and research institutes. These projects should fit in the line of the strategic fields in Alsace, namely in the fields of the *pôles de compétitivité* and the *pôles de compétence* such as textiles, materials, renewable energy, etc. (cf. Région Alsace 2006: 37).

in the regional incubator SEMIA at the Université Louis Pasteur.[186] Further measures are technology transfer and the technological level of small and medium-sized firms, the support of CRITT, of *Alsace Technologie* and the *Réseau Technologique d'Alsace*. Another bundle of measures concerns young high-skilled graduates and grants in the frame of PRISME, CORTECHS and the support of post-doctoral graduates in firms. Further measures for institutional support of technology and innovation in the region are the *plateformes technologiques* and the *pôles de compétence* (cf. Région Alsace 2003: 8). Innovation is also considered as one of the four objectives the *Conseil Régional d'Alsace* defined in 2005 for the economic development of the region (cf. Région Alsace 2005).[187]

Since October 2004, managers, economic experts, representatives of professional associations, elected members and members of the regional network discuss about the regional economic potentials and development options in *ateliers économiques*. The aim of those *ateliers* is to bring forward concrete suggestions. This activity is complementary to the regional economic foresight exercise PETRA (*Prospective Economique Territoriale en Région Alsace*). Innovation and technology transfer is one of four thematic emphases the *ateliers* are dealing with. Further objectives for a successful regional development are seen in endogenous development, initiation and support of linkages between regional actors and the territorial level, i.e. the consideration of territorial differences within the region and the conception of measures for the weaker parts. The creation of new firms and technological innovation as well as sustainable development have been defined as the pillars of economic restructuration.[188]

4.2.6 Innovation in Alsace: Concluding remarks

The preceding sections characterised Alsace as an industrial region with increasing, but below national average service sector activities. This latter relies to a large extent on tourism, commerce, as well as finance and insurance services. The share of knowledge-intensive business services (KIBS) in the region is not very high, since French KIBS are rather located in Paris. Alsace is further characterised by excellent scientific institutions and a regional strength in fundamental research, mainly in chemistry, biology and related fields such as life sciences. The manufacturing sectors are diversified

186 Cf. http://www.semia-incal.com/.

187 The other goals have been: (i) strategic: focus on endogenous development; (ii) practical: encourage collective activities, and (iii) territorial: considering the economic equilibrium of the region (cf. Région Alsace 2005).

188 Cf. http://www.region-alsace.fr/fr/investir/ateliers_economiques/synthese_ateliers_03052005.pdf.

and performant, showing for instance good patent performance, but comparatively low research and development activities. This leads to the assumption that the industrial fabric is rather specialised in advanced, but to a less extent in high technology activities and seems to be rather engaged in incremental than in radical innovation. A further characteristic of the Alsatian socio-economic structure are branch plants of firms that bring production, employment and wealth to the region. However, this advantage diminished since the beginning of the 2000s. This development enforced modifications in the development model from the attraction of foreign firms to endogenous development, to innovation, networking, and to a focus on SME and research. This is mirrored by institutional changes: ANVAR for instance, initially had the mission to make (public) research results available to large firms. In the meantime, ANVAR agencies and OSEO anvar have a stronger focus on SME innovation support, and on firm foundations (cf. Héraud 2004: 5, Muller et al. 2001: 72). To conclude on the general context for innovation activities in Alsace – the French national innovation system – it is crucial to stress the changes that occurred during the last decades. French policy philosophy evolved from a strong orientation on research policy and a "*Grands Programmes*" strategy towards a broader system of incentives schemes aiming at favouring the diffusion of technological innovation to a broader range of companies in the production system, especially to SMEs (cf. Quéré 1999: 19, European Commission 2005b: 1). The research system, initially referring to public sector research, increasingly adopted a more integrated view, and focused on the producers and users of knowledge and network approaches. Policies nowadays rather focus on favourable framework conditions and the innovation environment. Alsace is one of the regions relying on the *filière* concept to encourage interactions between actors of the same field (cf. Larédo/ Mustar 2001: 467, 476 and 485, European Commission 2005b: 1).

Innovation experts are reluctant in considering Alsace as a complete and coherent "system". The region hosts important scientific centres of high reputation which is mirrored in a good performance of regional indicators related to the research density, for instance public research expenses, the number of students, and publication density (cf. Bach/ Héraud 2003). But these scientific institutes are not completely connected with regional SMEs, thus regional knowledge supply and knowledge application by the industrial fabric show different orientations. This leads to a sub-optimal appropriation of regionally available knowledge. Co-operations between the regional industry and the *Université Louis Pasteur* (ULP) are moderate, and ULP researchers rather collaborate with region-external partners. The reason for this lacking coherence is attributed to the specialisation in "old industrial activities" of Alsatian firms whereas ULP focuses on "new economy" fields such as biotechnology (cf. Lévy 2004: 11/12 and 15). However, the regional universities have an important role in education and qualification: The provision of trainees and thus education of the regional workforce is the main aspect determining the relations between firms and the university (cf. Gagnol/ Héraud 2001: 595/596). Cooke (2004) generally describes French innovation regimes as 'dirigiste' because their support structure and institutional landscape are to a considerable extent shaped by national concepts (cf. page 19). However, concluding from the analysis of the national and regional institutional structure related to innovation as well as the socio-economic conditions in the region, the situation is changing, and the Alsatian innovation regime could be characterised as moving from top-down to bottom-up, from dirigiste to a network orientation.

The preceding section showed that Alsace has a dense net of (public) actors and institutions focusing on firm innovations, diffusion of research results and innovation support. However, French regions consider their capacities as limited: "Institutionnellement, les Régions et le niveau régional en France sont, et resteront, des échelons d'action relativement faibles comparés à leurs homologues en Europe, …" (Région Alsace 2003: 14).[189] But, as the recently introduced (national) measures such as the *Pôles de Compétitivité* and the *Réseaux Thématiques de Recherche Avancée* show, the regional level, its actors and institutions and particularly their interrelations and engagement in networks gain importance. Those instruments introduce a culture of 'interregional competitiveness' within the overall French objective of raising the countries' competitiveness. Alsace is well presented in these nation-wide competitions, with one *Pôle de Compétitivité* having gained the 'global vocation' label, integrating the three-nation cross-border BioValley initiative, and further two *Pôles* in co-operation with other regions, as well as the *Réseau Thématique de Recherche Avancée* '*Centre International de Recherche Avancée en Chimie à Strasbourg'*. The main future challenge seems to foster a coherent regional innovation system through stronger connecting the available elements.

4.3 The Baden region

4.3.1 Introduction

Baden is the western part of the federal state Baden-Württemberg which in 1952 resulted from a fusion of the former *Länder* of Baden, Württemberg-Hohenzollern and Württemberg. Since 1806, the *Land* Baden had been one of the German states. Baden

189 This is supported when considering the quite limited regional funding for R&D: In 2000, the share of public R&D funding by the French regions has been 1.4 %, compared to 88.2 % financed by the state, and 10.4 % by the European Communities (cf. European Commission 2005b: 9).

is bordered by the Rhine in the western part and the black forest in the east. The Lake Constance forms the border of the former *Land* in the south. The warm climate and fertile soils in the valleys favoured agriculture, particularly corn, but also tobacco, hops and wine. A considerable part of the region consists of forest. However, agriculture retreated and was replaced by industrial production. In the 19th century, the main production fields were textiles, leather, glass, clocks, jewellery, chemicals, toys and organs.

In 2002, the surveyed region of Baden had around 2.5 million inhabitants and a population density of 286 inhabitants/ km^2 with the highest density in Mittlerer Oberrhein (462 inhabitants/ km^2), followed by Südlicher Oberrhein (251 inhabitants/ km^2) and Schwarzwald-Baar-Heuberg (193 inhabitants/ km^2). The *Raumordnungsregionen* Mittlerer Oberrhein and Südlicher Oberrhein have a higher population density than Germany (231 inhabitants/ km^2, cf. Bundesamt für Bauwesen und Raumordnung 2005: INKAR database 2004). All three *Raumordnungsregionen* registered a positive development of the population between 1995 and 2002 with the highest share in Südlicher Oberrhein (4.9 %), followed by Mittlerer Oberrhein (3.5 %) and Schwarzwald-Baar-Heuberg (2.4 %). The Baden surveyed region is attractive in offering employment: In all three *Raumordnungsregionen*, but particularly in Mittlerer Oberrhein, the share of external commuters exceeds the share of the workforce commuting from the planning region to external workplaces (cf. Bundesamt für Bauwesen und Raumordnung 2005: INKAR database 2004). The three *Raumordnungsregionen* had a GDP/ inhabitant of more than 25 k€ in 2002.[190] The unemployment rates in the Baden surveyed region are comparable to that of the whole federal state of Baden-Württemberg, but more favourable than in Germany as a whole.[191] In 2002, Mittlerer Oberrhein had 25.2 students at technical colleges and universities/ 1,000 inhabitants, whereas Schwarzwald-Baar-Heuberg had 10.1 and Südlicher Oberrhein 31.5 students/ 1,000 inhabitants[192] (cf. Bundesamt für Bauwesen und Raumordnung 2005: INKAR database 2004). Baden-Württemberg's economy is one of the most prosperous in Germany; in 2003, the

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190 Mittlerer Oberrhein: 32.6 k€, Schwarzwald-Baar-Heuberg: 26.4 k€, Südlicher Oberrhein: 25.9 k€. These values are above the reference value for Germany (25.6 k€) whereas Mittlerer Oberrhein's GDP is even higher than the Baden-Württemberg value (29.4 k€) (cf. Bundesamt für Bauwesen und Raumordnung 2005: INKAR database 2004).

191 The unemployment rates in 2003 were 7.0 % in Mittlerer Oberrhein, 6.5 % in Schwarzwald-Baar-Heuberg and 6.8 % in Südlicher Oberrhein. Baden-Württemberg had an unemployment rate of 6.8 %, and Germany 11.2 % (cf. Bundesamt für Bauwesen und Raumordnung 2005: INKAR database 2004).

192 For comparison: The respective values are 40.0 for Baden-Württemberg: and 23.7 for Germany (cf. Bundesamt für Bauwesen und Raumordnung 2005: INKAR database 2004).

GDP/ inhabitant (€ 29,694.2) was the third largest of the German *Flächenländer* – after Bavaria (€ 30,989.9) and Hesse (€ 31,626.1).[193] Baden-Württemberg as a whole belongs to the European regions with high research intensity and innovation performance, and has a high rate of patent applications/ million persons (cf. Heidenreich/ Krauss 2004: 188).

4.3.2 Socio-economic structure of Baden

4.3.2.1 Industrial development

The territory currently constituting Baden-Württemberg was a poor region in the nineteenth century which forced farmers to supplement their income by crafts and thus laid the base for a specialised crafts tradition. Due to a lack of large firms before World War II, "… small craft firms in niche markets were forced to co-operate at an early stage with regard to R&D, training and business information." (Hassink 1996: 291). Still now, inventors, craftsmen and entrepreneurs are regional actors of crucial importance for industrial development, and still today Baden-Württemberg is an industrialised region.[194] In the decades after World War II, Baden-Württemberg's economy showed a successful development. Especially during the 1950s, the Baden-Württemberg economy recorded high growth rates, combined with a vibrant industrialisation of the federal state. The most important sector in this period was the textile industry. Large, internationally operating companies such as Daimler-Benz (now Daimler-Chrysler), Porsche and Bosch located in Baden-Württemberg. More recently, business-oriented software and service firms - including SAP, IBM, Hewlett-Packard - chose Baden-Württemberg as location. Baden-Württemberg's firm structure is partly characterised by multinational enterprises, but the dominating part of the business structure is small and medium-sized enterprises: The highest share of large firms and of manufacturing employment is in the mechanical and electrical engineering and in the automobile construction. Further important industrial fields are precision mechanics, optics, clock making, toy, metallurgy, and electronics industries. The long emphasis on production led to a comparatively lower part of services, but the importance of the service sector, for instance business-related software, is increasing. Additionally, the federal state hosts some small,

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193 The city states of Bremen (€ 35,492.6) and Hamburg (€ 44,505.2) furthermore had a higher GDP/ inhabitant than Baden-Württemberg. For comparison: The GDP/ inhabitant in Germany was € 26,216.7 in 2003. In France, € 25,650.2/ inhabitant had been reached and in Alsace € 24,694.5/ inhabitant. The reference value for EU-15 was € 24,770.4/ inhabitant (cf. Eurostat, regio database, retrieved on 31 July 2006. See also page 89).

194 Koschatzky (1998a: 278) gives an overview of the historical development of both surveyed regions.

rather local clusters in biotechnology, multimedia, photonics, and health. Regional firms are characterised as being innovative and export-oriented.[195] The diffusion of technologies is achieved in networks between large firms and suppliers and between large firms and institutions, and firms can rely on a rich research infrastructure. However, at the beginning of the 1990s, Baden-Württemberg's economy was hit by a severe recession (cf. Heidenreich/ Krauss 2004: 190/191, Hassink 1996: 291/292, Grupp et al. 1998: 28).[196]

Considering the employment shares in the primary, secondary and tertiary sectors, the services clearly account for the highest part of the employed persons in Baden-Württemberg (63.69 %) and also in Baden and in Germany in 2003 (cf. table 5).[197] The Baden values are slightly higher than the respective figures for the federal state as a whole. However, when comparing the respective shares with the national values, it becomes obvious that industrial employment is slightly over-represented in Baden. This is also the case for Baden-Württemberg where industrial employment is higher than on the national level and in many other European and OECD states.[198] Baden-Württemberg has thus an industrial focus with a clear "*Mittelstand*" character of the industrial fabric (cf. Heidenreich/ Krauss 2004: 190).[199]

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[195] However, according to Hassink, Baden-Württemberg is not an "archetypical high-tech region" due to the small number of new industries and of start-ups in those modern industries (cf. Hassink 1996: 291).

[196] Cf. also http://forum.europa.eu.int/irc/dsis/regportraits/info/data/en/de1_pop.htm, http://forum.europa.eu.int/irc/dsis/regportraits/info/data/en/de1_eco.htm, http://forum.europa.eu.int/irc/dsis/regportraits/info/data/en/de1_emp.htm, http://www.baden-wuerttemberg.de/de/Wirtschaft_und_Dienstleistung/85841.html.

[197] Percentages have been calculated on the base of absolute figures in the Eurostat regio database. Figures for the Baden surveyed region rely on the absolute figures for the *Kreise* of the three *Raumordnungsregionen*. The 2003 values are preliminary. In 2004, Baden had an employment share of 2.11 % in the primary, 31.30 % in the secondary and 66.59 % in the tertiary sector (comparable values for Alsace are not available). The respective values for Baden-Württemberg are 1.96 %, 33.76 %, 64.27 % and for Germany: 2.25 %, 26.42 %, and 71.33 %. This shows that Baden has a slightly higher employment share in the agricultural and service sectors than Baden-Württemberg, but a higher industrial and lower service orientation than the German average (cf. Eurostat, regio database, retrieved on 01.08.2006, own calculations).

[198] For comparison: In 2001, 4.12 % of the employment was in the primary, 25.86 % in the secondary and 70.19 % in the tertiary sector for the EU-15 countries (cf. Eurostat, regio database, retrieved on 01.08.2006, and own calculations).

[199] Cf. also http://www.baden-wuerttemberg.de/de/Wirtschaft_und_Dienstleistung/85841.html.

Table 5: Employment structure 1995 and 2003 in Germany and the surveyed region of Baden

Territorial unit	Share (%) of employment in*					
	Agriculture, forestry		Industry and construction		Services	
	1995	2003	1995	2003	1995	2003
Germany	2.87	2.28	32.55	27.02	64.58	70.71
Baden (surveyed region)	2.97	2.17	36.09	31.88	60.96	65.97

Data source: EUROSTAT, Regio database (retrieved on 01.08.2006), own calculations

*: The classification of branches relies on NACE Rev. 1.1. The sectors are divided into (i) agriculture, hunting, forestry, fishing, (ii) industry (including energy), mining and quarrying, manufacturing, electricity, gas and water supply, and (iii) financial intermediation, real estate, renting and business activities, other service activities, public administration and defence, compulsory social security, education, health and social work, other community, social and personal service activities, and private households with employed persons (cf. Eurostat 2006: 69).

4.3.2.2 Research and development

Baden-Württemberg takes a leading position among the German federal states concerning investment in research and development, both in personnel and in expenditures. In 1995, 3.56 % of the GDP have been invested in R&D, among 2.69 % from the private business sector. These shares slightly increased; the 2003 values are 3.88 % R&D expenditures as a whole, from which are 3.08 % of the GDP invested by firms. Concerning R&D personnel, in 2003 2.6 % of Baden-Württemberg employed persons have been working on R&D tasks, 1.7 % in the business sector. Compared to the R&D personnel in Germany as a whole, Baden-Württemberg takes the lead position with 25.7 % of the German R&D employees working here (cf. Eurostat, regio database, retrieved on 11.08.2006, Grenzmann/ Marquardt 2005: 6).

Concerning the Baden surveyed region and taking data collected at the federal state level for R&D expenditures in the business sector in 1997, 1999, and 2001, as well as in higher education institutes in 1999 (cf. table 6), it becomes obvious that Schwarzwald-Baar-Heuberg shows comparatively high shares, contrary to Südlicher Oberrhein. The shares for the surveyed region as a whole have been higher than 1 % in all three years: 1.13 % in 1997, 1.10 % in 1999, and 1.15 % in 2001. The R&D expenditures of the higher education sector in 1999 have been 0.51 % in Mittlerer Oberrhein, 0.67 % in

Südlicher Oberrhein, and 0.03 % in Schwarzwald-Baar-Heuberg,[200] pointing at the comparatively high importance of university research and development in the Freiburg region. Compared to Baden-Württemberg and to Germany as a whole, it becomes obvious that the Baden surveyed region has its strengths in the higher education sector R&D (Mittlerer Oberrhein and particularly Südlicher Oberrhein), and in business sector R&D (Schwarzwald-Baar-Heuberg).

Table 6: R&D expenses in the business sector 1997, 1999, 2001 and in the higher education sector 1999 in the *Raumordnungsregionen* of the Baden surveyed region (Share of GDP, %)

Territorial unit	Total R&D expenditure (% of GDP) in			
	Business enterprise sector			Higher education sector
	1997	1999	2001	1999
Mittlerer Oberrhein	0.98	1.02	1.17	0.51
Südlicher Oberrhein	0.96	0.74	0.78	0.67
Schwarzwald-Baar-Heuberg	1.82	2.00	1.82	0.03
Baden (surveyed region)	1.13	1.10	1.15	0.48
Baden-Württemberg	2.83	2.98	3.03	0.40
Germany	1.51	1.67	1.72	0.39

Data sources: Industrie- und Handelskammer Region Stuttgart 2003: 55, *Ministerium für Wissenschaft, Forschung und Kunst Baden-Württemberg*,[201] Industrie- und Handelskammer Ostwürttemberg 2006: 3-4, 9, Statistisches Bundesamt/ SV-Wissenschaftsstatistik GmbH 2006, Statistisches Bundesamt (no year given), own calculations

The share of employees subject to social insurance contribution working on research and development tasks has been 2.3 % in Mittlerer Oberrhein, 1.5 % in Südlicher Oberrhein, and 3.1 % in Schwarzwald-Baar-Heuberg (figures for 1999; cf. Industrie- und Handelskammer Region Stuttgart 2003: 55).[202] Concerning R&D personnel and expenditures in scientific institutions in the German *Raumordnungsregionen*, Mittlerer Oberrhein has a good position: The region belonged to the ten strongest German *Rau-*

200 Data sources: Industrie- und Handelskammer Region Stuttgart 2003: 54, Industrie- und Handelskammer Ostwürttemberg 2006: 3-4, own calculations.

201 Cf. http://www.mwk.baden-wuerttemberg.de/fileadmin/pdf/forschung/Statistische_Daten_Forschung.pdf.

202 For comparison: Baden-Württemberg as a whole had 4.7 % R&D employees, and the region Stuttgart 8.7 %.

mordnungsregionen in 1997, and ranked on third position after Berlin and München with respect to both indicators. Concerning the R&D personnel/ 10,000 employees in 1997, Mittlerer Oberrhein occupied the 12th position among the 97 German *Raumordnungsregionen* (31.4 % business sector, 19.8 % higher education, 48.8 % scientific institutions), whereas Südlicher Oberrhein received the 27th rank (42.4 % business sector, 31.0 % higher education, 26.7 % scientific institutions), followed by Schwarzwald-Baar-Heuberg on rank 29 (97.6 % business sector, 2.4 % higher education). Additionally, Mittlerer Oberrhein in 1990 and 1998 belonged to the ten German *Raumordnungsregionen* with the highest share of employment in business-related service sectors. Although these figures are based on data from the end of the 1990s, it shows the research focus of Mittlerer Oberrhein and Südlicher Oberrhein: These two *Raumordnungsregionen* belonged to the regional agglomerations in Germany concerning R&D intensity and personnel of their public and private R&D institutions, whereas Schwarzwald-Baar-Heuberg is strongly characterised by business sector R&D activities. Furthermore, business-oriented service sectors are important in Mittlerer Oberrhein (cf. Fraunhofer ISI et al. 2000: 292, 321, 333/334, 350, 463).

4.3.2.3 Patent applications

In order to characterise the Baden surveyed region with respect to patent applications, the following sub-section can refer to released patent application data to the German Patent and Trade Mark Office and the European Patent Office (excluding double counts), referring to the inventor's location. Both Mittlerer Oberrhein and Südlicher Oberrhein in 1995, 1998, and 2000 belonged to the ten German Raumordnungsregionen with highest applications originating from scientific institutions (cf. Fraunhofer ISI et al. 2000: 300, Greif/ Schmiedel 2002: 9 and 27).

In 2000, 1,603.8 patents have been applied to the German Patent and Trade Mark Office and the European Patent Office in the Baden surveyed region. Table 7 shows that Mittlerer Oberrhein and Schwarzwald-Baar-Heuberg, as well as the surveyed region as a whole, have above-average patent figures/ 100.000 inhabitants (patent intensity) when compared to the national level. However, none of the Baden *Raumordnungsregionen* reaches the Baden-Württemberg figures. This is due to the high patent activities in the Stuttgart region which is the German region with the highest number of patent applications both in 1995 and 2000 (cf. Greif/ Schmiedl 2002: 13). In sectoral terms, the most important fields for the surveyed region have been electrical engineering (181.8 patent applications), measuring/ testing/ optics/ photography (149.4 patent applications), vehicles/ ships/ aircraft (136.5 patent applications), mechanical engineering

(125.1 patent applications), health sector (120.9 patent applications), and construction (104.6 patent applications) (cf. Greif/ Schmiedl 2002: Tables 3.4.1 to 3.4.31).[203] Considering the structure of the inventor's institutional background in the *Raumordnungsregionen*, it becomes obvious that in Schwarzwald-Baar-Heuberg, patent applications from the business sector clearly dominate. In Mittlerer und Südlicher Oberrhein, the science sector has a considerable position, besides patent applications from the business sector. This tendency has also been observed in 1998, and shows the good patent performance of Mittlerer and Südlicher Oberrhein in science, pointing at the importance of research institutes in the region (cf. Greif 2000: table 1.1). Particularly in these two planning regions, but also in Schwarzwald-Baar-Heuberg, individual inventors[204] also have a remarkable contribution to the regional patent applications.

Table 7: Patent applications to the German Patent and Trade Mark Office and the European Patent Office in 2000 in the Baden surveyed region

Territorial unit	**Patent applications 2000**				**Total patent applications per 100,000 inhabitants**
	Total	**Business sector**	**Science**	**Natural persons**	
Mittlerer Oberrhein	720.6	519.7	81.0	120.0	74.9
Südlicher Oberrhein	462.2	322.6	43.7	96.0	46.8
Schwarzwald-Baar-Heuberg	421.0	339.0	3.4	78.7	87.7
Baden surveyed region	**1,603.8**	**1,181.3**	**128.1**	**294.7**	**65.5**
Baden-Württemberg	**9,582.9**	**7,668.8**	**328.8**	**1,585.3**	**92.0**
Germany	**40,374.2**	**30,288.4**	**1,603.1**	**8,482.8**	**49.2**

Data source: Greif/ Schmiedl 2002: Tables 1.1 and 1.2, own calculations

Table 8 aims at characterising the Baden surveyed region with the help of technical fields with the highest number of patent applications to the German Patent and Trade Mark Office and the European Patent Office, displaying the total number of applications for the period 1995-2000, the annual average and its distribution in inventor categories.

203 The patent applications are differentiated according to the system of 31 technical fields, developed by the World Intellectual Property Organisation on the basis of the International Patent Classification (cf. Greif/ Schmiedl 2002: 18). From these, the six most important ones for the surveyed region of Baden have been cited.

204 Patent applications from natural persons can mainly be attributed to individual inventors, for instance professors, employees or employeurs who individually apply for a patent (cf. Greif/ Schmiedl 2002: 25).

Table 8 lists technical fields with more than 50 patent applications per year (annual average). It becomes obvious that – according to patent applications - Baden is specialised in activities related to electrical engineering, measuring and testing, vehicle construction, health, mechanical engineering and construction. Electronics and telecommunications, i.e. activities related to the information and communication technologies sector, also belong to the technical fields in which the surveyed region has a remarkable number of patent applications.

Table 8: Baden patent applications to the German Patent and Trade Mark Office and the European Patent Office 1995-2000 in the most important technical fields

Technical field	Patent applications 1995-2000		Patent applications (average 1995-2000) in:		
	Total	Annual average	Business sector	Science	Natural persons
Electrical engineering	959.8	160.0	130.9	12.0	17.0
Measuring, testing, optics, photography	904.3	150.7	108.9	23.9	18.0
Vehicles, ships, aircraft	700.1	116.7	79.5	0.4	36.8
Health	666.4	111.1	64.7	6.5	40.0
Mechanical engineering	570.7	95.1	81.8	3.2	10.1
Construction	549.3	91.6	54.0	1.6	36.0
Time measurement, regulation, controlling, calculating	474.0	79.0	57.0	1.8	20.3
Electronics, telecommunications	379.6	63.3	54.4	2.1	6.8
Grinding, pressing, tools	326.8	54.5	39.0	3.0	12.6
Total (31 technical fields)	**8,369.9**	**1,395.0**	**993.0**	**89.5**	**312.6**
Baden-Württemberg	**48,663.6**	**8,110.6**	**6,269.9**	**254.0**	**1,586.7**
Germany	**207,425.5**	**34,570.9**	**25,422.2**	**1,271.9**	**7,876.9**

Data source: Schmiedel/ Greif 2002: 12, Table 2.2, Tables 3.4.1-3.4.31, own calculations

The high majority of patents are applied in the business sector, and remarkable figures originate from individual inventors, particularly in the health, vehicles and construction fields. Research institutions are mainly represented in measurement and testing. Summarising, the surveyed region showed above-average patent intensities in 2000, compared to the national level, with Schwarzwald-Baar-Heuberg and Mittlerer Oberrhein displaying the highest values. Schwarzwald-Baar-Heuberg has a strong focus on business sector patents, whereas Südlicher and particularly Mittlerer Oberrhein have remarkable patent application figures originating in scientific institutions. Electrical engineering, measurement, vehicles, health-related fields and mechanical engineering have been the most important technical fields in which inventions have been patented in the second half of the 1990s.

4.3.3 Framework for innovation in Baden: The German innovation system

4.3.3.1 Basic characteristics and evolution

As in many other industrialised countries, Germany's economic structure is increasingly determined by service sector activities. However, a crucial characteristic of the German innovation system is the focus on the manufacturing sector, particularly on chemicals, pharmaceuticals, mechanical engineering, automobiles and electronics. According to Harding (2001), the system creates favourable framework conditions for firms to support their innovation activities, but "… the 'system' is relatively weak in supporting German companies in radical technological areas like software and biotechnology." (Harding 2001: 390). The focus is on existing advanced technologies rather than on activities at the research frontiers; breakthrough innovations are comparatively limited. In parallel, the technology transfer system is less oriented towards company support in radical technological fields (cf. Harding 2001: 389/390, Meyer-Krahmer 2001: 206-209. See also Keck 1993: 146/147). In line with this characteristic, the recent report on Germany's technological performance emphasises networking between science and research on the one hand and the private economy on the other hand in order to leverage forces of both fields. The transfer of knowledge and technology is required to become more efficient (cf. Bundesministerium für Bildung und Forschung 2006a: VIII/IX).

The German business sector – particularly large firms - is the most important actor in financing and performing R&D.[205] R&D intensive sectors are mechanical engineering,

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205 In 2003, German enterprises spent 70 % of the total R&D expenditure in Germany. 87 % of this sum originated from large companies with 500 and more employees, particularly in the

the automotive and the chemical industries. Main strengths are in medium and advanced technologies and in some service sectors such as business software or technical services. Germany has an above-average share of innovative firms and R&D expenditures compared to the OECD average, and a differentiated and decentralised research system. Principal responsibilities for innovation policies and support are on the national and the federal state levels (see below). Additionally, local initiatives on the one hand and European support measures on the other hand play an important role. The different actors of the innovation system are considered as having a high level of co-operation. However, the share of employees with higher education degree and the share of university students among the younger population are comparatively low (cf. Meyer-Krahmer 2001: 243, European Commission 2005a: 1). A further characteristic of the German economy is its high export orientation.[206]

In the 1950s, the German research policy focused on university research, the core area of R&D activities at that time. Besides this basic research focus in universities – funded by the federal states – research was undertaken in federal and federal state's research institutes. Military research that pushed research and development activities in civil fields in other countries, especially in the United States and also in France, was forbidden in Germany until 1955. So policies supporting technical change on the Government level have not been introduced earlier in Germany. The Federal Ministry of Education and Research has been founded in 1955 as Ministry for Atomic Questions.[207]

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automobile, electronics, mechanical engineering, chemical and pharmaceutical sectors (cf. European Commission 2005a: 2).

206 The European Commission (2005a: i) states: "In 2004, Germany was the largest exporting nation of the world, and trade surplus reached the highest figure ever, €156 billion (= 7% of GDP)." The reason for this export success is seen in the innovation orientation of German firms, productivity gains, and the high quality of the products leading to high competitiveness (cf. European Commission 2005a: i). Export success is mainly founded on R&D intensive goods. Though mainly determined by large firms, German exports also have an important contribution of SMEs: 36 % of small high-tech firms engage on world markets. The German position in high-technology exports – biotechnology, pharmaceutics, aerospace, instruments, computer and electronics - is moderate though increasing. However, imports in these fields showed higher growth rates than exports, indicating the appropriation of international developments on the one hand, but the comparatively weaker exploitation of growth potentials in these fields (cf. Bundesministerium für Bildung und Forschung 2006a: I/II and 3/4).

207 Its responsibility was extended in 1962 into space research and technology; its name was changed into Federal Ministry for Scientific Research. In 1966, a programme for data processing was launched, and in 1969 started a programme for new technologies. With this programme, the Ministry's responsibilities were enlarged to technology in general, the Ministry now becoming the Federal Ministry for Education and Science. In 1972 followed a split into the Ministry for Education and Science, and the Ministry for Research and Technology, in charge of technological questions and R&D outside higher education (cf. Keck 1993: 143). However, according to Keck (1993: 145/146), it was not before the late 1970s and

The Ministry collaborated with the federal states in the foundation of research laboratories. Research and technology policies in the 1950s and 1960s aimed at technology catching up to the USA. Since the mid-1950s, large technology programmes with target fields such as nuclear technology, aerospace, data processing, and later microelectronics, have been introduced. Since the early 1970s, the export of technology-intensive goods was the policy goal, so industrial research projects and institutes for applied research were targeted. The Federal Ministry granted support for R&D activities,[208] and the technology transfer infrastructure. The support of small and medium-sized enterprises and of less-developed regions increasingly came in the focus of government support. In the 1980s, the exploitation of research results as well as the creation of new firms were the main policy targets. Furthermore, the Ministry's policy aimed at strengthening co-operation structures between firms and between firms and research organisations. Incentives for collaboration in co-operative projects were given in selected areas such as microelectronics, robotics, computer-aided design and manufacturing, and biotechnology. In the 1980s, the improvement of links between industry and higher education has been identified by the Federal and the states' governments as important task for technology policy. Universities and technical colleges (or Universities of Applied Sciences, *Fachhochschulen*) should further integrate the needs of the regional industry in their research programmes. This resulted in the introduction of offices for technology transfer at higher education institutions (cf. Keck 1993: 141). Since the 1980s, the federal states increasingly promoted R&D and innovation in their regional industries. Their governments have the general responsibility for SME support. Baden-Württemberg was one of the federal states which developed a set of innovation support programmes at that time. Since then, technology and innovation policy became important means for economic modernisation and economic structural change. In parallel, evaluations of programmes and instruments gained importance in Germany (cf. Meyer-Krahmer 2001: 221). Since the 1980s, science parks and innovation centres to attract new high-technology firms and to support spin-offs from research institutes have been promoted by the federal states and some cities. Main challenges of policies in the 1990s were related to research and science policies in the new German *Länder*, coupled with globalisation and increasing international competition in technology development, locations and direct investment. Favourable framework conditions were increasingly considered crucial with respect to economic competitiveness. The main objectives

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1980s that the Federal Ministry for Research and Technology started to manage the national innovation system by fostering co-operation and the flow of personnel and information between different organisations. Before, the institutions were not really linked within a system: "In the reconstruction period after World War II each organization primarily looked after itself, and the system as such fell into oblivion." (Keck 1993: 145).

208 but to an increasing extent as co-funding (cf. Keck 1993: 143).

of the German Government's research policy in the 1990s were the support of advanced technologies, as well as strengthening and interlinking of the research landscape (cf. Meyer-Krahmer 2001: 219/220, Keck 1993: 142-145, Fier 2002: 36ff.).

4.3.3.2 The German research landscape

Basic research activities in Germany are performed by universities and by institutes of the *Max-Planck-Gesellschaft zur Förderung der Wissenschaften* (MPG) that are specialised in selected fields such as natural sciences and humanities.[209] MPG has the mission to complement university research by concentrating on specific fields. Furthermore, it tries to engage in emerging fields which require interdisciplinary cooperation. Former centres for large-scale research questions (*Großforschungseinrichtungen*) now belong to the *Hermann von Helmholtz-Gemeinschaft Deutscher Forschungszentren* (HGF).[210] Those institutes have a broad research spectrum, ranging from basic to strategic research and to industrial technology development. These centres run large machines and apparatus which are also used by universities. Institutional funding mainly originates from the Federal Government and also from the federal states in which the centres are located. Though the Federal Ministry of Education and Research defines broad guidelines, the centres have a clear autonomy in defining their research priorities (cf. Meyer-Krahmer 2001: 216).

Contract research in the German research landscape is for instance fulfilled by the *Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung* (FhG)[211] and its institutes. Their mission is contract-based applied research for clients in industry and government in diverse technology fields, for example microelectronics, information technology, production engineering, advanced materials, environmental research and also innovation research. Fraunhofer institutes receive institutional funding – divided between the Federal Government and the federal state in which the institute is located - but the main part of the institutes' funding is earned via contract research (cf. Meyer-Krahmer 2001: 216/217, Keck 1993: 144). Institutes of the *Gottfried-Wilhelm-Leibniz-Gemeinschaft der Forschungseinrichtungen*[212] have different functions, differ in size

209 Cf. http://www.mpg.de/. This non-profit organisation has been founded in 1948, succeeding the *Kaiser-Wilhelm-Gesellschaft* founded in 1911. Contrary to universities that have a broad research mission, Max Planck Institutes specialise in specific research fields (cf. Meyer-Krahmer 2001: 215, Keck 1993: 141 and Harding 2001: 397).

210 Cf. http://www.helmholtz.de/.

211 Cf. http://www.fraunhofer.de/.

212 Cf. http://www.wgl.de/.

and legal structure. The majority of institutes perform mission-oriented research in science fields and the humanities, or are service institutions. The institutes receive Federal and federal state institutional funding (cf. Meyer-Krahmer 2001: 217/218). Institutes of the *Arbeitsgemeinschaft industrieller Forschungseinrichtungen* AiF (Federation of Industrial Research Associations)[213] perform co-operative research and experimental development mainly in branches with lower research intensity (cf. Meyer-Krahmer 2001: 213). Further actors of the German research landscape are the *Wissenschaftsrat* (Science Council),[214] an advisory body to the Federal and the state Governments on higher education and research policy issues. The Council prepares reports and advice concerning the development of the German higher education and research institutions (cf. Meyer-Krahmer 2001: 224/225). Besides the Federal and the state Governments, there are various foundations such as the *Deutsche Forschungsgemeinschaft* (DFG)[215] that allocate funding for research projects. Further institutes of the Government and the federal states belong to the German research landscape.

4.3.3.3 Innovation policy on the Federal and the *Länder* level

On the Federal level, the Ministries for Education and Research and of Economics and Technology are in charge of innovation policy.[216] The main lines of innovation support are (i) thematic programmes, (ii) co-operative R&D in SMEs, and (iii) R&D funding for East German enterprises. The federal states are responsible for education issues whereas research and taxation questions, among others, are jointly treated by the Federal and the federal states levels.[217] The Federal Government is contributing to the general framework conditions for innovation (legislation, macroeconomics, competi-

213 Cf. http://www.aif.de/.

214 Cf. http://www.wissenschaftsrat.de/.

215 Cf. http://www.DFG.de/.

216 Some of the activities of the other ministries also have an impact on technology and innovation without being primarily addressed to those issues.

217 However, education and research have been treated in negotiations about the attribution of competencies between the Federal and the *Länder* governments (*Föderalismusreform*), which came into force on 1st September 2006. Education policies remain under responsibility of the federal states. Concerning higher education, the federal states receive enlarged competencies, particularly concerning the establishment of higher education facilities (which was formerly subject of a Joint Agreement between Federal state and the *Länder*). However, the Joint Agreement for the support of research remains in force, i.e. under joint responsibility of the Federal and the federal state levels. The Government can contribute to financing teaching in higher education (cf. http://www.bundestag.de/parlament/gremien/foederalismus/index.html, http://www.dfg.de/aktuelles_presse/themen_dokumentationen/foederalismusreform/index.html).

tion), and develops a vision containing preferred technological fields. It grants institutional funding to public research organisations and launches programmes targeted at specific technologies and/or actors, for instance SMEs and their R&D and innovation activities. The Federal Government supports high-technology R&D projects by grants to firms and public research institutions ("direct promotion of research"), mainly in information and communication technologies, biotechnology, medical and health technologies, production technologies such as nanotechnology, microsystem and optical technologies, environmental and energy technologies as well as transport technologies.[218] Further programmes aim at regional clustering in eastern Germany (e.g. 'Entrepreneurial Regions' with several specific programmes) or the 'Learning Regions' initiative[219] for lifelong learning, as well as start-up initiatives. The Federal Ministry of Economics and Technology funds co-operative R&D in SMEs, while enterprises in eastern Germany and their R&D activities are targeted by both the Ministries of Economics and Technology and of Education and Research. The KfW Banking Group grants innovation support for SMEs in the frame of the ERP Innovation Programme. Further programmes address the protection of intellectual property rights and technology-based start-ups. Finally, innovation policy measures on the Federal level also include awareness for technological and innovation issues and dialogue processes such as foresight and the participate dialogue on technologies, FUTUR (2001-2005, cf. Bundesministerium für Bildung und Forschung 2003), as well as network building between government representatives, researchers and firm representatives, for instance in the initiative D21 focusing on the Information Society.[220] Innovation and technology analyses (ITA) identify fields of technological change and options for research and innovation.[221] The Federal and the federal state governance levels are co-ordinated by institutions such as the *Bund-Länder-Kommission für Bildungsplanung und Forschungsförderung* (BLK, Bund-Länder Commission for Educational Planning and Research Promotion) (cf. European Commission 2005a: 1-6 and 28/29).

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218 Those thematic R&D programmes (*Fachprogramme*) belong to the key innovation policy measures in terms of volume (about € 2.7 billion per year), longevity (existing since the 1960s) and their mission (support of research in firms, co-operations between science and industry, and clustering). From a theoretical perspective, the Government tries with its programmes to compensate for market failures in business sector R&D activities (cf. European Commission 2005a: 39).

219 Cf. http://www.unternehmen-region.de/index.php, http://www.lernende-regionen.info/dlr/index.php.

220 Cf. http://www.initiatived21.de/.

221 Cf. http://www.bmbf.de/de/6502.php.

The regional level assumes an important role in German innovation policy, first of all through the competences of the *Länder*, the federal states, in the conception of innovation policy measures. But also on the Federal level, innovation policy programmes partly have a regional approach. Their aim is to develop regional competences in co-operation between regional actors. Public funding is granted on the base of a competitive proceeding. Examples are the EXIST programme for the promotion of university spin-offs, launched in December 1997 by the Federal Ministry for Education and Research and now run under the Federal Ministry for Economy and Technology, or the BioRegio and BioProfile programmes aiming at promoting existing strengths in biotechnology on a regional level. Further examples are the already mentioned "learning regions"-initiative or the umbrella initiative "Entrepreneurial Regions"[222] (Cf. also Koschatzky 2001: 319-326, Koschatzky 2000a: 14ff.). The *Länder* have the competence to implement innovation policy measures, but – compared to the Federal level - a more limited financial base to rely upon for their measures. *Länder* are responsible for higher education policy and associated measures such as technology transfer. The measures are limited to actors within the territorial borders of the federal state, and these programmes generally have their focus on smaller scale activities, particularly on SMEs. There is a differentiation in policy measures between the Federal and the federal state levels since certain measures such as technology and incubator centres are exclusively targeted at the *Länder* level.[223] Generally, the Ministries of Science or Education are in charge of higher education policy whereas the Ministries of Economy or Finance focus on firm support (cf. European Commission 2005a: 8).

4.3.3.4 Recent trends in German innovation policy

Currently, the German Government focuses at investing 3 % of the GDP for research and development until the year 2010, to stronger involve SMEs in R&D and innovation, and to develop and diffuse new technologies.[224] Further focal aims are the support of technology-based firms, and of application and commercialisation of public research results as well as co-operations between the business sector and academia, and finally

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222 Cf. http://www.exist.de, http://www.bmbf.de/de/962.php, http://www.bmbf.de/de/414.php.

223 As Hassink (1996: 291) states: "Generally, each Land has selected a wide range of regional technology policy measures to assist enterprises in developing their innovative potentials, to build up a technology and science infrastructure, to transfer information, to train employees technologically and to promote business start-ups."

224 A particular focus is on information and communication technologies, biotechnology, nanotechnology, fuel cell technology, medical and health technologies, optical technologies, micro-system technology, space and aircraft technologies, environmental technologies, and alternative energy technologies (cf. European Commission 2005a: 25).

education, innovative activities in Eastern Germany, and the bundling of actors' competences (cf. European Commission 2005a: 25). The Government recently introduced public venture capital for founders of technology-based start-ups and introduced the competition *Exzellenzinitiative - Spitzenuniversitäten für Deutschland*[225] as well as the *Pakt für Forschung und Innovation*[226] to support the German research base (considered as prerequisite for innovation activities in private firms). Both belong to the innovation initiative of the German Government. Finally, the Federal Technology Venture Capital Programmes have been reformed (cf. European Commission 2005a: 28). These measures aim at mitigating the obvious current weaknesses of the German innovation system, namely the education system, the decreasing share of innovative SMEs, and the diminishing power of high-tech sectors leading to an increasing dependence on the automobile sector.[227] Recently, the Federal Government launched the *Hightech-Strategie* as a concerted action of different policy fields related to research and development. With this strategy, the Government wishes to manifest the central importance of innovation policy. The strategy involves several Federal Ministries that carry out the measures under their responsibility. Besides a focus on markets, the strategy seeks to improve the framework conditions for high-tech start-ups and for innovative SMEs, and to transfer research results in products, processes and services. In addition to these general aims, the strategy envisages 17 technology fields for which innovation strategies are developed. Among these fields are for instance health and medicine technologies, energy, security, environment, information and communication technologies, services, as well as nanotechnology, biotechnology, micro-system technologies, optical technologies and new materials (cf. Bundesministerium für Bildung und Forschung 2006b). In order to foster co-operation between public research institutions and business firms, particularly SMEs, the Federal Government launched the *Forschungsprämie*, a "Research Bonus" to research institutes, as a part of the *Hightech-Strategie* (cf. Bundesministerium für Bildung und Forschung 2006b: 13).[228]

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225 Cf. http://www.bmbf.de/de/1321.php. This initiative comprises three lines: (i) postgraduate (PhD) programmes, (ii) clusters of excellence, i.e. co-operation of universities with non-university research institutes, technical colleges, and the business sector, (iii) future-oriented high level university research. Support in this category requires at least one cluster of excellence, one postgraduate programme and the development of a strategy for high-level scientific development.

226 Cf. http://www.bmbf.de/de/3215.php.

227 Cf. http://trendchart.cordis.lu/tc_country_list.cfm.

228 Cf. http://www.hightech-strategie.de/ as well as http://trendchart.cordis.lu/tc_policy_information_fiche.cfm?ID=3437, http://www.bmbf.de/_media/press/pm_20060620-111.pdf, http://trendchart.cordis.europa.eu/tc_policy_information_fiche.cfm?ID=3367.

Summarising, Germany's economy can be characterised by a high focus on manufacturing, on advanced technologies rather than high-tech, and on a high export orientation. The private business sector has a high importance in R&D and innovation; Germany has above-average shares of innovative firms and of R&D expenses. A high level of co-operation between the actors is characteristic for the German innovation system. Germany has a differentiated and decentralised research system with university and non-university research organisations in basic and applied research. Besides the Federal level that determines the general lines of technology and innovation support, the regional level, the *Länder*, have competencies in technology and innovation policy, including education and research. The Government follows the goal to achieve 3 % of GDP spending for research and development by 2010. In order to achieve these goals, the Government pursues the following lines of supporting measures: (i) Improvement of the framework conditions for innovation, (ii) improvement of the education system, and (iii) the support of innovation in firms.

4.3.4 Institutional structure related to innovation in Baden

The presentation of the institutional structure relies again on the concept of Institutions of Technological Infrastructure (ITI) and their functions (cf. section 4.1). The first function, the management of the knowledge base, is at first position fulfilled by the universities of Karlsruhe and Freiburg,[229] the technical colleges or Universities of Applied Sciences (*Fachhochschulen*), and the Universities of Cooperative Education (*Berufsakademien*),[230] professional high schools with a high part of vocational training being performed in the business sector, as well as the International University in Bruchsal.[231] Research organisations external to the higher education sector are institutes of the *Max-Planck-Gesellschaft* located in Freiburg, institutes of the *Fraunhofer-Gesellschaft* located in Freiburg and Karlsruhe, contract research institutions such as the FZI IT Research Centre at the University of Karlsruhe (*Forschungszentrum Informatik (FZI) an der Universität Karlsruhe*) or the Hahn-Schickard Company Institute for Micro- and Information Technology (*Hahn-Schickard Gesellschaft, Institut für Mikro- und Informationstechnik*, IMIT) Villingen-Schwenningen (*Landesforschungseinrichtungen*, i.e. research facilities receiving institutional funding from the federal state).[232] Further re-

229 Cf. http://www.uni-karlsruhe.de/, http://www.uni-freiburg.de/.

230 The concept of Berufsakademie has been developed in Baden-Württemberg in the 1970s integrating elements of the dual qualification and the tertiary education systems.

231 Cf. http://www.i-u.de/.

232 Cf. http://www.fzi.de/, http://www.hsg-imit.de/.

search institutes are the *Forschungszentrum Karlsruhe* (Karlsruhe Research Centre – Technology and Environment), belonging to the Hermann-von-Helmholtz Confederation of German Research Centres (HGF; see above) and the institutes of the Leibniz Association located in Baden: The *Fachinformationszentrum Karlsruhe GmbH* (FIZKA) and the *Kiepenheuer-Institut für Sonnenphysik* (KIS) in Freiburg as well as further research institutes. Mission-oriented institutes such as for instance the *Bundesforschungsanstalt für Ernährung und Lebensmittel* (BfEL), the Federal Research Centre for Nutrition and Food, in Karlsruhe or the *Institut für Atmosphärische Radioaktivität des Bundesamtes für Strahlenschutz* are also located in Baden. Further federal state research institutes are for instance the *Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg* (LUBW),[233] located in Karlsruhe, the *Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg* or the *Staatliches Weinbauinstitut Freiburg*.[234]

The second function, referring to interactions between economic actors, refers to innovation policy (cf. section 4.3.5) and technology transfer. Technology transfer in Baden is supported by the institutes of the Steinbeis Foundation (see below) and its Baden locations, for instance in Baden-Baden, Freiburg and Karlsruhe, Kehl, Malsch, Marxzell-Burbach, Offenburg, Pfinztal or Villingen-Schwenningen. The *Technologie-Lizenz-Büro der Baden-Württembergischen Hochschulen GmbH*, located in Karlsruhe,[235] focuses at commercialisation of inventions realised at universities in Baden-Württemberg. General information concerning the location of Baden-Württemberg – i.e. information considered relevant for investors as well as territorial marketing issues – are not specifically organised for the surveyed region of Baden. Existing initiatives refer to the federal state of Baden-Württemberg as a whole or to smaller territorial units such as the *TechnologieRegion Karlsruhe* (see below). On the federal state level, the Agency for International Economic and Scientific Cooperation offers information and training for companies planning to locate in Baden-Württemberg and for regional firms that wish to engage in international markets.[236] Information platforms or marketing agencies support research institutes and companies in technological fields, e.g. biotechnology or

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233 Cf. http://www.lubw.baden-wuerttemberg.de/servlet/is/10215/.

234 Cf. http://www.freiburg.de/3/306/30601/objektart_detail.php?objektart_id=570 and http://cordis.europa.eu/baden-wuerttemberg/links.htm, http://www.wm.baden-wuerttemberg.de/sixcms/detail.php/63670 for an overview of the Baden-Württemberg research infrastructure.

235 Cf. http://www.tlb.de/.

236 Cf. http://www.bw-i.de/en/. Business information of the Baden-Württemberg location relevant for investors are given by the Investor's Link at http://www.bw-invest.de.

information technologies. Economic promotion and further company-related information is provided by several further agencies such as the Chambers of Commerce - the Baden surveyed region has three chambers of commerce in Karlsruhe, Freiburg and Villingen-Schwenningen - the *Rationalisierungs- und Innovationszentrum der Deutschen Wirtschaft e.V.*,[237] located in Stuttgart and being responsible for Baden-Württemberg as a whole, trade associations and agencies specialised on handicraft companies.[238] Financial support for innovation and venture capital is granted by local funds (cf. Hilpert 2000: 11).

4.3.5 Innovation policy in Baden-Württemberg

In Baden-Württemberg, regional economic and industrial policies have a long tradition. Already in the nineteenth century, Ferdinand von Steinbeis supported many small craft firms concerning technological knowledge, export and training. Technology policy has been introduced in Baden-Württemberg in 1976; priority measures of technology policy were SME support and technology transfer. Since 1987, Baden-Württemberg's technology policy is based on (i) the support of the public research infrastructure, (ii) technology transfer, and (iii) aid schemes for individual firms. After the economic crisis at the beginning of the 1990s, technology policies supported traditional industries on the one hand and focused on developing new technologies and industries on the other hand (cf. Hassink 1996: 291/292, Koschatzky et al. 2000: 240).[239]

The Baden-Württemberg Ministry of Science, Research and the Arts is in charge of the research policy conception whereas the Ministry of Economic Affairs is responsible for technology policy and innovation support. The State ministry launches initiatives in new technologies, for instance biotechnology, and acts as initiator for innovation policy. The *Land* Government has designed close co-operation between the different ministries' departments responsible for research, technology, education and qualification. Baden-Württemberg's technology policy is based on dialogue processes between science, economy and policy. In the 1980s and 1990s, innovation policy focused on the constitution of an institutional network for R&D and technology transfer, as well as co-operative projects and technology transfer promotion of firms. However, since the beginning of the 1990s, budget consolidation requirements constricted institutional funding. The *Land* pursued new innovation policy approaches, particularly cluster initiatives. In the period of economic difficulties, commissions were launched in order to perform

237 Cf. http://www.rkw-bw.de/Info/en.

238 Cf. also http://cordis.europa.eu/baden-wuerttemberg/links.htm.

239 Cf. also http://www.wm.baden-wuerttemberg.de/sixcms/detail.php/63667 for the current conception of technology policy.

foresight exercises on future needs. These commissions involved experts from research, governance and industry. In 2000, the consultant Roland Berger repeated this exercise and defined new fields for support such as health and life sciences, ICT and sensors/ photonics (cf. Dispan/ Stieler 2005: 51-53 and 63/63, Hassink 1996: 299-301, Cooke 2004: 12). The first priority of Baden-Württemberg's current innovation and technology policy is the strengthening of innovation capacities and innovation readiness of the regional firms. In order for them to get access to knowledge and research results from universities and research institutes, the federal state emphasises co-operation between science and industry; co-operative projects between research institutes, universities and firms are funded in production engineering, material research and power engineering. Further support is granted for the introduction of new technologies in individual firms. Technology transfer organisations like transfer centres of the Steinbeis foundation focus on co-operations between research institutes and business firms. Emphasis is put on fundamental research in growth areas, on cross-sectoral technologies and on clusters. Identified strategic research fields are life sciences, new materials, IT/ information and communication/ applied mathematics, miniaturisation, optical technologies, process technology, and sensor technology.[240]

Baden-Württemberg's research policy conception focuses on initiatives for intensified co-operation, young scientists, internationalisation tendencies of the scientific institutes, and favourable framework conditions (cf. Ministerium für Wissenschaft, Forschung und Kunst des Landes Baden-Württemberg 2000): The *Land* engages in the support of research in universities and non-university research institutions, in the design of a favourable framework for knowledge and technology transfer, and in the creation of a research supportive climate. The Ministry argues for more flexibility and co-operation within and between institutes in the research sector. Competition and evaluation, research networks and clusters are important elements of the Ministry's research conception. Instruments envisaged by the Ministry concern the acquisition of third-party funds by universities,[241] as well as start-up initiatives,[242] the further support of inven-

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240 Cf. Regional Service Baden-Württemberg 2006a, b, c as well as the Internet information of the Ministry of Economic Affairs: http://www.wm.baden-wuerttemberg.de/sixcms/detail.php/63667, http://www.wm.baden-wuerttemberg.de/sixcms/detail.php/63670, http://www.wm.baden-wuerttemberg.de/sixcms/detail.php/63671, http://www.wm.baden-wuerttemberg.de/sixcms/detail.php/63672.

241 Cf. for instance the orientation towards *Sonderforschungsbereiche* fostering interdisciplinary co-operations, or the public support of fundamental science oriented towards the acquisition of external funds, on the Ministry's website: http://www.mwk.baden-wuerttemberg.de/themen/forschung/forschungsfoerderung/sonderforschungsbereiche-an-baden-wuerttembergischen-universitaeten/, http://www.mwk.baden-wuerttemberg.de/themen/forschung/forschungsfoerderung/forschungsschwerpunktprogramm-universitaeten/.

tive potentials and patent applications, supporting measures for research at *Fachhochschulen*,[243] and the Research Award.[244] The *Struktur- und Innovationsfonds für die Forschung* supports the generation of favourable conditions for scientists.[245] The federal state maintains two bodies for the development and support of high-technology fields of Biotech/ Life Sciences and of information and communication technologies: BIOPRO Baden-Württemberg GmbH and the *Medien- und Filmgesellschaft Baden-Württemberg.* Photonics BW supports regional networks in photonics, whereas BW con – Baden-Württemberg connected is active in the IT fields. The *Dienstleistungsoffensive* aims at exploiting the potential of the service sector. Nanomat, a network of universities, research institutes, and large companies, co-ordinates the member's research projects in a given part of nanotechnological research. Nanomat is located in the *Forschungszentrum Karlsruhe* in Baden.[246] However, the dominating fields in Baden-Württemberg are vehicle construction, mechanical engineering and electrical engineering, including the automobile supplier industry. The latter widely contributes to Baden-Württemberg's economic success and favourable situation, but is also in danger to be hit by structural crises (cf. Dispan/ Stiegler 2005: 73).

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242 The measure *Junge Innovatoren* (Young innovators) grants financial support and coaching for young entrepreneurs starting their business (cf. http://www.mwk.baden-wuerttemberg.de/themen/hochschulen/foerderung-von-wissenschaftlern/existenzgruendung/). Ifex is an initiative for start-ups (cf. http://www.ifex.de/ifex/index.php). The spectrum of supporting measures for research is presented on the Ministry's website: http://www.mwk.baden-wuerttemberg.de/service/foerderprogramme/forschung/.

243 Cf. http://www.mwk.baden-wuerttemberg.de/themen/forschung/forschungsfoerderung/foerderung-von-fue-projekten-fuer-die-jahre-2005-ff-an-fachhochschulen-durch-das-land-baden-wuerttemberg-innovative-projektekooperationsprojekte/, http://www.mwk.baden-wuerttemberg.de/themen/forschung/forschungsfoerderung/zentren-fuer-angewandte-forschung-an-fachhochschulen-zafh/, and http://www.mwk.baden-wuerttemberg.de/themen/forschung/forschungsfoerderung/schwerpunktprogramm-fachhochschulen/.

244 Cf. http://www.mwk.baden-wuerttemberg.de/themen/forschung/forschungsfoerderung/landesforschungspreis/.

245 Cf. Ministerium für Wissenschaft, Forschung und Kunst des Landes Baden-Württemberg 2000: 14-47, Regional Service Baden-Württemberg 2006a, http://www.mwk.baden-wuerttemberg.de/themen/forschung/forschungspolitik, http://www.mwk.baden-wuerttemberg.de/themen/forschung/forschungsfoerderung/struktur-und-innovationsfonds-si-bw/ on the Ministry's website.

246 Cf. http://www.mfg.de/, http://www.photonicsbw.de/, http://www.bw-con.de/index.php?id=bwcon, http://www.bio-pro.de/en/index.html for biotechnology and http://www.english.doit-online.de/cms/At+a+glance/Baden-Wuerttemberg for IT and media, http://www.photonicsbw.de/ for photonics, http://www.bw-con.de/index.php?id=bwcon for BW con, http://www.dienstleistungsoffensive.de/dienstleistungsoffensive/index.php, http://www.nanomat.de/.

4.3.6 Innovation initiatives in Baden

Innovation-related initiatives on a smaller territorial scale than the federal state are attributed an important role for strengthening industrial innovation capacities. Examples are the region of Stuttgart, the *TechnologieRegion Karlsruhe*, the innovative region of Ulm, the BioRegio Rhein-Neckar, the *Solarregion Freiburg* and the BioRegio in the Upper Rhine BioValley (cf. Dispan/ Stieler 2005: 72/73).[247] The Baden surveyed region hosts three of these initiatives: the *TechnologieRegion Karlsruhe* (TRK), the *Solarregion Freiburg* and *BioRegio Freiburg* in the BioValley. The *Solarregion* aims to foster solar energy applications in the Freiburg region.[248] The *TechnologieRegion Karlsruhe*, founded in 1987, associates ten cities, three administrative districts (*Landkreise*) and the *Regionalverband Mittlerer Oberrhein* in a triangle between Mannheim, Stuttgart and Strasbourg under the guideline "high tech - high life". Under this motto, the association refers to the natural environment in the southwest of Germany, its favourable climatic conditions, infrastructure, and living standard on the one hand, and the high research density on the other hand. The TRK hosts for instance the *Forschungszentrum Karlsruhe*, the largest German research centre,[249] three institutes of the *Fraunhofer-Gesellschaft* and further research institutes and transfer centres belonging to the Steinbeis foundation, the technical university of Karlsruhe as well as the start-up initiative KEIM (see page 142). The initial goals of the association were the ensuring of locational advantages, engagement in regional marketing and communication. Particular locational advantages are the research capacities, qualification, a high and growing number of innovative firms as well as cultural and environmental factors. The *TechnologieRegion Karlsruhe* is based on a voluntary co-operation of the members and is managed by the chamber of commerce Karlsruhe.[250] The *TechnologieRegion*'s mission currently comprises territorial marketing, economic and technological support, cultural co-operation, tourism, and regional infrastructure issues.[251]

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247 Cf. also http://www.wm.baden-wuerttemberg.de/sixcms/detail.php/63667.

248 Cf. http://www.solarregion.freiburg.de/.

249 Cf. http://www.fzk.de/fzk/idcplg?IdcService=FZK.

250 The political governance is assumed by the lord mayor of the city of Karlsruhe, a board of directors and the shareholders, supported by working groups for specific themes. New ideas are further generated by the regional conference, a committee associating firm representatives, researchers, scientists as well as members representing cultural affairs and education. The financial basis was given through a contribution of the cities and municipalities (cf. Fenrich 2005, *TechnologieRegion Karlsruhe* 2006, http://www.technologieregion-karlsruhe.de/ueber/organe.de).

251 Cf. Fenrich 2005, *TechnologieRegion Karlsruhe* 2006, http://cordis.europa.eu/paxis/src/karlsruhe.htm, http://www.TechnologieRegion-karlsruhe.de/.

Around 995,690 persons are living in the *TechnologieRegion*. In 2004, the GDP per economically active person has been higher than for Baden-Württemberg as a whole (€ 61,902 *versus* € 60,054 in the federal state).[252] Between 1991 and 2000, the GDP growth in the *TechnologieRegion* (37.9 %) was higher than in Baden-Württemberg (30.6 %) and in Germany (34.8 %). In 2004, 0.52 % of the employees in the *TechnologieRegion* have been working in agriculture, 36.47 % were industrial employees (29.96 % in the manufacturing sectors), and 63.01 % were employed in services. The most important industries in terms of employed persons are electrical engineering/ computer and office machines/ precision engineering/ optics, vehicle construction and mechanical engineering.[253] The unemployment rate was 7.1 % in 2005 (annual average value)[254] (cf. Industrie- und Handelskammer Karlsruhe 2005: 2/3, 7/8). The *TechnologieRegion* has a high share of employees working in high tech fields, and around 3,500 scientists and more than 20,000 students at the higher education organisations.[255] Of special importance are information and communication technology firms. The *TechnologieRegion* hosts the *Technologiefabrik Karlsruhe*, a technology and business incubation centre,[256] the *Karlsruher Existenzgründerimpuls KEIM*,[257] an initiative to support university spin-offs which has been one of the five pilot regions in the frame of the federal university spin-off EXIST programme (see below), and the virtual business incubation centre CyberForum.[258] Furthermore, co-operation between industry

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252 Cf. http://www.karlsruhe.ihk24.de/produktmarken/standortpolitik/zahlenundfakten/Zahlen_Wirtschaftskraft/Bruttoinlandsprodukt_je_Erwerbstaetigen.jsp.

253 Cf. http://www.karlsruhe.ihk24.de/produktmarken/standortpolitik/zahlenundfakten/Zahlen_Industriestatistik/Industriebranchen.jsp.

254 For comparison: The 2005 unemployment rate of Baden-Württemberg was 7.0 %, and the German rate was 11.7 % (cf. http://www.karlsruhe.ihk24.de/produktmarken/standortpolitik/zahlenundfakten/Zahlen_Arbeitsmarkt/Arbeitslosenzahlen.jsp).

255 The *TechnologieRegion* is cited as having the highest researcher density in Europe (cf. for instance Hilpert 2000: 11/12). The *TechnologieRegion* identifies the following core competencies: Information and communication technologies, microsystems, mechatronics, chemical and material technologies, robotics and product and process technologies, automotive engineering network, energy technology, environmental and biotechnology, medical technology, and interdisciplinary fields (cf. http://www.technologieregion-karlsruhe.de/ForschungsRegion/kompetenzschwerpunkte.de).

256 Cf. http://www.technologiefabrik-ka.de/.

257 Cf. http://www.keimforum.de/.

258 Cf. http://www.cyberforum.de/index.jsp.

and science as well as contract research for industry are important characteristics of the *TechnologieRegion*.[259]

The *TechnologieRegion Karlsruhe* is nowadays recognised as important location for high-technology, innovation and firm foundation with one special focus on information and communication technologies (ICT) in manufacturing and particularly services. Both established IT firms with high competence and young firms are an important prerequisite for successful future networking and regional development (cf. Industrie- und Handelskammer Karlsruhe 2003: 5/6). Technology transfer is organised through technology centers as well as the *Technologiepark Karlsruhe.*[260] Regional technology networks are for instance the *Karlsruher Informatik Kooperation* (KIK)[261] and the *Karlsruher Produktionstechnik Kooperation* (cf. Hilpert 2000: 11). The foundation of the Karlsruhe Institute of Technology (KIT) between the Technical University and the Research Centre in April 2006 is at the core of the future-oriented research strategy of the Karlsruhe University in the nation-wide *Exzellenzinitiative* launched by the Federal Ministry of Education and Research (cf. page 135). Besides Karlsruhe, two Munich universities have been successful.[262]

The *TechnologieRegion* has been selected as "Region of Excellence" by the PAXIS (The Pilot Action of Excellence on Innovative Start-ups) exercise.[263] This award has been granted for the first time in 2002 to 15 European regions and cities, among them the *TechnologieRegion Karlsruhe*. Selection criteria are "… an outstanding track record in supporting the creation and growth of innovative start-ups". Karlsruhe-Pforzheim (the "enlarged *TechnologieRegion Karlsruhe*") associates Karlsruhe with Oxford, Lyon-Grenoble and Emilia-Romagna in the KREO network. The common goal of those regions is the creation of favourable environments for innovative start-ups based on re-

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259 Cf. Industrie- und Handelskammer Karlsruhe 2005: 2/3, 7/8, *TechnologieRegion* GdbR: 4-9. See also http://www.karlsruhe.ihk24.de/produktmarken/standortpolitik/zahlenundfakten/Zahlen_Industriestatistik/Industriestatistik_2004.jsp,.

260 Cf. http://www.techpark.de/00_00_portal/home.htm.

261 Cf. http://www.kik-karlsruhe.de/index.html.

262 Cf. http://www.ka-it.de/, http://www.fzk.de/fzk/idcplg?IdcService=FZK&node=Press&document=ID_055866.

263 Launched in 1999, PAXIS aims at fostering innovative companies (foundation and development) in Europe. It is managed by the European Commission, Enterprise Directorate-General in the 'Research and Innovation Programme' of the sixth Framework Programme. Besides the support of regional and local innovation excellence, its missions are the exchange of tacit knowledge, learning and co-operation between local actors (cf. http://cordis.europa.eu/paxis/src/about_paxis.htm).

search competences of the regions.[264] The "enlarged *TechnologieRegion*" is one of the five first German EXIST regions, the KEIM initiative Karlsruhe-Pforzheim (*Karlsruher Existenzgründungs-Impuls* KEIM, now KEIMforum e.V.).[265]

A further technology-oriented initiative in Baden the *BioRegio* Freiburg, located in the French-Swiss-German BioValley (cf. page 113). Contrary to the *TechnologieRegion*, this initiative has a technology focus, aiming at supporting activities in biotechnology and bringing together the university of Freiburg, hospitals, fundamental and applied research institutes as well as regional firms in the biotechnology sector. Policy, research and industry are co-operating with the objective to foster life science activities in the Freiburg region. The management of the BioRegio also operates the BioTechPark, offers diverse consulting services, is in charge of locational marketing, etc. It is part of the BioValley initiative in the life sciences, involving science, business, economic development and technology transfer (cf. BioValley 2004b).[266]

4.3.7 Innovation in Baden: Concluding remarks

Baden-Württemberg is frequently listed as successful example of an industrial district, with the '*Mittelstand*' structure and a rich infrastructure for innovation support – among them universities and technical colleges, Fraunhofer Institutes and Steinbeis transfer centres – as main success factors (cf. Koschatzky et al. 2000: 240). Baden-Württemberg was hit by the economic crisis at the beginning of the 1990s. Though the situation of increased unemployment and decline of GDP was quickly mastered due to the favourable situation in the automotive industry, the problems of depending on two mature products – automobiles and machines – became obvious. The regional strengths are particularly rooted in automobile production, machinery, electrical equipment, thus on advanced, but less on high technology sectors. On the other hand, the service sector is weaker than in Germany and the European Union (cf. Heidenreich/ Krauss 2004: 188/189). Baden-Württemberg has a high density of skilled workers. Fordist production methods have not gained a very crucial position. The region is innovative, innovation being performed within the context of a rich research, scientific and technological infrastructure. Researchers examining the innovation system in Baden-Württemberg classify it as network-oriented and interactive, based on large companies

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264 Cf. http://cordis.europa.eu/paxis/src/about_paxis.htm, http://cordis.europa.eu/ paxis/src/kreo.htm.

265 Cf. http://www.exist.de/, http://www.keimforum.de/, http://cordis.europa.eu/paxis/src/ karlsruhe.htm.

266 Cf. http://www.biovalley.com.

with global orientation and innovative SMEs, and as evolving towards globalised when compared to the mid-1990s (cf. Heidenreich/ Krauss 2004: 186ff., Heidenreich 2004: 363ff., Cooke 2004: 15 and 366). As Heidenreich (2004) concludes from his analysis of the Baden-Württemberg innovation system, the regional institutional structure for innovation support – including policies, technology transfer, education and research – very well answers the needs of the existing industries. However, an open attitude towards new technologies is also necessary in order to develop new technologies, new forms of co-operation and new future perspectives: "In the temporal dimension, regional innovation systems are characterised by the tension between previous strengths and new technological fields. The success of an RIS [regional innovation system; added by the author] depends both on the development of previous strengths and technological trajectories and on openings for new developments and chances." (Heidenreich 2004: 374). Lacking engagement in new development paths and new technologies leads to a path-dependency of regional and technological development which can hardly be counter steered by industrial policies. As Lambooy/ Boschma (2001: 117) argue, it is hardly possible to deliberately generate a new development path, "… because it is the result of, first, surprising, unexpected discoveries or not consciously made decisions, and second, many unrelated decisions, divided by time and space." Nevertheless, Baden-Württemberg still occupies a strong position in advanced technologies and rather continues its present specialisation path (cf. Heidenreich 2004: 375 and 383, Heidenreich/ Krauss 2004: 207/208), and initiatives in new technology fields have been established.

In the context of Germany's federal character, the regional level has a high importance in innovation policy and in related fields such as education and research policies or technology support. As also in other German federal states, technology policy during the 1980s was supply-oriented and had a top-down direction of interventions. During this period, the technology transfer infrastructure has been established and did not experience large-scale modifications. There is a considerable number of agencies aiming at fostering firms' innovation activities; however, as Hassink (1996: 299-301) analyses, SMEs' main innovation impulses stem from their business partners, particularly from customers. In the 1990s, the innovation support strategy shifted towards co-operative projects ("new dialogue-oriented strategy") (cf. Hassink 1996: 299-301). Additionally, 'bottom-up' initiatives on the local level foster technology- and innovation-oriented networks, communication, identity, and image among local actors.

4.4 Synthesis: The Alsatian and Baden frameworks for the empirical analysis

The presentation of the surveyed neighbouring regions of Alsace and Baden and their respective national contexts show diverse similarities, but also differences. Both are comparatively prosperous regions, both are industrially shaped with a slight under-representation of the service sector – with lower shares of service sector employment in Germany as a whole and in Baden than in France and Alsace (cf. table 1 and table 5) – and in both regions, the industrial fabric seems to be rather rely on advanced technologies than on high technology, though with some 'high-tech locations' for instance in biotechnology. Both regions show a good patent performance. Alsace has a strong (publicly funded, university-based) basic research tradition. Baden also hosts various research institutes, but with a mixed basic and applied character. Both regions have a dense net of innovation support, shaped by national and regional conceptions, and – in the case of Alsace – regional agencies of national institutions. The surveyed region of Baden is not a federal state, and does not represent an own governance level with competencies and financial means to launch innovation supporting programmes and further measures. But, as the preceding section showed, Baden hosts network-based bottom-up initiatives that support innovation and the innovation conditions in the region. Alsace is successfully engaged in region-based network initiatives such as the competitiveness cluster programme of the French Government; thus both regions engaged in processes of interaction and common strategy building on the local level. Alsace seems to have a strong focus on the transfer of research results to private firms and seems to be successful in the diffusion and application of technologies. Firms can thus rely on knowledge provided by institutions of the intermediary transfer structure. Additionally, programmes like CORTECHS, CIFRE or PRISME induce networking and knowledge transfer between different partners, related through an innovation project.

The overviews of the national contexts demonstrated that Alsace and Baden are embedded in different innovation governance systems. Both regions face various innovation policy measures from the national and from regional governance levels (besides the European one), with France being characterised through region-specific features and regionalised national actors and measures, while the German federal level has specific competencies in innovation issues, comprising technology policy, research and higher education. In France, the regional level gained increased competences, and the national level is present in the regions through regional agencies, or through its participation in the CPER negotiations. Both surveyed regions have a high variety of agencies and programmes referring to innovation support, and in both regions, (public) research activities are of high importance, though in Alsace in rather basic fields, whereas the Baden research infrastructure also has a focus on applied research. Both in France and in Germany, the initial research orientation of innovation policy has broadened and nowadays comprises a complex mix of policy measures related to the whole process of innovation. The diverging organisational structures of the national surroundings lead to different structures in innovation-related domains and policy fields: The German research system is decentralised and diversified. Mission orientation did not receive the high importance as in France; however, institutes for applied research in specialised fields have been established (cf. Keck 1993: 123, Meyer-Krahmer 2001: 219). Public research in France has a vertical structure, i.e. a strong thematic orientation of the research organisations, and a rather modest level of linkages between science and industry. Business sector research tends to be rather performed by large companies. However, the French innovation structure can be characterised by an increasing network orientation and 'bottom-up' character (cf. European Commission 2005b: 3/4).

Innovation in both regions and thus in both national contexts is increasingly conceived from a regional perspective. In both countries, local and regional, network and co-operation based conceptions in a competitive context have been introduced[267] (cf. Harding 2001: 398ff. for Germany). This is in line with policy conceptions that focus not exclusively on material high-tech support, but on the complex knowledge generation and application process. Hilpert (2001: 73) for instance argues that regional technology policy in more advanced development stages comprises moderation, information and stimulation instruments. This requirement is increasingly integrated in regional innovation policies of both surveyed regions: The transfer of research results to regional firms in order to enhance their innovative capacities, is supplemented by instruments that focus on co-operation and networking, thus rather by integrating the knowledge generating and applying regional 'sub-systems' (in Autio's terminology) than by transferring knowledge between them. Co-operation and networking, information, and awareness for innovation are some of the keywords of current innovation initiatives, embedded in a superordinate context of competitiveness.

267 Harding (2001: 402) assesses this development in Germany, particularly the BioRegio and InnoRegio initiatives, as follows: "The result is strong inter-regional competition but intra-regional institutional collaboration, which has produced innovation hubs across Germany, including in the new Länder, as well as significant strengths in biotechnology…"

5 Survey perceptions in Alsace and Baden

5.1 Introduction

The empirical investigation presented in the following section relies on the European Regional Innovation Survey (ERIS) to manufacturing and business service firms as well as research institutes in ten European regions and Slovenia. ERIS has been performed by the Universities of Hanover and Cologne, the *Technische Universität Bergakademie Freiberg* and the Fraunhofer Institute for Systems and Innovation Research Karlsruhe in the frame of the research programme "Technological change and regional development" commissioned by the German Research Association (*Deutsche Forschungsgemeinschaft*). Apart from Baden and Alsace, the surveys have been performed in the Research Triangle Lower Saxony, in Saxony, South Wales, Rotterdam, Gironde, the metropolitan regions of Stockholm, Vienna and Barcelona as well as in Slovenia (cf. Fritsch et al. 1998: 248ff., Sternberg 2000: 396ff.). The survey among manufacturing small and medium-sized enterprises (SME) took place in 1995 whereas the questionnaires to knowledge-intensive business services (KIBS) date from 1996.[268] In order to facilitate the reading, this survey round is referred to in the following as the 1995 investigation. The Fraunhofer Institute for Systems and Innovation Research (ISI) Karlsruhe and the *Bureau d'Economie Théorique et Appliquée* (BETA) at the *Université Louis Pasteur* Strasbourg organised and performed the surveys in Baden and Alsace. Main topics of the written, questionnaire-based investigation have been firms' innovation and co-operation characteristics as well as their assessments of the respective regional framework conditions and obstacles to innovation.[269] This survey and its results have been the base for the current study in 2004/2005. In order to trace possible changes in firms' perceptions concerning innovation-related characteristics in their (regional) environment, a sub-sample of the 1995 one has been selected and asked again to provide information concerning innovation characteristics and their assessments of the innovation conditions in their region.[270] The overall aim of the 2004 investigation was to rep-

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268 The survey was addressed to enterprises' local production facilities.

269 Further information concerning the samples as well as some selected results of this survey are given in annex 2.

270 This survey relates to a research project realised by the *Laboratoire Européen Associé* (LEA) between BETA Strasbourg and Fraunhofer ISI Karlsruhe, supported by the *Centre National de la Recherche Scientifique* (CNRS) and the Fraunhofer Society. The French part of the survey has been supported by Zhao Wang and Francis Munier of BETA and the *Université de Haute Alsace,* Mulhouse, whereas Christine Schädel and Roxana Papuc contributed to the analysis on the German side. The survey took place in the last weeks of

resent the respective regional firm populations; the regional samples may slightly differ in their sectoral composition. Contrary to the 1995 survey that was based on comprehensive written questionnaires, this time telephone interviews have been chosen as survey method. This enabled to explain the aim of the survey and to be able to discuss with the same person as in 1995, where possible (see below). Furthermore, telephone interviews have been assumed appropriate to reach the aim of obtaining 100 firm answers. In order to facilitate firms' contribution to the survey, the questionnaire focused on central questions, was therefore short and mainly standardised, so that firms did not have to spend much time for the interviews.[271]

From the samples of the first inquiry round, 100 innovating firms – firms that considered themselves as innovative in the 1995 survey, i.e. that had performed product (or, in the case of manufacturing SMEs, process) innovation projects during the preceding three years – have been identified, contacted again and requested to comment innovation and perception issues.[272] The selection of firms from the 1995 survey aimed at obtaining a sample with a good representation of the regional business structures. Thus, innovative manufacturing and knowledge-intensive business service firms representing the sectoral and size structures of the first inquiry samples have been selected. Table 9 shows the targeted number of firms in the size classes, according to their activities in product and process industries or in technical and business-related service activities.[273]

2004 and the first ones in 2005. Again, to simplify reading, this survey round is referred to as the 2004 one.

271 However, these differences in the survey methods 1995 and 2004 have to be kept in mind when interpreting the results.

272 Innovation has been defined as the process or the manufacture of a new – for the enterprise - or significantly improved product. Innovation in services have been circumscribed as new – for the firm - or significantly improved services, and the implementation of new or significantly improved processes for the generation of services.

273 Firms from the food, textiles, wood and chemical sectors constitute the process industries sub-sample whereas basic metals, machinery and electrical machines are the basic sectors for product industries. Business KIBS resume firms from the legal, accounting and tax consultancy sectors as well as firms active in the business, management and marketing fields. On the other hand, the technical KIBS sub-sample comprises firms with computer-related consultancy and activities as well as with architectural, engineering and technical activities. Analyses according to sectors of activity (or size classes) are not in the focus of the analysis; sectoral fields and size classes have been considered to represent the firm structure in the surveyed regions.

Table 9: Targeted distribution of interviews in Baden and in Alsace 2004 according to the distribution of firms in branches and size classes 1995/96

Alsace manufacturing SMEs

Industry type/ Size class	< 20	20 - 49	50 - 99	100 - 199	200 - 499	Total
Process industries	2	4	4	2	2	**14**
Product industries	2	3	2	3	1	**11**
Total	**4**	**7**	**6**	**5**	**3**	**25**

Alsace KIBS

KIBS type/ Size class	5 to 9	10 to 19	>20	Total
Technical KIBS	7	3	5	**15**
Business KIBS	7	2	1	**10**
Total	**14**	**5**	**6**	**25**

Baden manufacturing SMEs

Industry type/ Size class	< 20	20 - 49	50 - 99	100 - 199	200 - 499	Total
Process industries	2	3	2	1	1	**9**
Product industries	3	5	3	2	3	**16**
Total	**5**	**8**	**5**	**3**	**4**	**25**

Baden KIBS

KIBS type/ Size class	5 to 9	10 to 19	>20	Total
Technical KIBS	5	5	5	**15**
Business KIBS	4	3	3	**10**
Total	**9**	**8**	**8**	**25**

For each cell the triple amount of required questionnaires has been selected in order to take into account firm closures, changes of telephone numbers and/ or locations as well as lack of interest to participate in the study.[274] If more 1995 questionnaires than needed existed, the respective number of original questionnaires was randomly selected. Quite often, the persons who answered the questions in the first round had given their names and direct phone numbers. So during the second round 2004, it was

274 With this procedure, the investigation thus exclusively relies on still existing firms and cannot take into account firm closures in the meantime.

attempted to contact these persons directly. Of course, they have not always been in the company anymore, but quite often, the initial contact persons were still working in the firm and agreed to participate in the second round. Interviewees were mainly managers or responsible for R&D in their firms.

In cases where firms could not be contacted with the initial telephone number, a web-based research was performed. Sometimes, only the numbers and/or the addresses in the same town have been changed in the meantime.[275] In some cases, firm ownership structures have been changed and/ or firms have been merged with or taken over by other firms. Once the contact persons were identified, they were very often ready to answer the questions directly. In cases where this was not possible due to time restrictions, appointments for the telephone interviews were made. In some (rare) cases the interviewees indicated they were too busy and required the questionnaire via e-mail and sent it back per e-mail or fax. The shortness and the high degree of standardisation of the interview guideline proved to be useful. So the contact persons were not forced to spend much time for the interviews. For questions that required quantifications (number of employees, number of R&D employees, share of turnover spent for R&D, and turnover), the answers of the first round have been noted and in cases where the contact persons could not give the exact numbers, the interviewers could indicate the quantity of the last survey, so that the contact person could indicate whether the figures had been increased, decreased or remained stable since the first survey.

It proved to be more difficult to get interview appointments with KIBS than with manufacturing firms. This seems to be related to the fact that knowledge-intensive business service firms of the sample are generally small firms. So the R&D responsible or manager could not always be contacted immediately. Moreover, innovation is often differently perceived by KIBS representatives than by their manufacturing counterparts. Daily work and innovation preparing tasks are frequently interwoven and not strictly divisible, and KIBS do not always have a research department or explicit research staff. Also, it is often development and not always research that is performed. Development tasks are often performed by the staff in parallel to other tasks since research and development activities are differently organised and much less formalised than in manufacturing firms. Thus questions concerning R&D and innovation are not as common as for manufacturing firms. The telephone character of the interviews allowed explaining the goal of the questions, i.e. to obtain information concerning research and development activities, understood as innovation preparing tasks.

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275 For instance when companies moved from their original location to a technology park.

The overall aim was to ask similar questions as in the first round in order to be able to contrast the respective results of both surveys. Additionally, the survey aimed at asking similar questions to manufacturing and to business service firms. This complete comparability between the activity types and the different time-period samples was not always strictly possible so that some minor deviations had to be taken into account. Possible deviations will be mentioned when presenting the results.

Following section 3, the results of the 2004 investigation and the selection of the respective answers in 1995 aimed at gaining information concerning the following aspects:

- Structural firm characteristics: Size and turnover
- Engagement in innovation preparing tasks in terms of expenses for and employees devoted to research and development
- Innovation-related information sources: Firms' evaluations of the importance of clients, competitors, as well as research and technology transfer institutes for their innovation projects
- Perception of selected regional characteristics with respect to firms' innovation activities: Firms' assessments of the regional workforce, research and technology and the general innovation climate in the region
- Estimation of the future development of research and development, size and turnover
- Evaluation of the importance of the region for acquiring innovation-related information, and possible relocation plans.

Those aspects aim at gaining information concerning possible innovation and perception patterns among the firms of the sub-samples according to activity type and regional location. Possible structures can then be juxtaposed to the situation about ten years ago, searching for indications concerning changes in perceptions and innovation behaviours in time. The analysis aims at revealing if innovation (input) behaviours of the sample firms are rather stable or evolving in time. Furthermore, the innovation-related information sources nowadays and about ten years ago are in the focus. Thus, the analysis tries to answer the following questions: Are there indications for specific innovation patterns among the sample firms? Do these characteristics differ between the manufacturing SME and the KIBS sub-samples and/ or the sample firms in the regions of Baden and Alsace? How do the sample firms perceive their environments with respect to the selected innovation-related variables? Finally, the analysis tries to reveal if there are associations between the regional focus of information acquisition, i.e. the "inward orientation" in terms of intra-regional innovation relations of the sample firms, and their innovation inputs.

5.2 Innovation and perception of the surveyed firms in the mid-2000s

5.2.1 Basic characteristics of the 2004 investigation

The obtained answers from selected firm representatives results in a database structure with variables for manufacturing and business service firms in two regions and at two points in time. The original 1995 database has been used as base; descriptions and encodings have been adapted. In line with the first survey round and due to differences in the 1995 questionnaires to manufacturing and to business service firms, the data have been separated in two databases for the following descriptive overview. The multivariate analysis, performed with a selected set of variables (cf. section 5.3), requires the integration of the relevant variables in one database.

Answer categories to assessment questions have been "rather favourable", "without impact" and "rather unfavourable". Questions concerning firm representatives' anticipations of future development of turnover, R&D activities and number of employees are likewise measured on an "increase", "decrease" and "remaining constant" scale. Concerning innovation-related information sources, the interview guideline provides "yes" or "no" answers. Figures have only been requested with respect to firms' numbers of employees, R&D employees, R&D expenses and turnover. Open questions only occurred twice, first enabling respondents to mention further information sources for innovation and second, when being asked about their relocation plans (destination and reasons for relocation). Calculations have been performed with SPSS 11.0.

The following statements exclusively refer to the sample firms and are not inferred to the whole firm population. The Alsatian sample consists of 11 product and 14 process industry as well as 9 technical and 9 business KIBS firms[276] whereas the sample for the Baden region is made up by 16 product and 9 process industry as well as 10 business and 15 technical KIBS firms (as targeted). In 56 from the 93 cases (from which 37 in Baden and 19 in Alsace) the 1995 respondent could be contacted and agreed to participate in this second survey round.[277] In the context of high fluctuations of companies and staff, this seems a fairly satisfactory amount.

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276 The goal of 25 sample KIBS in Alsace could not be reached since (i) the share of innovating KIBS in the original 1995 sample and thus the base for the 2004 sample has been smaller than in Baden, (ii) some firms did not exist any more, at least not under the civil form and name given in 1995, and (iii) sometimes firm representatives were not inclined to participate in the 2004 survey.

277 Among manufacturing firms, in 72.0 % of the Baden and 36.4 % of Alsatian firm cases, the 1995 respondent also answered the questions in 2004. Concerning the KIBS sub-sample,

In 1995, 12 of the selected Baden manufacturing sample firms were companies without subsidiaries, and 13 were head offices of companies with subsidiaries, whereas the largest part of Alsatian manufacturing sample firms (20 firms) stated in 1995 that they were companies without subsidiaries. Four firms were head offices of companies with subsidiaries and one firm was a subsidiary. The 1995 KIBS sample consisted of 19 companies without subsidiaries, of 4 head offices of companies with subsidiaries on the Baden side. Both in Baden and Alsace, one firm was a subsidiary. Among Alsatian KIBS, there have been 7 companies without subsidiaries and 10 head offices of companies with subsidiaries.

Manufacturing SMEs of the 2004 sample had an average of 105.0 employees with a median of 41.5 persons. While Baden manufacturing SMEs have an average size of 108.8 persons (median: 40.0 employees), their Alsatian counterparts reported on average 101.3 employees (median: 43.0). These differences between mean value and median indicate some larger firms and a comparatively high share of smaller firms in the sample. 30.0 % of Baden and 43.5 % of Alsatian manufacturing sample firms reported a turnover of the last business year of less than € six million. On the other hand, about one fifth of the sample firms (25.0 % of the German and 21.7 % of the French sample firms) achieved more than € 30 million turnover in 2004.[278]

The sample KIBS are smaller, not only in terms of their number of employees, but also with respect to their turnover. Baden KIBS had on average 20.0 employees (median: 15.0) whereas in the Alsatian KIBS sample, three larger firms raised the mean value to 32.3 employees (median: 13.5). The sample KIBS reported an average turnover of € 2.8 million (median: € 1.4 million), this variable being comparable in both regions: in Baden, KIBS achieved an average turnover of € 2.9 million (median: € 1.4 million) while Alsatian KIBS reached € 2.7 million (median: € 1.3 million). 29.4 % of the Baden and 43.8 % of the Alsatian KIBS had a turnover of the latest business year of less than € 1 million.[279] 29.4 % of Baden and 31.3 % of Alsatian KIBS reported a turnover of more than € three million in the last business year. Concerning manufacting firms with less than 50 employees, the sub-samples of both regions are similar. The Alsatian subsample has a higher share of larger manufacturing and of small KIBS. With respect to firms' turnover, the Alsatian sub-sample has a higher share of manufacturing firms in

76.0 % of the Baden and 73.3 % of the Alsatian sample firms had the same respondents in both surveys.

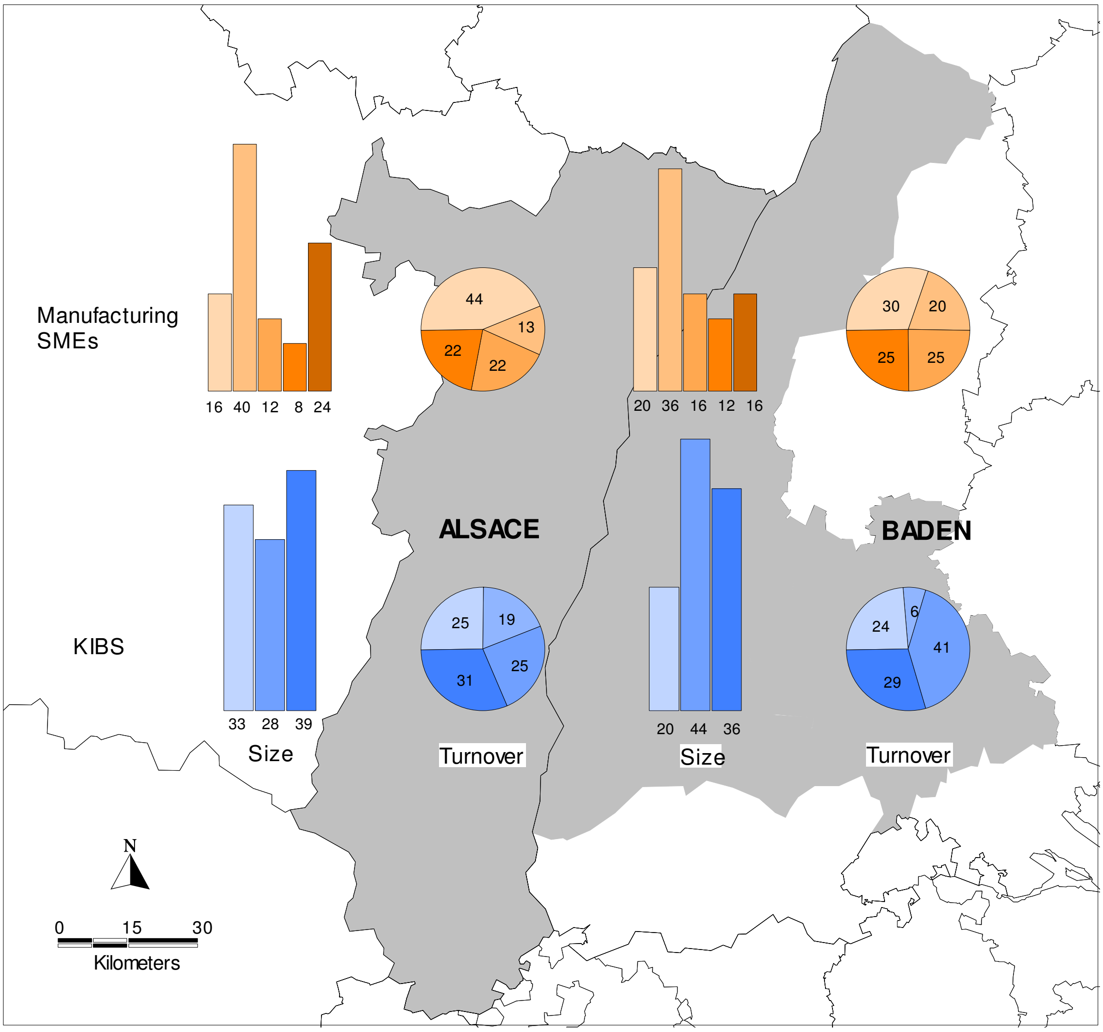
278 The turnover classes have been chosen with respect to the median values. The mean values are € 20.5 million for Baden and € 25.1 million for Alsatian firms (median values: € 13.8 million in Baden and € 13.0 million in Alsace); n_{Baden}: 20 and n_{Alsace}: 23.

279 However with an n being 17 in Baden and 16 in Alsace for this question.

the smallest class and a slightly more homogenous distribution of sample KIBS in the turnover classes than Baden sample firms.

Figure 12 shows the sample composition with respect to firm size – one of the criteria for selecting the firms – and turnover. Both manufacturing sub-samples show the highest shares of firms in the 20-49 employee size class. Both in Alsace and in Baden, more than 50 % of the manufacturing sample firms have less than 50 employees. Both regional sub-samples have about one forth of the firms in the turnover class with more than € 30 million. The regional KIBS sub-samples are less homogenous with respect to their size class, the Alsatian sub-sample having higher shares of smaller (less than 9 employees) and larger (20 and more employees) firms. In both regions, about one forth of the KIBS belong to the turnover class '< € 0.5 million', and about 30 % registered more than € 3 million.

Figure 12: Sample structure: Size and turnover (Share of firms in classes, %)



Software: MapInfo 4.1

Size classes manufacturing SMEs:
- < 20 employees
- 20 – 49 employees
- 50 – 99 employees
- 100 – 199 employees
- 200 – 499 employees

Size classes KIBS:
- < 9 employees
- 10 – 19 employees
- 20 and more employees

Turnover classes manufacturing SMEs:
- < € 6 million
- € 6.1 – 13 million
- € 13.1 – 30 million
- > € 30.1 million

Turnover classes KIBS:
- < € 0.5 million
- € 0.6 – 1 million
- € 1.1 – 3 million
- > € 3 million

5.2.2 Firms' innovation activities and innovation-related decisions

In order to get further insights into sample firms' innovation activities, interviewees have been asked to quantify the innovation-related activities of their firms: Number of employees and expenses devoted to research and development, besides information sources for innovation and the prospective development of R&D activities.

In Alsace, nearly half of the manufacturing sample firms (48.0 %) spend less than 1 % of their turnover for internal research and development activities (cf. figure 13).[280] Only one of the 25 firms reports a share of more than 8 % of its turnover for innovation preparing work and can thus be classified as "high-tech"-firm. In Baden, seven sample firms (28.0 %) can be classified as high-tech and a further 32.0 % as "medium-tech", i.e. spending between 3.5 and 8 % of their turnover for R&D. On the contrary, three firms (12.0 %) belong to the group of firms that report R&D expenses below 1 % of their turnover. On the whole, 3.1 % of the turnover of manufacturing sample firms of both regions has been spent for R&D on average of the preceding three years (median: 3.0 %). The Baden average is 5.0 % (median: 5.0, the Alsatian mean 1.7 % (median: 1.5 %).[281]

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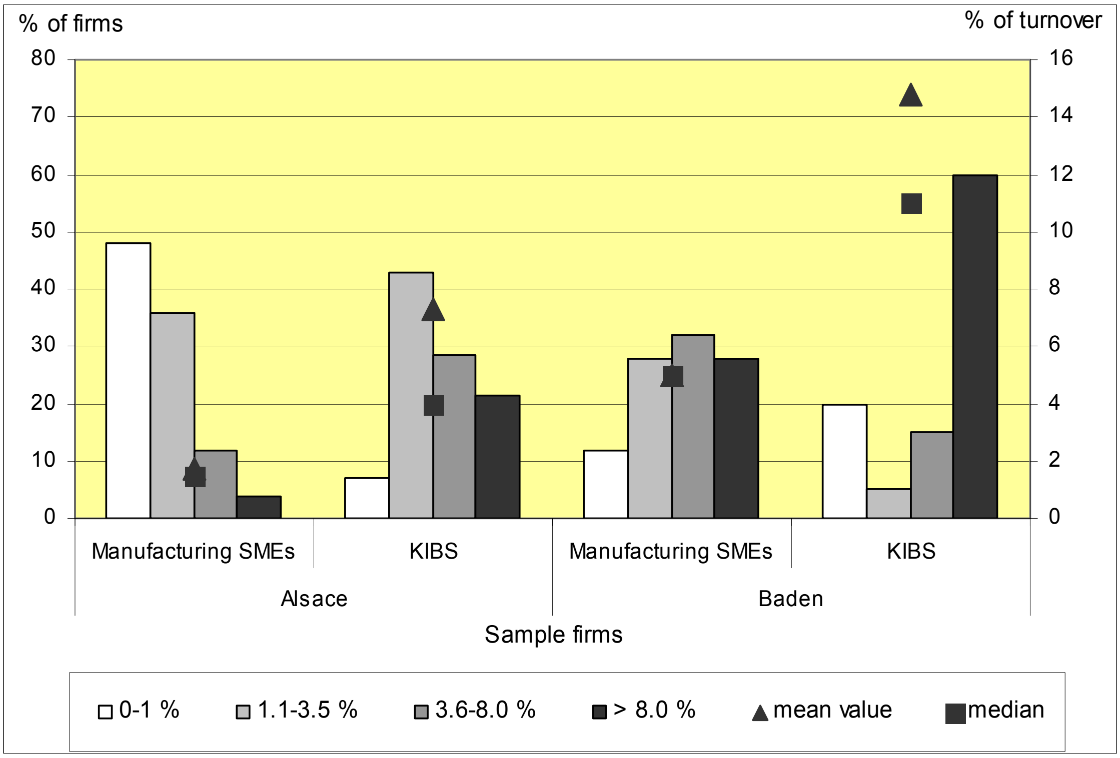
280 Asked as average of the preceding three years.

281 The mean values are understood as averages of the sample firms' turnover spent for R&D, thus referring to the number of firms which could figure both their turnover of the last year and the share of their turnover spent for innovation related activities (average of the preceding three years). 20 Baden and 23 Alsatian firms belong to this group.

Figure 13: Sample firms' expenses for research and development (% of turnover, in classes)



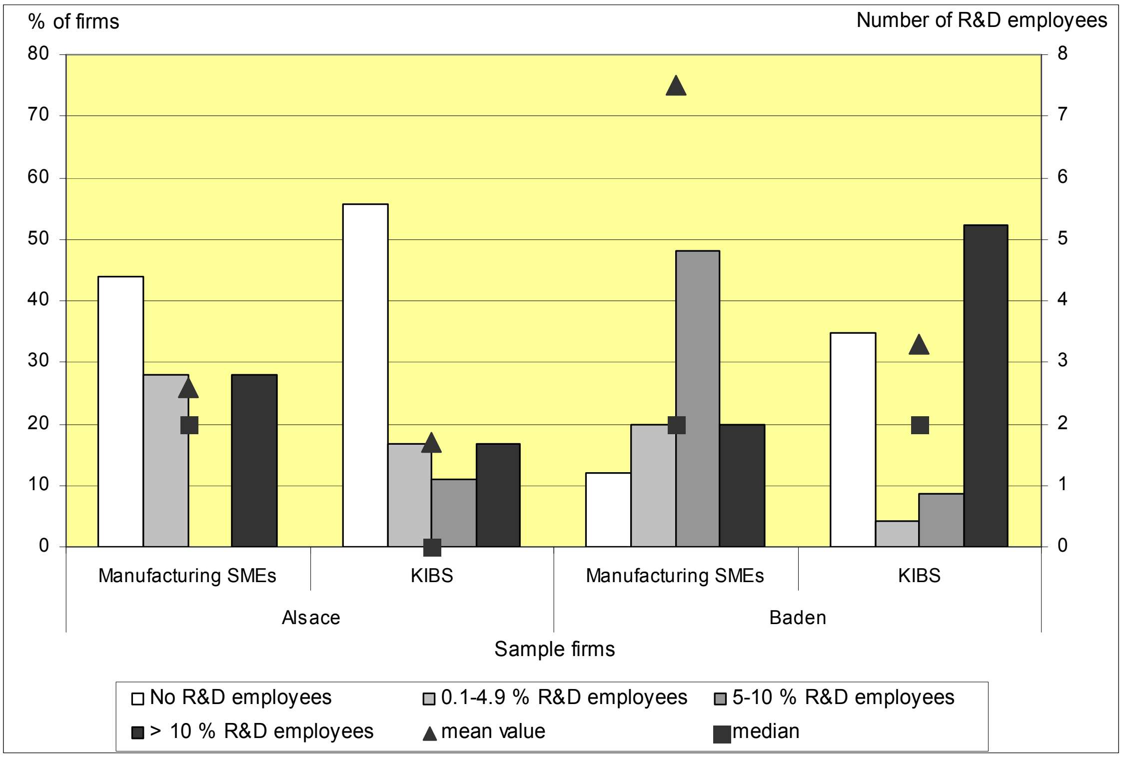
7.1 % of Alsatian and 20.0 % of Baden firms belong to the sample KIBS group spending less than 1 % of their turnover for innovation preparing projects.[282] 28.6 % of the Alsatian KIBS belong to the "medium-tech" group with between 3.5 and 8 % of their turnover spent for innovation preparing activities. In Baden, 15.0 % of the sample KIBS can be classified into this group. On average, sample KIBS firms spend 11.5 % of their turnover for innovation activities (median: 8.0 %).[283] A closer look at the details reveals differences between Baden and Alsace KIBS: While in the former sub-sample, 14.8 % of the turnover has on average been spent for R&D (median: 11.0 %), the respective figure for Alsace is 7.3 % (median: 4.0 %). This is also mirrored by the share of KIBS

282 However, only 20 Baden and 14 Alsatian sample KIBS could give either figures concerning the share of innovation preparing expenses from the turnover, or figures concerning the absolute values of turnover and R&D expenses.

283 This result has to be interpreted carefully because only 27 firms (14 Baden and 13 Alsace firms) provided figures concerning their innovation-related spending and their turnover. This is due to the fact that the terms 'innovation' and especially 'R&D' are still not as common as in manufacturing firms (see above). Thus, many respondents reported difficulties or the impossibility to numeralise R&D employees and/or R&D spending. Additionally, some firm representatives did not figure the turnover of their firms.

with more than 8 % of their turnover devoted to innovation preparing projects: The Baden sample contains 60.0 % of such "high-tech firms", the Alsace sample 21.4 %.

Figure 14: Sample firms' shares of R&D employees (% of employees, in classes)



Eighteen of the 41 sample KIBS representatives reported no R&D employees in 2004; two firms could not answer this question. On average, sample KIBS have 2.6 persons devoted to innovation-related tasks (median 1 person). The respective results vary in the sample regions: In Baden, the sample firms – with an average size of 20.0 persons; median 15 persons - have on average 3.3 (median: 2) R&D employees. With an average of 32.3 employees (median: 13.5 persons), Alsatian KIBS however have less persons employed for research and development activities: The mean value is 1.7, the median 0.0 persons (cf. figure 14). The comparison between the two regions and the respective mean and median values indicate that knowledge creation within the firm seems to be of lower importance for a part of Alsatian KIBS. At least the amount of R&D employees and related spending reveal such an assumption.[284]

Among Baden sample KIBS, 52.2 % have more than 10 % of their employees devoted to innovation related tasks – and on the other side of the spectrum, 34.8 % of the firms

284 Indeed, some firms reported during the interview that innovation is (currently) not an important issue for them.

do not have any R&D employees. In Alsace, 55.6 % of the sample KIBS did not mention anyone of their employees working on research and development projects. 16.7 % of the firms have less than 5 and more than 10 % of their staff working on R&D while 11.1 % lay in the group 5-10 % R&D employees. Concerning manufacturing sample firms, figure 14 shows that the share of firms with more than 10 % of R&D employees is higher in Alsace than in Baden. On the other side of the spectrum, among the Alsatian manufacturing sample firms, a high amount of firms has less than 5 % of their employees occupied with knowledge generation within the firm. In Baden, nearly 50 % of the manufacturing sample firms have between 5 and 10% R&D employees. At large, the mean values for R&D employees are 2.6 persons (median: 2 employees) in Alsace, and 7.5 persons in Baden (median: 2 employees), pointing at a few sample firms with comparatively high R&D employee figures. This corresponds to 2.6 % R&D employees in Alsace and 6.9 % of all employees in Baden.

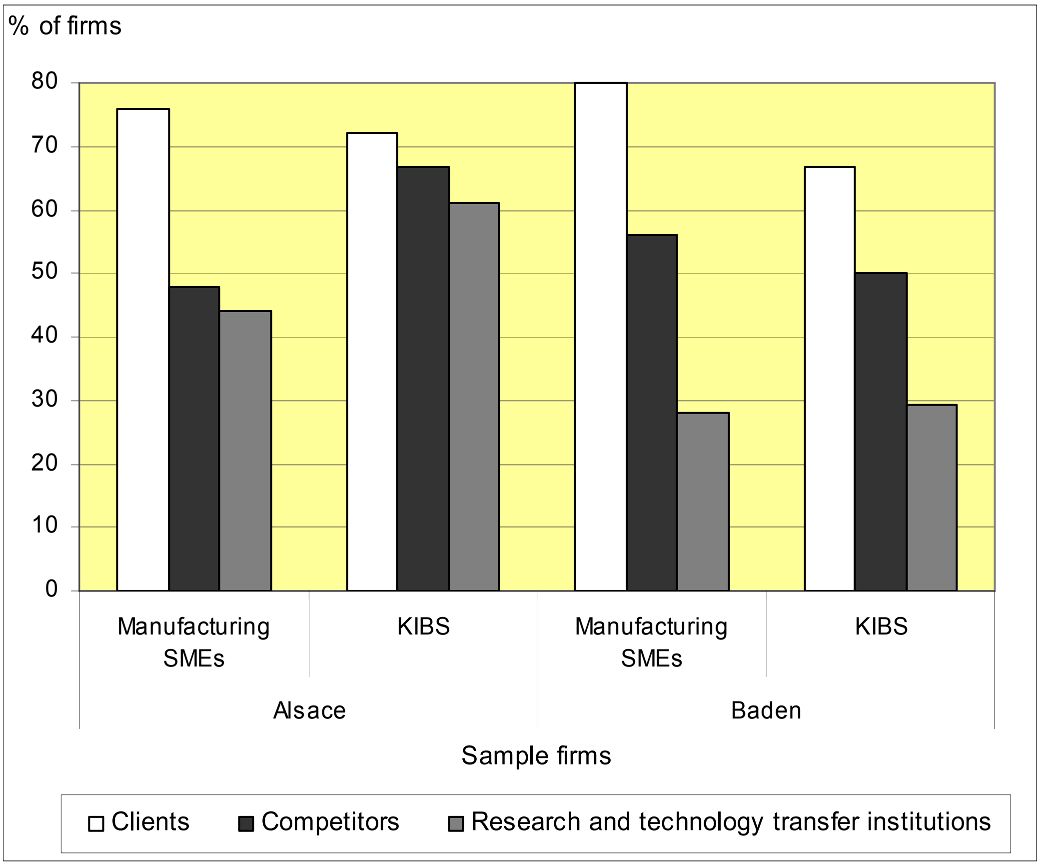
Besides innovation input in terms of expenses and qualified manpower, the interviews contained questions about the main sources for innovation-related information and their territorial acquisition. Figure 15 presents the share of positive answers concerning the anticipated importance of clients, competitors and research and technology. In both regions, manufacturing sample firms rate their clients as very important information sources for innovation (80.0 % in Baden, 76.0 % in Alsace). Clients are also considered as crucial information source for innovation for knowledge-intensive business service firms, both in Alsace and in Baden: 66.7 % of the German and 72.2 % of the French sample firms approved this question. The impact of competitors is less pronounced for the manufacturing sample firms: 56.0 % of the Baden and 48.0 % of the Alsatian manufacturing sample firms approved this question. Competitors are rated higher as innovation related information source for Alsatian KIBS than for their German counterparts (66.7 % versus 50.0 % of the Baden firms gave a "yes"-answer). Equally, research and technology seems to play a more important role on the French side, as well for manufacturing as for business service sample firms (44.0 % of "yes"-responses versus 28.0 % in Baden concerning the former and 61.1 % versus 29.9 % for KIBS). Complementing the overview of innovation-related information sources, firms have been given the opportunity to name further information sources: 28 Baden and 18 Alsatian answers have been given by the manufacturing firms.[285] Whereas suppliers and staff propositions have been mentioned four times and professional literature and the market each three times in Alsace,[286] Baden manufacturing firms have a clear

285 Multiple responses were possible.

286 One naming: Fairs, exhibitions; contacts to universities and other higher education institutions; media; miscellaneous.

focus on exhibitions and fairs (seven responses), followed by the professional literature (four mentions), contacts to universities and other higher education institutions as well as market observation/ internal searches/ evaluation of technical opportunities (three responses each).[287]

Figure 15: Sample firms' information sources for innovation: Importance of clients, competitors and research and technology transfer institutions (Share of firms with positive answers)



Being asked to name further information sources, KIBS on the French side rate the professional literature as most important (five mentions), followed by contacts to universities or other higher education institutions as well as the media (three mentions each), fairs, exhibitions; other firms; the market and international partners (one naming each). Baden firms clearly point at the Internet, an information source which was mentioned nine times. The professional literature obtains the second ranking (five mentions), followed by market observation/ internal searches/ evaluation of technical oppor-

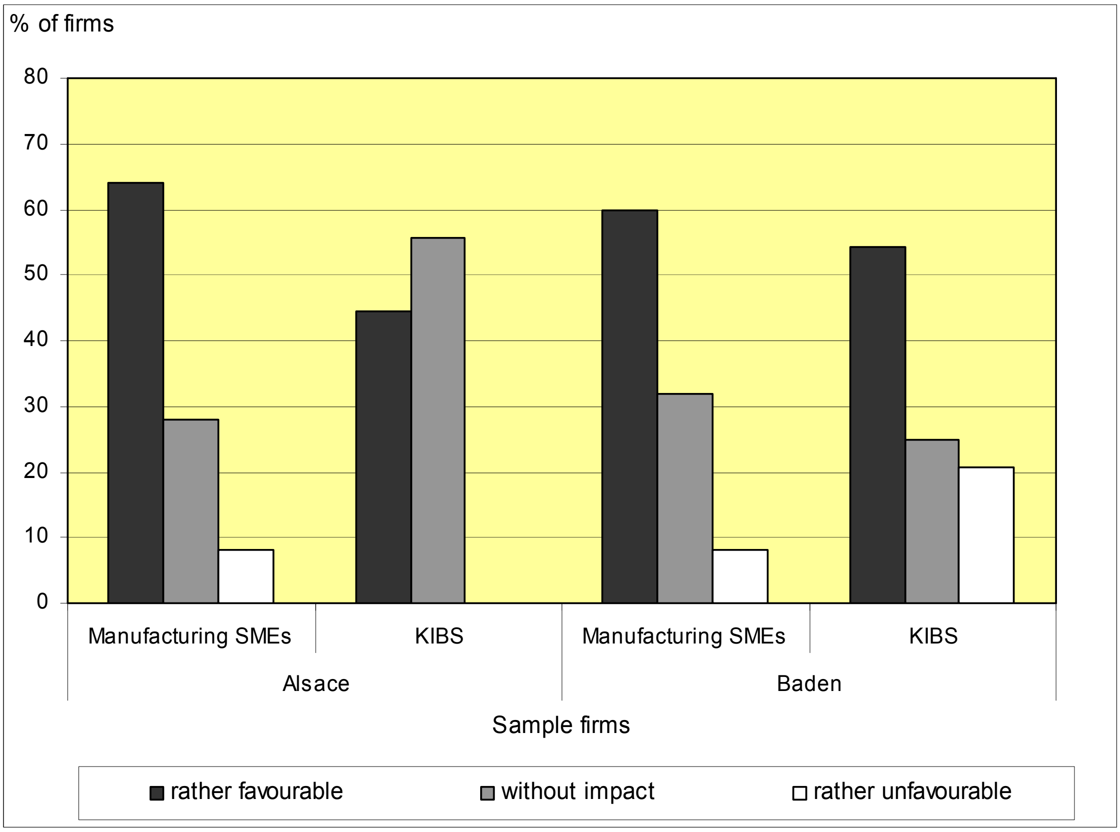
287 Two namings: suppliers; associations. One naming: Development projects with partners; proposition of staff; seminars, conferences; other firms; Internet; market; miscellaneous.

tunities; contacts to universities or other higher education institutions; benchmarking (two mentions each), and fairs, exhibitions; seminars, conferences; propositions of the staff; international partners and patent searches (one mention each). Further miscellaneous mentions have been given twice.

5.2.3 Perception of the respective environments: Assessment of human capital, innovation climate and research and technology

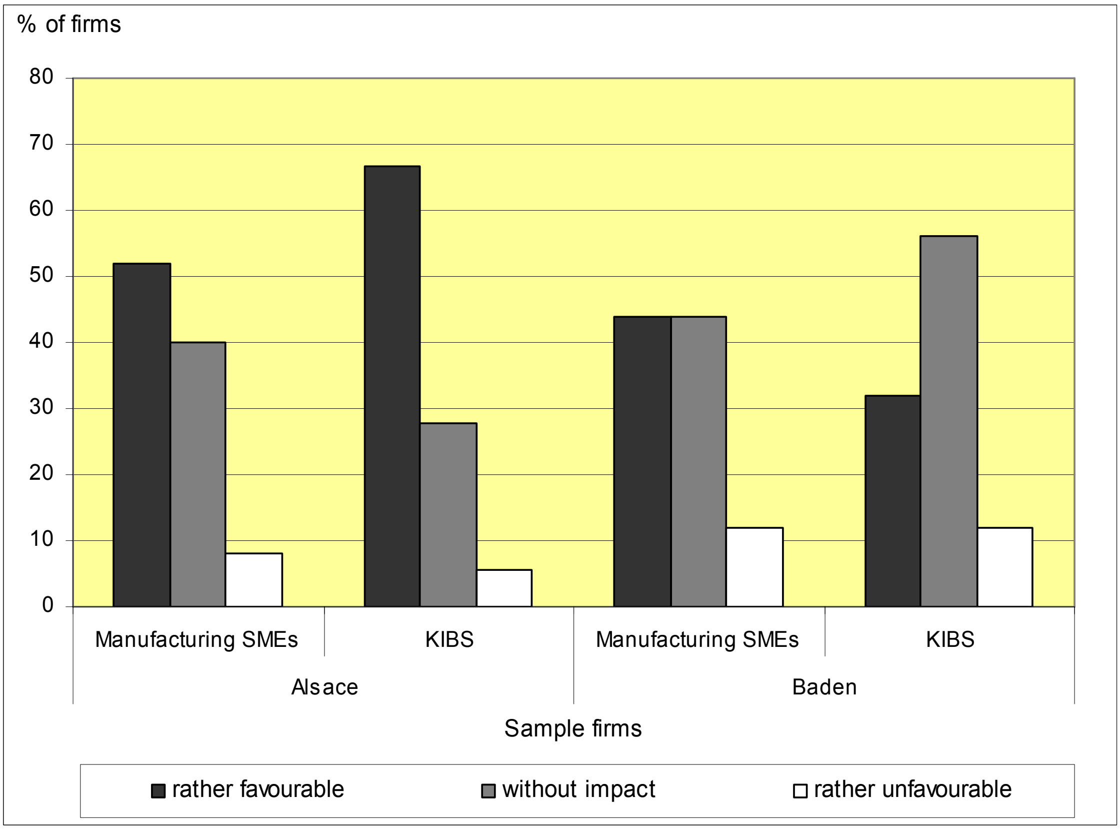
Concerning the assessed impact of the workforce, of research and technology and the innovation climate on firm-internal innovation activities in the respective regions, the analysis shows that both Baden manufacturing and knowledge-intensive business service sample firms assess the impact of regional human capital rather favourable for their internal innovation activities, even though the share of manufacturing firms (60.0 %) is slightly higher than among the respective KIBS (54.2 %, cf. figure 16). In Alsace, there is a higher divergence between manufacturing and business service firms: While 64.0 % of the manufacturing SMEs rank the impact of human capital rather positively, 44.4 % of the KIBS have such a positive attitude. This difference could be the result of (i) either a less adequate provision of qualified staff for Alsatian KIBS or (ii) due to a different role of innovation projects and innovation preparing activities in business service firms in general, or (iii) the external acquisition of human capital. The share of Alsatian sample KIBS whose representatives are of the opinion that the regionally available human capital has no impact on their innovation activities (55.6 %) combined with the fact that not one KIBS answered "rather unfavourable" indicates that either the regional human capital is not considered as crucial for KIBS' innovation projects, or that innovation is not rated important for a part of Alsatian KIBS. The first option could indicate that innovation related knowledge is not generated within the KIBS, but acquired from external sources. This would explain the rather moderate innovation input in terms of expenses and specialised employees (cf. section 5.2.2), as well as the indistinct answers concerning the regional workforce. Moreover, the high ratings of research institutes and technology transfer agencies as innovation-related information source (cf. figure 15) would be a further indication for an external acquisition of knowledge and technology.

Figure 16: Assessment of the impact of the regional workforce on internal innovation activities in the sample firms (Share of firms)



The share of manufacturing firms that reported no important impact or a rather unfavourable one of the human capital on internal innovation activities is quite similar in both regions (without impact: 32.0 % in Baden, 28.0 % in Alsace; rather unfavourable impact: 8.0 % in both regions). 20.8 % of the Baden KIBS indicate a rather unfavourable impact of the regional human capital on their innovation activities, but contrary to the Alsace case with its high share of "without impact" answers, this result of Baden KIBS may rather indicate a lack of specific qualifications of the regional human capital supply for a part of the sample KIBS.

Figure 17: Assessment of the impact of regional research and technology supply on internal innovation activities in the sample firms (Share of firms)



Concerning the impact of external research and technology supply on sample firms' internal innovation activities, figure 17 shows a quite different picture between the Baden and Alsace sub-samples with the exception of the answer category "rather unfavourable" which is comparatively low for both firm types in both regions. Generally, Alsatian firms of both types rate the supply of research and technology in their home region rather positively whereas in Baden, the "without impact" group has a high weight, particularly in the KIBS sub-sample (56.0 % for KIBS vs. 44.0 % for manufacturing SMEs). The same amount of Baden manufacturing SMEs gave a positive assessment concerning the impact of research and technology while 32.0 % of the sample KIBS had a similar impression. In Alsace, positive perceptions prevail: 52.0 % of manufacturing and 66.7 % of KIBS firms assessed the impact of regional research and technology rather favourably for their internal innovation activities. This indicates a comparatively high degree of contentment of Alsatian firms with the research and technology supply of their region with respect to their internal innovation activities, especially for the sample KIBS, and supports the assumption that Alsatian sample KIBS rather rely on knowledge generated in regional research institutes or transferred through technology transfer agencies than creating it internally.[288]

Figure 18: Assessment of the regional innovation climate in the sample firms (Share of firms)

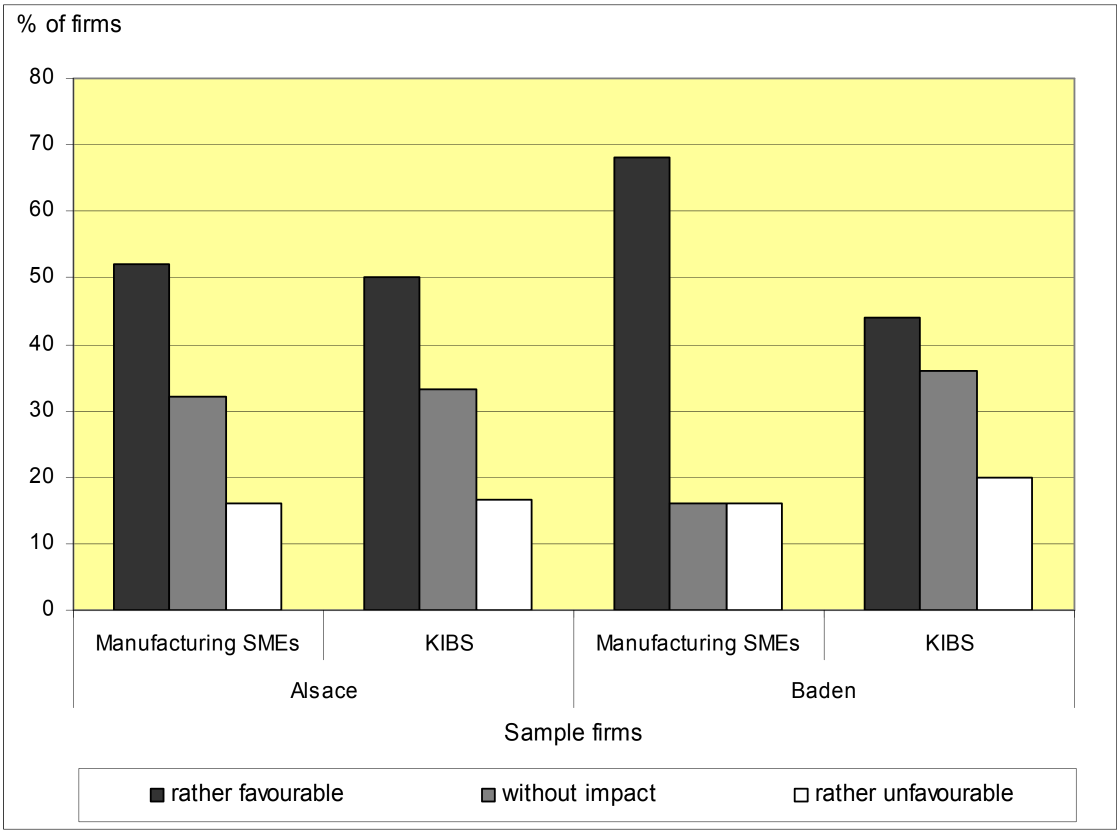


Figure 18 illustrates how the sample firms perceive the general innovation climate in their respective region. This is a central question in the regional perception and innovation context since the innovation climate is assumed to represent the sum of innovation supporting factors as well as the innovation atmosphere in the region. A positive innovation climate can for instance be generated by an appropriate institutional structure for innovation support, and through official commitments to innovation, giving innovative firms a positive feedback and encouraging them in their efforts towards new inventions. As figure 18 shows, the assessments of manufacturing and business service firms in Alsace are very similar, showing the highest shares in the positive assessment fields

288 As table 9 shows, the sub-sample compositions in terms of activity types are very similar in Alsace and in Baden, so that perceptive differences are not ascribed to differences in the sample compositions. They are rather assumed to be rooted in the different innovation and perception modes.

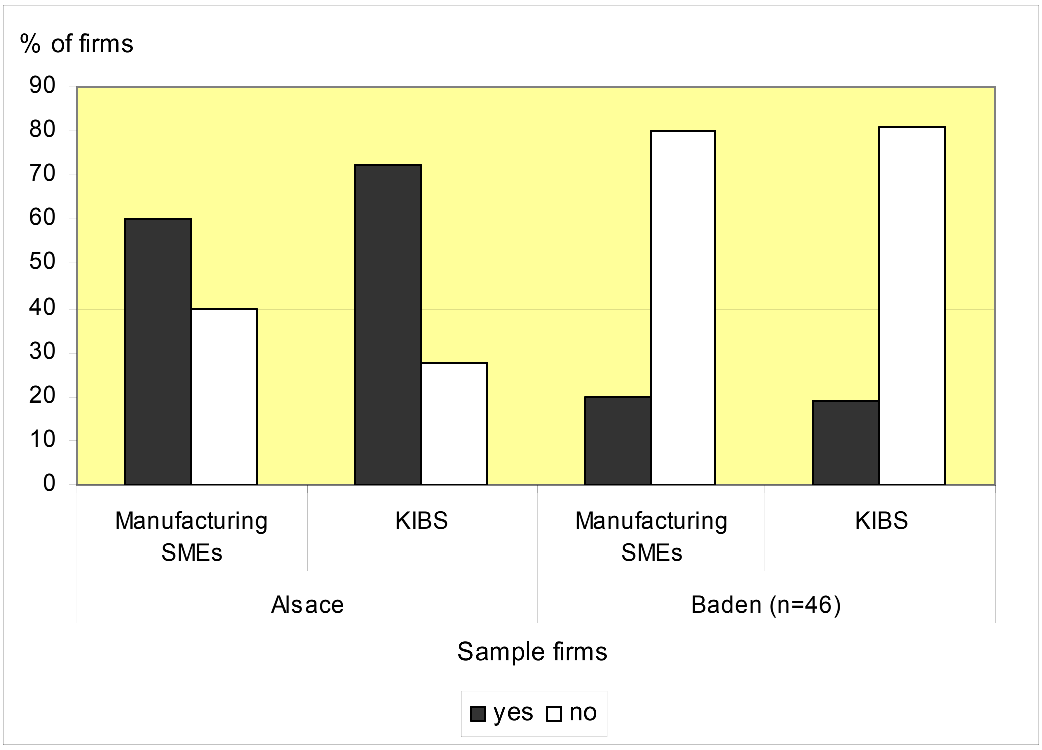
with levels around 50 % for both firm types. More than 30 % of Alsatian manufacturing and service SMEs gave a "no impact" answer whereas around 16 % in each subsample rated the impact of the innovation climate rather unfavourable. This indicates that the innovation climate in Alsace is rather stimulating for about half of the sample firms, while a considerable part of the firms had indistinct ("no impact") evaluations, pointing at a low importance of innovation-related questions for these firms.

In Baden, the results seem rather heterogeneous between the firms of the subsamples. In fact, in both firm types, positive assessments received the highest shares, but with a difference of 24 % (68.0 % of manufacturing SMEs and 44.0 % of the sample KIBS). In turn, a higher share of KIBS (36.0 % versus 16.0 % of manufacturing SMEs) reported that the Baden innovation climate had no impact on their internal innovation activities. In the "rather unfavourable" answer category, the assessments of the two firm types differ to a smaller degree (16.0 % for manufacturing and 20.0 % for service firms). This may permit the assumption that the aspects making up the innovation climate in Baden, are rather tailored to the manufacturing sample firms than to sample KIBS. Similar differences in the perception of both firm types are not visible in the Alsatian sample.

Summarising, the selected regional factors of innovation support are perceived and assessed differently by the two firm types and in the two regions. The regional workforce does not seem to be a highly crucial factor for Alsatian KIBS, since more than 50 % did not perceive an impact on their innovation projects. Innovation in Alsatian KIBS seems to be less based on internal efforts in knowledge creation, but to rely rather on external knowledge sources such as regional research institutes. The regional supply of a suitable workforce seems to be fairly good for Baden firms and Alsatian manufacturing SMEs. Research and technology is more positively perceived in Alsace (though better by KIBS than by manufacturing SMEs), but not rated important by a high share of Baden KIBS. The innovation climate is predominantly rated positively in Baden, but mainly by manufacturing SMEs.

In order to get deeper insight into the innovation-related perception of sample firms concerning their home regions as a whole, the questionnaire aimed at further details about the sources for information relevant to innovation. The interviewees have been asked if clients, competitors and research and technology transfer organisations as innovation-relevant information sources are mainly located within the respective home regions. Figure 19 shows the results of this question and highlights the differences between the surveyed regions. 60.0 % (manufacturing SMEs) and 72.2 % (KIBS) firms of the Alsatian sample claimed their region as main source for innovation-related information supply whereas 20.0 % of Baden manufacturing and 19.0 % of Baden KIBS approved this. Alsatian firms seem to be rather intraregionally oriented whereas Baden firms use intra- and interregional information sources for their innovation activities. This seems to indicate that Alsatian firms are generally more embedded in their region whereas Baden manufacturing sample firms mainly use extra-regional information sources though respondents often mentioned that many of their innovation partners are located in Baden.[289]

Figure 19: Importance of the regions for providing innovation-related information in the sample firms (Share of firms)



A further, rather indirect indication concerning the regional perception and the general contentment of firms with the regional framework conditions for their operations may be gained when analysing the question "Do you plan to relocate your firms or parts of your activities?" A negative answer indicates that firms do not have an urgent motivation to leave their home region or that the respective transaction costs are estimated too high. 24.0 % of Baden and 20.0 % of Alsatian manufacturing SMEs and 12.0 % of Baden

289 The question was "Are the innovation-related information sources mainly located in your region?", i.e. a negative answer does not exclude regional information sources. On the contrary, many Baden respondents claimed Baden information sources as important, but as not being the main source of information. Thus, it can be concluded that Baden firms generally use as well intra- as interregional sources for their innovations.

KIBS (none of the Alsatian KIBS) answered to plan a relocation though some firms reported already performed relocations or foreign affiliates. This shows that most of the sample firms seem to perceive their environment as conducive to their activities and therefore do not plan to leave their home region.

5.2.4 Firms' expectations for their future development

The sample firms have been asked to anticipate the development of their R&D activities, their size and their turnover during the subsequent three years. Being asked about the expected evolution of their R&D activities, Baden manufacturing sample firms are more optimistic than Alsatian ones: Whereas on the German side, 52.0 % of the manufacturing sample firms count on an increase, 48.0 % think that their R&D activities remain more or less constant. In Alsace, 20.0 % of the sample firms are of the opinion that their R&D efforts will be reinforced while the majority of 80.0 % expect constant R&D inputs. None of the interviewees expects decreasing R&D efforts within their firms. Thus, when also considering the lower level of R&D (cf. section 5.2.2), it becomes obvious that Alsatian firms seem to consider the firm-internal generation of knowledge through research and development as less significant than their Baden counterparts. Comparably to the manufacturing sample firms, none of the KIBS representatives foresees a decrease in its research and development activities. The majority of the sample firms on both sides of the Rhine estimate constant innovation preparing activities (77.8 % of the Alsatian and 62.5 % of the Baden firms) whereas 37.5 % of Baden sample KIBS and 22.2 % of their Alsatian counterparts think that their internal innovation preparing tasks are going to be reinforced during the following three years.

Manufacturing sample firms located in Baden and Alsace show differences concerning their assessments of the future development of their size: In Alsace, the highest share of firms (84.0 %) anticipates their size staying constant. Among Baden sample firms, 44.0 % reported a similar expected development. 32.0 % Baden interviewees were of the opinion that the size of their firms will be increasing during the succeeding three years, but 24.0 % expect a decrease in size (Alsace: both increasing and decreasing categories contain 8.0 % of the responses). In the case these predictions hold true, the results indicate a more dynamic manufacturing firm structure in Baden while the majority of Alsatian manufacturing sample firms anticipate stability. KIBS of both regions estimate their size development more optimistic than their manufacturing counterparts. Although the majority of sample firms expects their size to remain constant during the following three years (61.1 % of Alsatian and 52.2 % of Baden KIBS), about one third (33.3 % in Alsace and 39.1 % in Baden) of the sample KIBS representatives are of the opinion that their firms will be growing in size during the following years. However, it has to be kept in mind that their size development refers to lower reference values, since sample KIBS are generally smaller than their manufacturing counterparts. Generally, the creation of workplaces seems to be rather attributed to KIBS than to manufacturing sample firms; a contrast between the manufacturing and KIBS sub-samples which is much more pronounced in Alsace than in Baden.

Concerning the expected development of manufacturing firms' turnover during the following three years, the sample firms seem quite optimistic: 52.0 % of Alsatian interviewees count with an increase in turnover and 48.0 % expect it to remain stable. In Baden, 64.0 % think of increasing, 28.0 % of stable and 8.0 % of decreasing turnover figures. Thus, turnover expectations are more optimistic than their size expectations, especially in Alsatian firms. 50.0 % of the Alsatian sample KIBS evaluate a positive turnover development, 50.0 % think their turnover will remain unchanged. The share of Baden KIBS with an optimistic view on their turnover development is nearly equal (48.0 %) whereas 36.0 % of the firms estimate their turnover to remain stable. 16.0 % of the sample firms are less optimistic and think they cannot hold their current turnover.

Figure 20: Sample firms' expectations for their development in the succeeding three years: R&D activities, size and turnover (Share of firms with positive anticipations)

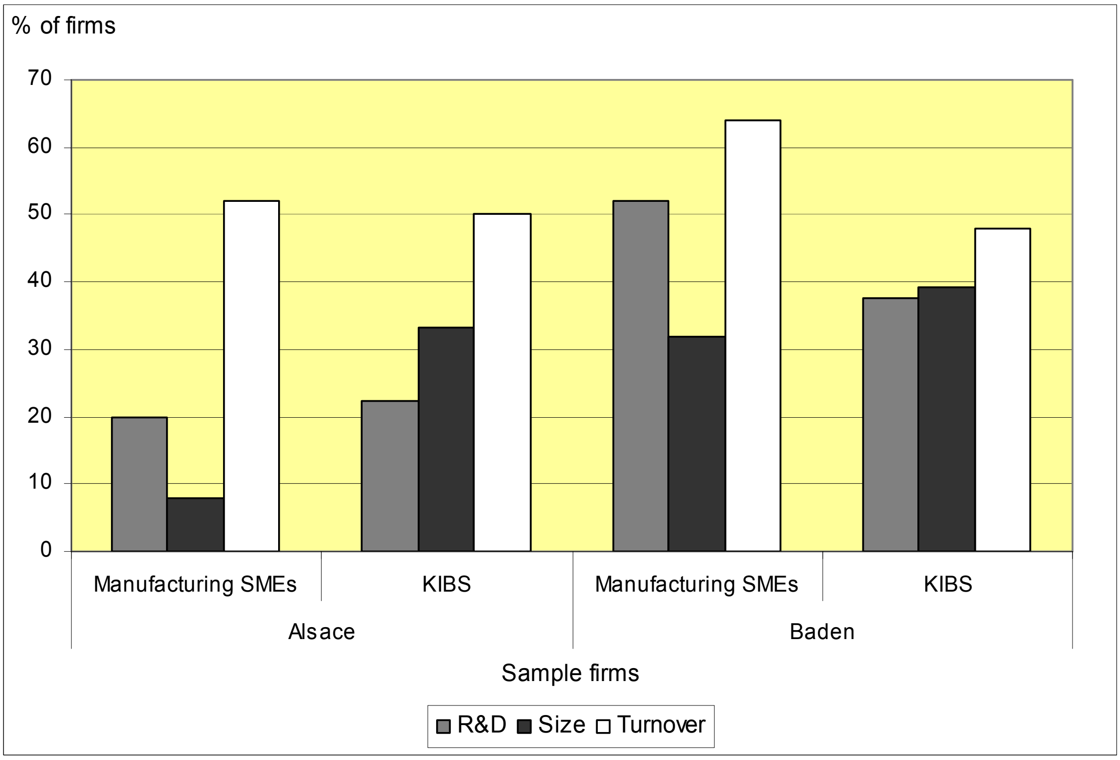


Figure 20 summarises the respective shares of sample firms expecting an increase of their R&D activities, their size and their turnover during the following three years. It clearly shows that the highest share of the sample firms expect an increase in turnover, particularly among Baden manufacturing sample firms. However, this positive anticipation does not seem to be necessarily coupled with an increase in employment, especially among Alsatian manufacturing sample firms. Increasing research and development activities are expected particularly among Baden sample firm representatives, rating even higher than an increase in employment by Baden manufacturing sample firms. Alsatian sample firms generally seem to be more cautious concerning their future development anticipations, expecting at first place positive evolutions of their turnover. Alsatian sample KIBS rather expect growth than their manufacturing counterparts, and more than 20 % of them also believe that the research and development activities of their firms will be augmented.

If the assumption of the theory of reasoned action and of planned behaviour is followed in the sense that (behavioural) intentions are an important predictor for behavioural action (cf. page 62ff.), the positive anticipations of turnover evolution of the sample firm representatives lead to the assumption that a high share of the sample firm representatives is foreseeing a successful (in economic terms) further evolution of their activities. About one third of the Baden sample firms and the Alsatian sample KIBS expect to create employment. An increase of research and development activities is especially expected by Baden sample firms, whereas about one fifth of the Alsatian sample firm representatives expect their firms to increase internal R&D activities.

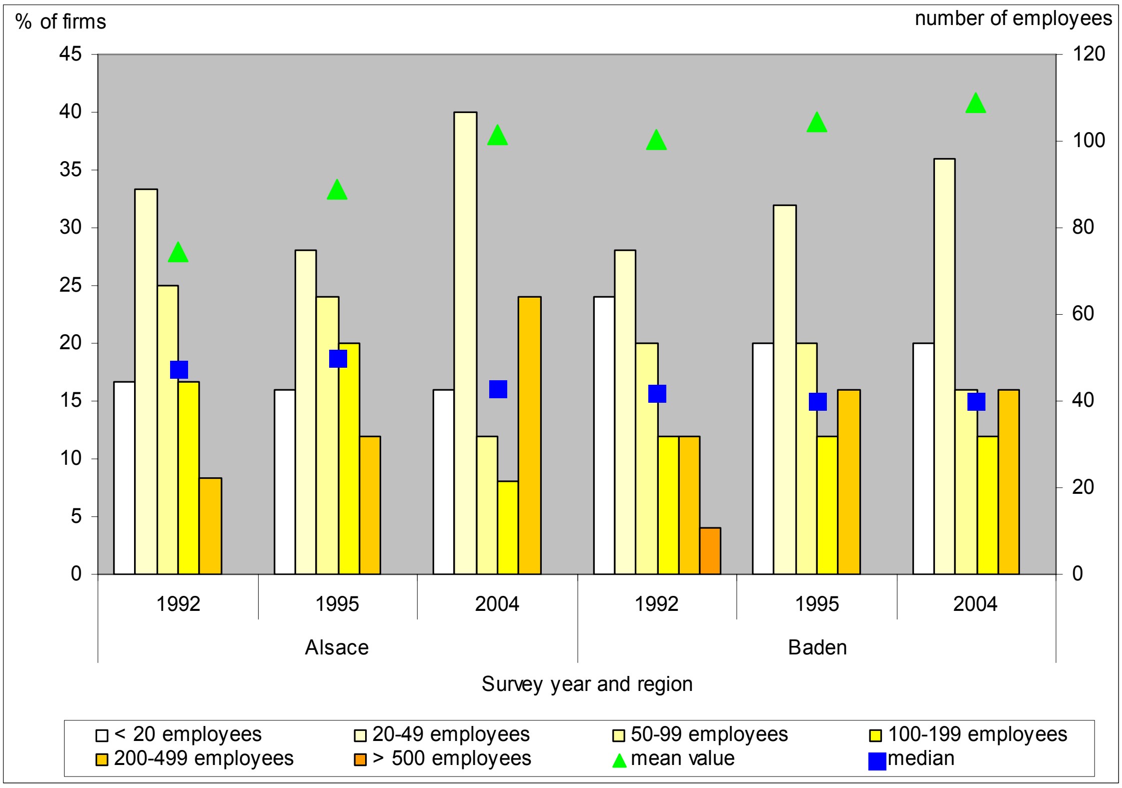
5.2.5 Firms' evolution between the mid-1990s and mid-2000s

The great advantage of this investigation is its repetitive character which at least allows to approximate trends in firms' evolution and their perceptions between the mid-1990s and the mid-2000s. Since in 1995, the firms were asked to give some hints as to some of their characteristics three years earlier, it is even possible to trace back the development of sample firms from the beginning of the 1990s to the mid 2000s, however with a larger time span between the second and the third point in time of the analysis.

5.2.5.1 Size

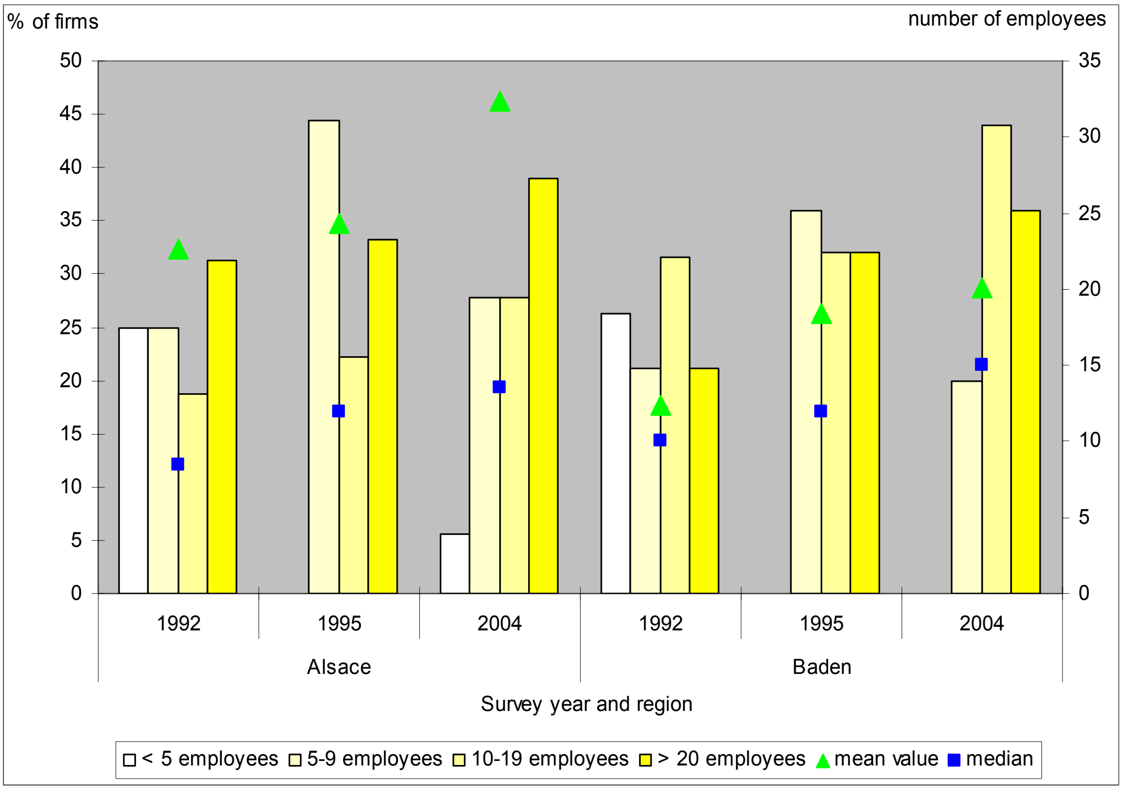
On average, manufacturing sample firms increased their size from 87.5 employees in 1992 to 96.6 in 1995 and to 105.0 persons in 2004. The median values show a slightly different picture, reaching from 45.0 in 1992 to 50.0 in 1995 and to 41.5 in 2004. This indicates that the sample contains some comparatively large firms which could increase their size during the analysed time period whereas a high share of firms kept their size constant or (partly) decreased it. Baden firms grew on average from 100.2 employees in 1992 to 104.3 persons in 1995 and 108.8 employees in 2004 (median values: 42.0, 40.0 and 40.0 employees). In Alsace, manufacturing sample firms could increase their size between 1992 and 1995 (mean values: 74.3 and 89.0 employees, median values 47.5 and 50.0 persons). Between 1995 and 2004, the mean value also increased to 101.3 employees, but with a decreasing median (43.0). This shows a successful size development of one or a few larger firms, but a less successful evolution of the smaller ones. Figure 21 shows the distribution of sample firms in size classes at the three surveyed points in time (the size distribution in 1995 being the base for the 2004 sample selection) as well as mean and median values (right axis). In both regions, the highest share of manufacturing sample firms is in all three survey years the 20-49 employee class. Also in both regions, the mean values are increasing in time, but with higher rates (and lower reference values) in Alsace. However, this increasing tendency is not reflected in the median values since between 1995 and 2004, the number of employees of the median firm have been comparatively stable (Baden) or slightly decreasing (Alsace). The high average growth rate of Alsatian firms is mirrored by a comparatively high and increasing share of firms in the 200-499 employee size class. On the other hand, the share of firms in the size class with between 20 and 49 employees enhanced too between 1995 and 2004 with a constant share of firms in the smallest size class with less than 20 employees. This confirms that the Alsatian manufacturing sample contains some large firms, but also a high share of smaller ones. In Baden, the manufacturing firm sample size structure between 1995 and 2004 remained relatively constant which is also mirrored by the nearly constant median value. The size class of between 20 and 49 employees gained some firms and on the other hand, the share of firms in the 50-99 size class decreased.

Figure 21: Size structure of manufacturing sample firms between 1992 and 2004 (share of firms in classes)



Between 1992 and 1995, 66.7 % of the Alsatian and 60.0 % of the Baden manufacturing sample firms could increase their size; 56.0 % of German and 41.7 % of the French firms grew more than 10 %. On the other hand, 32.0 % of Baden and 25.0 % of Alsatian firms decreased in size during this time period, 16.0 % of the German and 8.3 % of the French firms with more than 10 %. In 1995, 44.0 % of the Baden manufacturing sample firms estimated an increase of their size during the following three years and also 44.0 % thought their size would remain stable. Alsatian firms were less optimistic: 33.3 % anticipated an increase in their size and 66.7 % believed their size to stay constant. However, these anticipations cannot directly be contrasted to the real development in 2004, since firms in 1995 have been asked to give their anticipations for the following three years.

Figure 22: Size structure of knowledge-intensive business service sample firms between 1992 and 2004 (share of firms in classes)



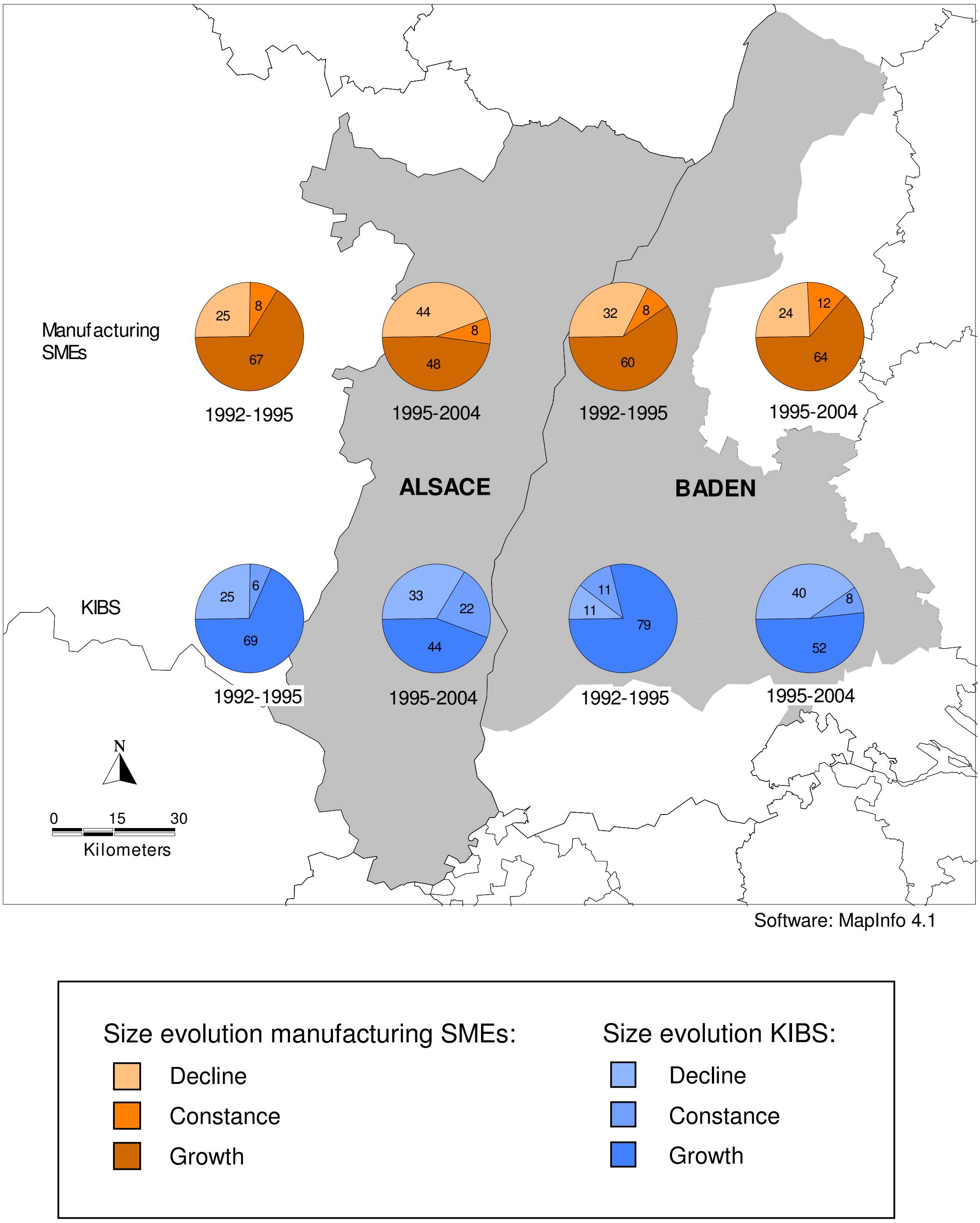
As figure 22 shows, sample KIBS tended to grow continually in the analysed time period. Having on average 17.0 employees in 1992 (median: 10.0), the figure increased to 20.9 (median: 12.0) in 1995 and to 25.2 (median: 15.0) in 2004.[290] The average values of Alsatian sample KIBS have been higher than those in Baden, with 22.6 employees in 1992, 24.3 in 1995, and 32.3 persons in 2004. Baden sample KIBS reported on average 12.3 employees in 1992, 18.4 in 1995 and 20.0 in 2004. However, the median values are not as diverging as the mean values: 8.5, 12 and 13.5 person in Alsace and 10.0, 12.0 and 15.0 persons in Baden. The share of firms in the class with more than 20 employees is constantly increasing between the survey dates in both regions. It seems that KIBS' firm sizes had an active evolution within the survey period, showing a continuous increase in size. This can be observed in both surveyed regions. Obviously, the Alsatian sample contains a few quite large firms besides a considerable share of smaller ones. This is reflected by the high distance between mean and median values, the mean values exceeding the Baden ones.

290 Five Baden and two Alsatian firms have been founded between 1992 and 1995.

As figure 23 shows, 78.9 % of Baden and 68.8 % of Alsatian sample KIBS could increase their size between 1992 and 1995; all the Baden growing ones and 50.0 % of the Alsatian growing firms had a growth rate of more than 10 %. 10.5 % of Baden and 25.0 % of Alsatian firms decreased in size during this time period. Between 1995 and 2004, 52.0 % of Baden and 44.4 % of Alsatian sample KIBS could increase their size, again with a high share of firms growing more than 10 %: 48.0 % of Baden and 38.9 % of Alsatian sample KIBS. On the other hand, 36.0 % of Baden and 27.8 % of Alsatian sample KIBS lost more than 10 % of their employees between 1995 and 2004. In both regions, about one third of the firms (39.1 % of Baden and 33.3 % of Alsatian KIBS) expect an increase in their size structure during the period 2005-2008. The majority of interviewees (52.2 % of Baden and 61.1 % of Alsatian firms) expect their size to remain constant. In Alsace, the less positive development of firm sizes in the second half of the survey period may mirror the changing general conditions in the whole region: Less attraction of foreign direct investment might have led to less favourable economic conditions for manufacturing and also for business service firms.

The size evolution of both Alsatian firm types between 1992 and 1995 is relatively similar, while in Baden, the share of sample firms showing a positive size evolution during this period is higher among KIBS than among manufacturing sample firms. Between 1995 and 2004, the share of growing firms has been higher among manufacturing sample firms than among KIBS in both regions, however more pronounced in Baden. The comparison of manufacturing and KIBS sample firms show that KIBS had a continuous increase in their size structure (both mean and median values), whereas the manufacturing sample firms indicate few larger and growing firms while the median remained constant or slightly decreased (however on higher size levels than the sample KIBS). Comparing sample firms' anticipations for their size evolutions in the subsequent three years, it becomes obvious that among Alsatian firms, KIBS have more positive anticipations concerning their future development with higher shares of positive expectations and lower shares of decreasing size expectations. Baden KIBS sample firms also tend to have more positive anticipations (particularly lower shares of firms with decreasing size expectations) than their manufacturing counterparts. However, these contrasting trends are less pronounced than in Alsace.

Figure 23: Size evolution of the sample firms between 1995 and 2004



5.2.5.2 Turnover

Measured in terms of turnover development, the manufacturing sample firms of both regions seem to have undergone a quite positive development between the mid-1990s and the mid-2000s: 57.1 % of Alsatian and 78.3 % of Baden firms could increase their turnover during the time period considered whereas 38.1 % of the French sample firms and 8.7 % of their German counterparts showed a decrease in their turnover development during this time span (cf. figure 24).[291] Sample firms also see their future rather optimistic: 52.0 % of Alsatian and 64.0 % of Baden firms expect their turnover to increase in the subsequent three years while only 2 Baden firms (8.0 %) and none of the Alsatian ones expect a decrease of their turnover (cf. also section 5.2.4). The remaining share of firms (48.0 % of Alsatian and 28.0 % of Baden ones) expect their turnover to remain stable in the near future.

The KIBS sample firms results also show positive turnover developments between the two survey dates: 92.3 % of Alsatian and 63.2 % of Baden firms increased their turnover. 31.6 % of Baden firms reported a lower turnover in 2004 compared to 1995 while none of the Alsatian firms showed smaller figures than in 1995.[292] The anticipated turnover development during the following three years is equally optimistic: 50.0 % of Alsatian and 48.0 % of Baden sample KIBS expect a further increase of their turnover while 50.0 % of the French and 36.0 % of the German KIBS expect their turnover to remain stable. Four Baden firms (16.0 %) are sceptic concerning their future turnover expecting a decrease of the respective figures. The 2004 turnover characteristics of the manufacturing sample firms have comparable median, though higher mean values in Alsace. This result is slightly diverging from the 1995 values that effected higher mean and median values for Alsatian manufacturing sample firms. The KIBS sub-samples of both regions show similar characteristics; their mean and median values being quite similar in 2004 (cf. table 10).

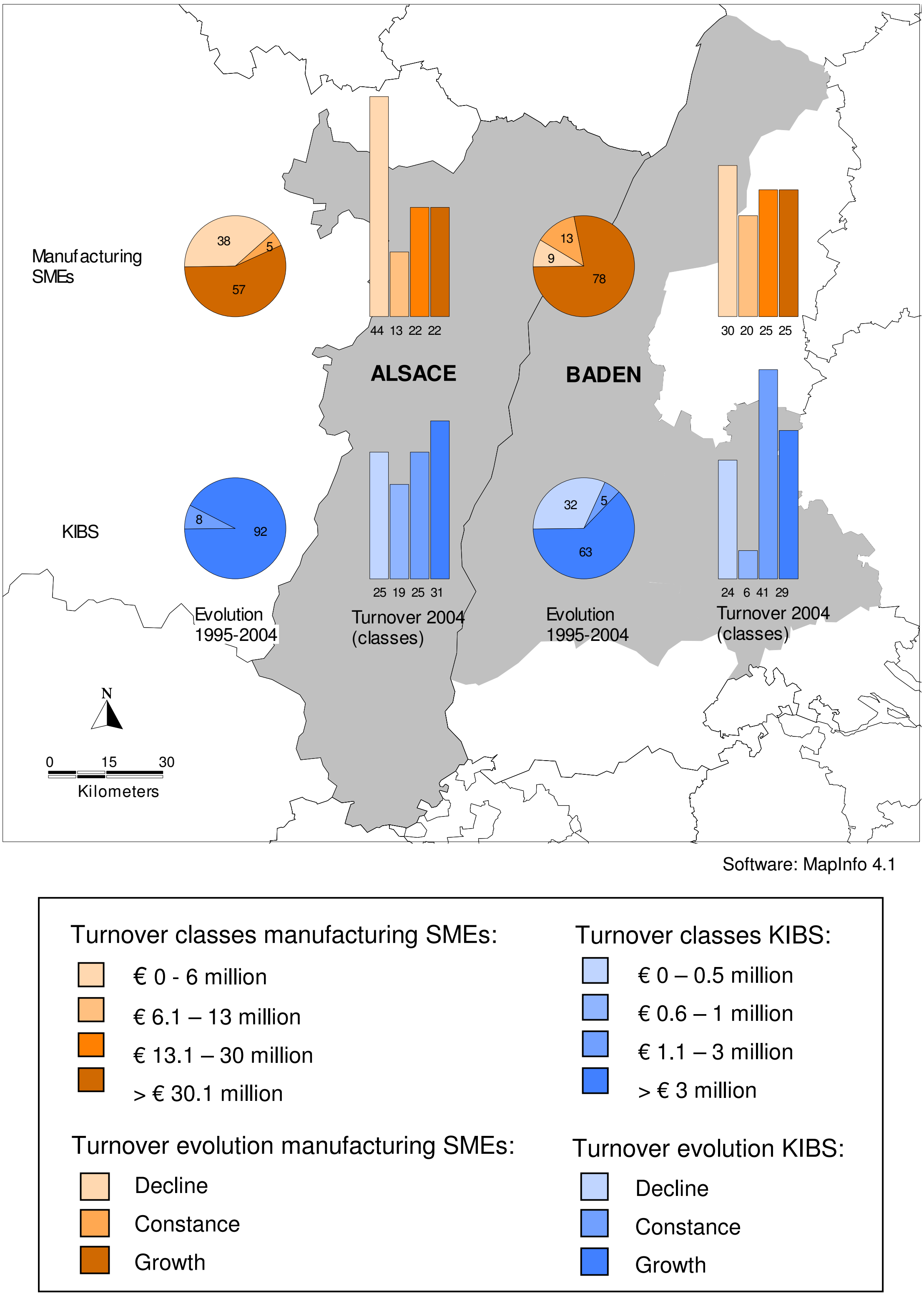
291 A turnover evolution of between -5 % and + 5 % during this time span is considered as "constant" (or inflation caused).

292 It has to be mentioned however that only 19 Baden and 13 Alsatian firm representatives gave the respective figures in both surveys.

Table 10: Mean and median values of sample firms' turnover in 1995 and 2004 (million €)

Region	Firm type	Parameter	Year	
			1995	2004
Alsace	**Manufacturing SMEs**	Mean value	15.2	25.1
		Median	5.5	13.0
	KIBS	Mean value	1.2	2.7
		Median	0.6	1.3
Baden	**Manufacturing SMEs**	Mean value	11.8	20.5
		Median	4.9	13.8
	KIBS	Mean value	1.5	2.9
		Median	1.0	1.4
Total	**Manufacturing SMEs**	Mean value	13.4	23.0
		Median	5.3	13.0
	KIBS	Mean value	1.4	2.8
		Median	0.6	1.4

Figure 24: Turnover 2004 (in classes) and turnover evolution of the sample firms between 1995 and 2004 (Share of firms, %)



5.2.5.3 R&D employees

The share of employees working on innovation preparing research and development tasks has increased during the time span considered (cf. table 11).[293] The mean value of the whole manufacturing firm sample slightly increased from 1992 to 1995 and then showed a higher upward trend during the second (longer) time period analysed in this investigation. The median lying below the mean value indicates one or a few firms with comparatively high shares of R&D employees. Comparing the two regions, it becomes obvious that there are only minor changes observed in Alsatian manufacturing sample firms and that the level of R&D employee shares is higher in Baden. This is also due to the fact that the share of firms without R&D employees is higher in Alsace than in Baden. In 2004 for instance, three Baden firms responded to have no R&D employees compared to 11 Alsatian firms.[294]

Table 11: Share of R&D employees of manufacturing sample firms in 1992, 1995 and 2004 (% of total number of employees)

Region	Parameter	Year 1992	Year 1995	Year 2004
Alsace	Mean value	2.5 %	2.3 %	2.6 %
	Median	1.0 %	1.2 %	1.3 %
Baden	Mean value	4.1 %	4.8 %	6.9 %
	Median	3.5 %	3.9 %	6.7 %
Total	Mean value	3.5 %	3.7 %	4.8 %
	Median	2.4 %	2.8 %	3.9 %

Concerning the evolution of the share of their R&D employees between 1995 and 2004, 70.8 % of Alsatian manufacturing sample firms at least maintained their rates. From these, 41.7 % increased their share of R&D employees in relation to the total number of employees. In Baden, 54.2 % of the sample firms increased their shares of R&D employees, but only one firm (4.2 %) kept its staff in this field stable. 41.7 % of Baden and 29.2 % of Alsatian manufacturing sample firms decreased their share of R&D employees during this time period. This latter indicates a more positive picture of Alsatian firms but on a lower level as mean and median values show (cf. table 11).

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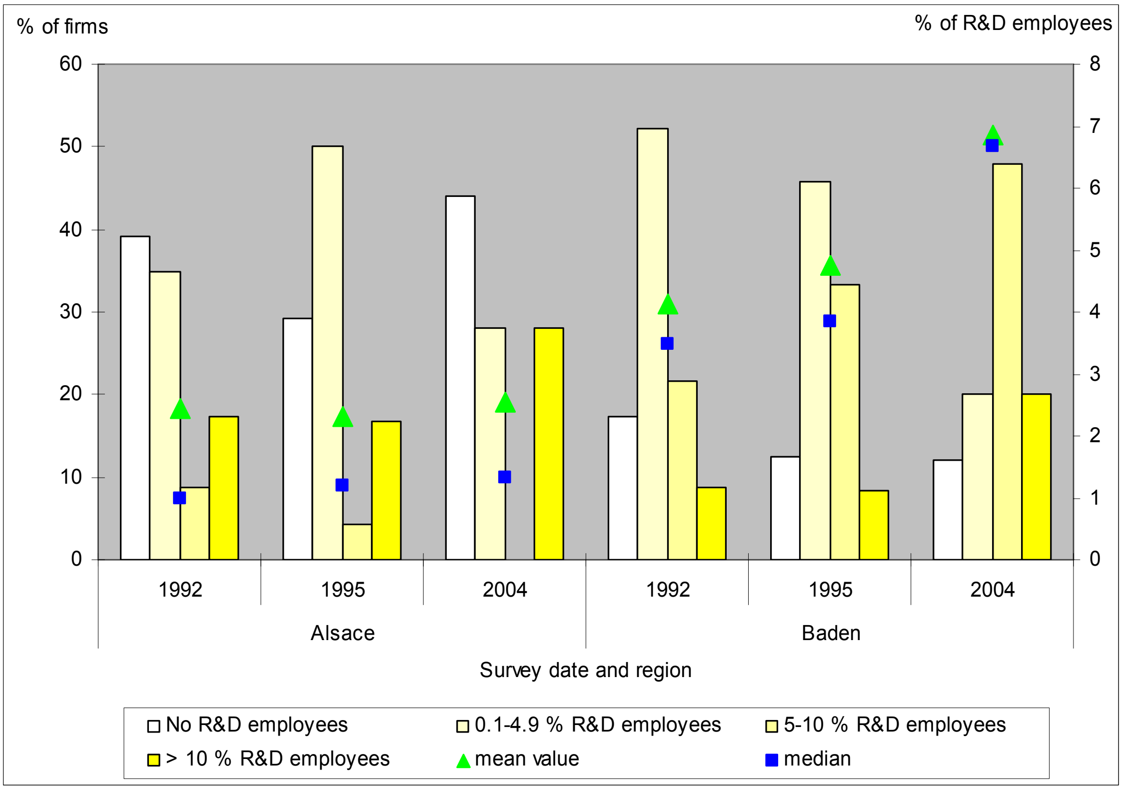
293 Calculated on the base of the absolute values for the whole sub-samples.

294 However, this difference was less pronounced at the beginning and in the mid-1990s: For 1992, four Baden and nine Alsatian firms and in 1995, three German and seven French ones did not figure R&D employees.

Figure 25 shows the share of employees devoted to research and development tasks in manufacturing sample firms in 1992 (estimations ex-post given in the 1995 survey), 1995 and in 2004. Results confirm indications of table 11 with comparatively higher shares of Alsatian firms without R&D employees at all three points in time, but on the other end of the spectrum higher shares of firms with more than 10 % R&D employees. This points at a part of the sample firms with a high share of R&D employees in Alsace with the majority of firms without or with low shares of R&D employees.

Figure 25: R&D employees of manufacturing sample firms in 1992, 1995 and 2004 (Share of firms in classes)



In Baden, an increasing share of firms with more than 5 % of their employees being concerned with research and development tasks can be observed when looking at the results for the three points in time. This is reflected by the increasing mean and median values which nearly converge in 2004. The mean and median values for the Alsatian manufacturing firm sample reflect the fact that the sub-sample contains a certain number of firms with high shares of R&D employees, and a considerable number of firms with less than 5 % of their staff working on research and development.

An intertemporal presentation of R&D employee characteristics is only possible for the manufacturing sample firms. Knowledge-intensive business service firms of the sample have not been asked in the 1995 survey to figure the share of employees devoted to innovation preparing research and development tasks (cf. section 5.2.2 concerning their R&D characteristics in 2004).

5.2.5.4 R&D expenses

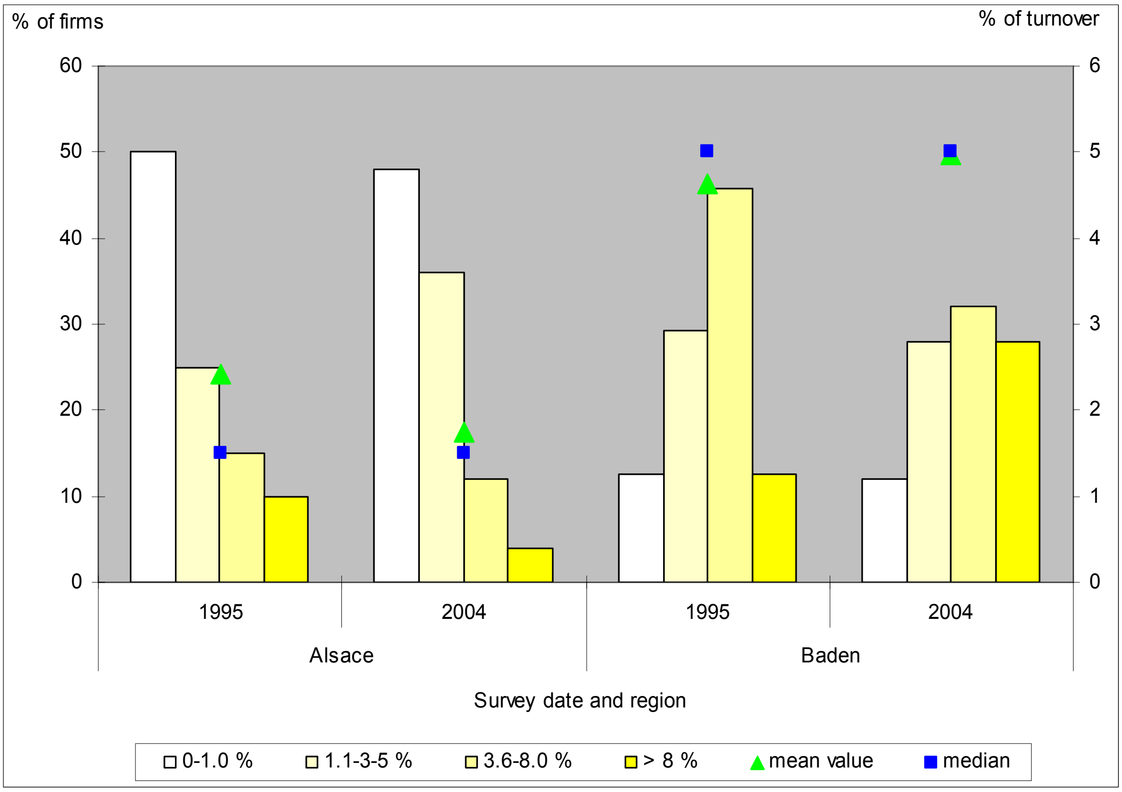
Firms have been asked in 1995 and in 2004 to figure the share of their turnover spent for internal research and development activities. The results for the manufacturing sample firms are presented in table 12. It becomes obvious that there are no changes in the median values between 1995 and 2004 in both regions. Furthermore, there are no large differences between mean and median values. Again, the Alsatian values are below the Baden ones, indicating less importance of innovation projects on the base of internally generated knowledge for the French sample firms.

Table 12: Manufacturing sample firms' shares of turnover spent for R&D activities in 1995 and 2004

Region	**Parameter**	**Year** 1995	2004
Alsace	Mean value	2.4 %	1.7 %
	Median	1.5 %	1.5 %
Baden	Mean value	4.6 %	5.0 %
	Median	5.0 %	5.0 %
Total	Mean value	3.5 %	3.1 %
	Median	3.0 %	3.0 %

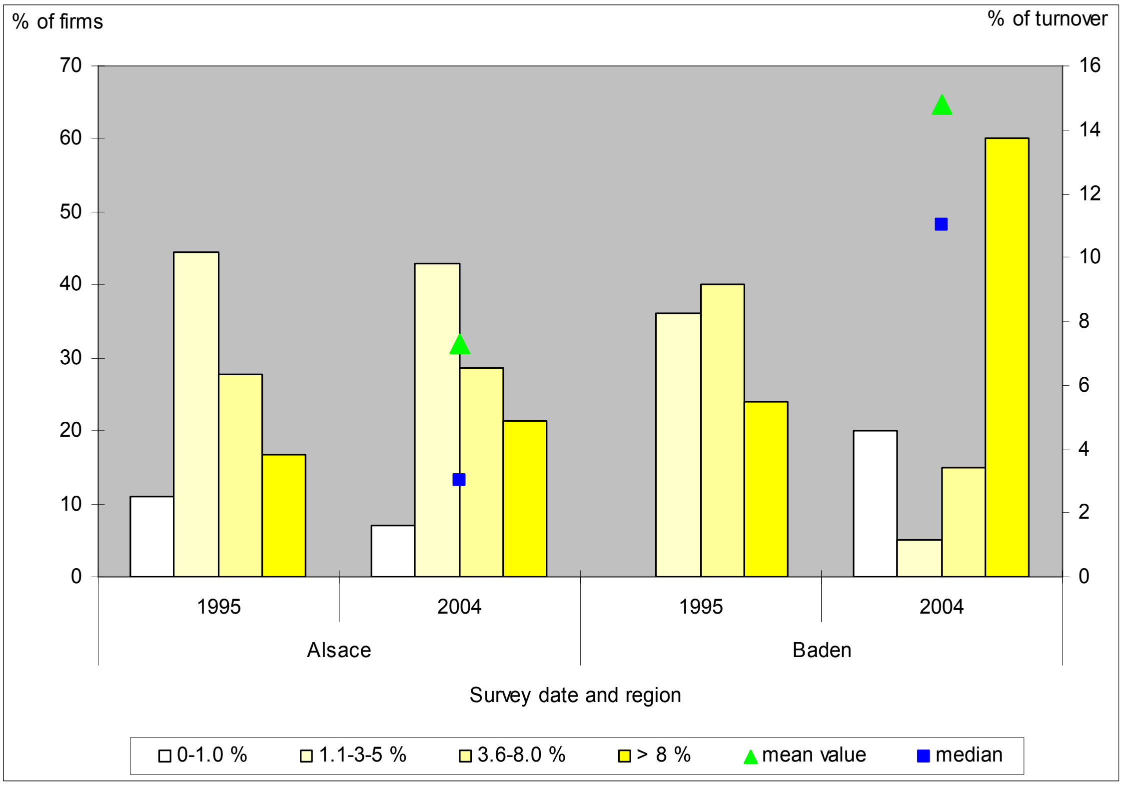
54.2 % of Baden and 20.0 % of Alsatian firms increased their share of turnover devoted to R&D activities during this (nearly) ten-year-period whereas 33.3 % of Baden and 50.0 % of Alsatian firms reported lower shares in 2004 than in 1995. This is (partly) mirrored in the distribution of firms according to the share of turnover they spent for R&D activities in classes (cf. figure 26). In Baden, the share of "low tech" firms did not change during the time span considered. But the share of "medium tech" firms (3.6 – 8 % of their turnover spent for R&D) decreased for the benefit of the "high tech" class, i.e. firms with more than 8 % of their turnover devoted to R&D projects. In Alsace, a different development of the sample firms took place: When comparing the results of both surveys, it becomes obvious that the 1.1 – 3.5 % class gained in importance.

Figure 26: R&D expenses of the manufacturing sample firms in 1995 and 2004 (% of turnover, share of firms in classes)



Sample KIBS have been asked in 1995 to figure their innovation related expenses (average during past three years) as share of their turnover in the following classes: 0-1 %, 1-3.5 %, 3.5-8 % and more than 8 % (cf. figure 27). According to this rating, 16.7 % of Alsatian and 24.0 % of Baden sample KIBS belonged to the "high-tech" category whereas 40.0 % of Baden and 27.8 % of Alsatian firms spent between 3.5 and 8 % of their turnover for innovation related projects and can therefore be classified as "medium-tech" firms. Compared to these results, the share of "high-tech" KIBS slightly increased in 2004 in Alsace, while it increased to 60.0 % in Baden. The distribution pattern of firms in R&D expense classes remained comparatively stable in Alsace, but changed heavily in Baden: The higher importance of the "high tech" category was accompanied by decreased firm shares in the "medium" and low tech classes. Being asked in 2004 to assess the anticipated development of their innovation related activities during the following three years, none of the sample firms was pessimistic. Indeed, most of the firms expect their R&D activities to remain stable: 77.8 % of the Alsatian and 62.5 % of Baden firms were of this opinion (cf. also section 5.2.4).

Figure 27: Innovation expenses of the knowledge-intensive business service sample firms in 1995 and 2004 (% of turnover, share of firms in classes)



5.2.5.5 Innovation-related information sources

Clients being a crucial source for innovation-related information in 2004 (cf. section 5.2.2), these findings were even more pronounced in the 1995 manufacturing firm sample,[295] at least for product innovations: 96.0 % of Baden and 92.0 % of Alsatian manufacturing sample firms rated clients as important or very important information source for product innovations. Concerning process innovations, the importance of clients as information source was rated less important by manufacturing sample firms; 36.4 % of Baden and 50.0 % of Alsatian firms answered "important" or "very important"

295 In the 1995 survey, the respective question has been asked slightly differently: The sources of innovation-related information and their importance were asked and seven different categories - clients/ customers, suppliers, competitors, research institutes, engineering and planning agencies, fairs/ exhibitions, professional literature - have been presented to the firm representatives for evaluation, divided into their relevance for product and for process innovations (manufacturing sample firms). Possible answer categories have been "not important", "important" or "very important". For KIBS, the question concerning innovation-related information was combined with the geographical origin of these sources, divided into the region, the rest of the country and foreign locations.

(cf. table 13).[296] Competitors proved to be an important or very important innovation related information source in 1995, but more so for Alsatian (80.0 %) than for Baden (64.0 %) firms' product innovations. When looking at the 2004 results, competitors seem to have lost in importance during the time span considered. Concerning research institutions,[297] Baden firms' assessments remained stable: 28.0 % of the firms in 1995 concerning product innovation (process innovation: 36.3 %) and also 28.0 % in 2004 considered this information source relevant. In Alsace, on the contrary, manufacturing sample firms' assessments changed: While in 1995, 16.0 % of the sample firms considered information from research institutions relevant for their (product) innovation projects, and 36.3 % for process innovations, the share of firms with a positive evaluation increased to 44.0 % in 2004. In 1995, manufacturing sample firms in both regions rated research institutes more relevant for their process than their product innovations, thus indicating the research orientation of new processes.

Table 13: Evaluation of the importance of clients, competitors and research institutes as innovation-related information source in manufacturing sample firms 1995 and 2004 (share of answers, %)

Type of innovation	**Year**	**1995**				**2004**		
		Product innovation		**Process innovation**				
Source of information / Region	**Evaluation**	**Alsace**	**Baden**	**Alsace**	**Baden**	**Evaluation**	**Alsace**	**Baden**
Clients	**not important**	8.0	4.0	50.0	63.6	**not important**	24.0	20.0
	important	28.0	28.0	27.3	22.7	**important**	76.0	80.0
	very important	64.0	68.0	22.7	13.6			
Competitors	**not important**	20.0	36.0	45.5	54.5	**not important**	52.0	44.0
	important	48.0	52.0	36.4	45.5	**important**	48.0	56.0
	very important	32.0	12.0	18.2	0			
Research institutes	**not important**	84.0	72.0	63.6	63.6	**not important**	56.0	72.0
	important	12.0	24.0	31.8	31.8	**important**	44.0	28.0
	very important	4.0	4.0	4.5	4.5			

296 In 2004, 80.0 % of Baden and 76.0 % of Alsatian manufacturing sample firms had approved this question.

297 Research and technology transfer institutions in 2004.

KIBS' assessments of innovation-related information sources differed between Baden and Alsatian sample firms.[298] While industrial clients prove to be the most important information source for Baden KIBS in both surveys, competitors were attributed the highest importance by Alsatian KIBS in 1995 (94.5 %). In Alsace, the general assessment concerning the importance of the surveyed information sources changed between 1995 and 2004: In 2004, clients were rated as crucial by the highest share of firms (72.2 %), followed by competitors (66.7 %) and research and technology transfer (61.1 %). In conformity with the results for manufacturing firms, the evaluation of research and technology transfer increased markedly between 1995 and 2004: While research institutes were less important as information source for Alsatian sample KIBS, 61.1 % of the firms gave a positive answer in 2004 (cf. table 14).

Table 14: Evaluation of the importance of clients, competitors and research institutes as innovation-related information source in knowledge-intensive business service sample firms 1995 and 2004 (Share of answers, %)

Region / Information source	Year	1995		2004	
		Alsace	**Baden**	**Alsace**	**Baden**
(Industrial) clients	**not important**	44.4	32.0	27.8	33.3
	important	55.6	68.0	72.2	66.7
Competitors	**not important**	5.6	44.0	33.3	50.0
	important	94.5	56.0	66.7	50.0
Research (and technology transfer)	**not important**	94.4	72.0	38.9	70.8
	important	5.6	28.0	61.1	29.2

5.2.5.6 Perceptions

Questions concerning the perception variables differed between the two points in time of the analysis. In 1995, firms have been asked to assess the framework conditions in their regions with respect to the performance of innovations. Several factors have been listed and firms could choose between "bad", "no impact" and "good". Among these factors were the availability of suitable manpower, the research supply, and the general

298 The KIBS questionnaire 1995 contained this question in a slightly different manner, in combining the question of innovation-related information sources with their location (see page 184). Thus, the "important" category in table 14 represents answers except "no impact", independently from the location of the information source.

innovation climate. In 2004, firm representatives have been asked again to assess the impact of these variables. In 1995, the "region" was supposed to be the district of the chamber of industry and commerce in Baden and in Alsace the *département*. The 2004 survey defined the region in a broader sense, referring to the locations of the sample firms, i.e. the surveyed regions as a whole.

Looking at manufacturing sample firms' assessments concerning the regionally available labour force, research and technology and the general innovation climate with respect to their innovation activities, it appears that firms modified their evaluations between the mid-1990s and mid-2000s (cf. figure 28). The comparatively high share of indistinct answers in 1995 in all categories[299] is now replaced by more positive assessments: Currently, 60.0 % of Baden and 64.0 % of Alsatian manufacturing sample firms (versus 24.0 % of Baden and 39.1 % of Alsatian firms in 1995) have a positive assessment considering the regional workforce. Many Baden sample firms for instance reported during the interview that a high share of their staff is from the region. Concerning research, the sample firms of the regional sub-samples differ in their assessments: While the share of Baden manufacturing firms for which research has no important impact on innovation is still comparatively high (48.0 % in 1995 and 44.0 % in 2004), the share of respondents with a positive perception of research (and technology) has been 28.0 % in 1995 and 44.0 % in 2004. Alsatian manufacturing sample firms nowadays have a different view of research than in the mid-1990s: Whereas research institutes have been positively rated by 22.7 % of the manufacturing sample firms in 1995, research and technology currently has a positive impact on firms' innovation activities for 52.0 % of the respondents (with a decreasing share of indistinct answers and of negative assessments). The regional innovation climate is generally perceived more positively now than about ten years ago with a constant share of firms with negative perceptions in both regions. The share of firms that rated the innovation climate positively for their innovation projects, has been 16.0 % (1995) and 68.0 % (2004) in Baden and 25.0 % (1995) as well as 52.0 % (2004) in Alsace.[300]

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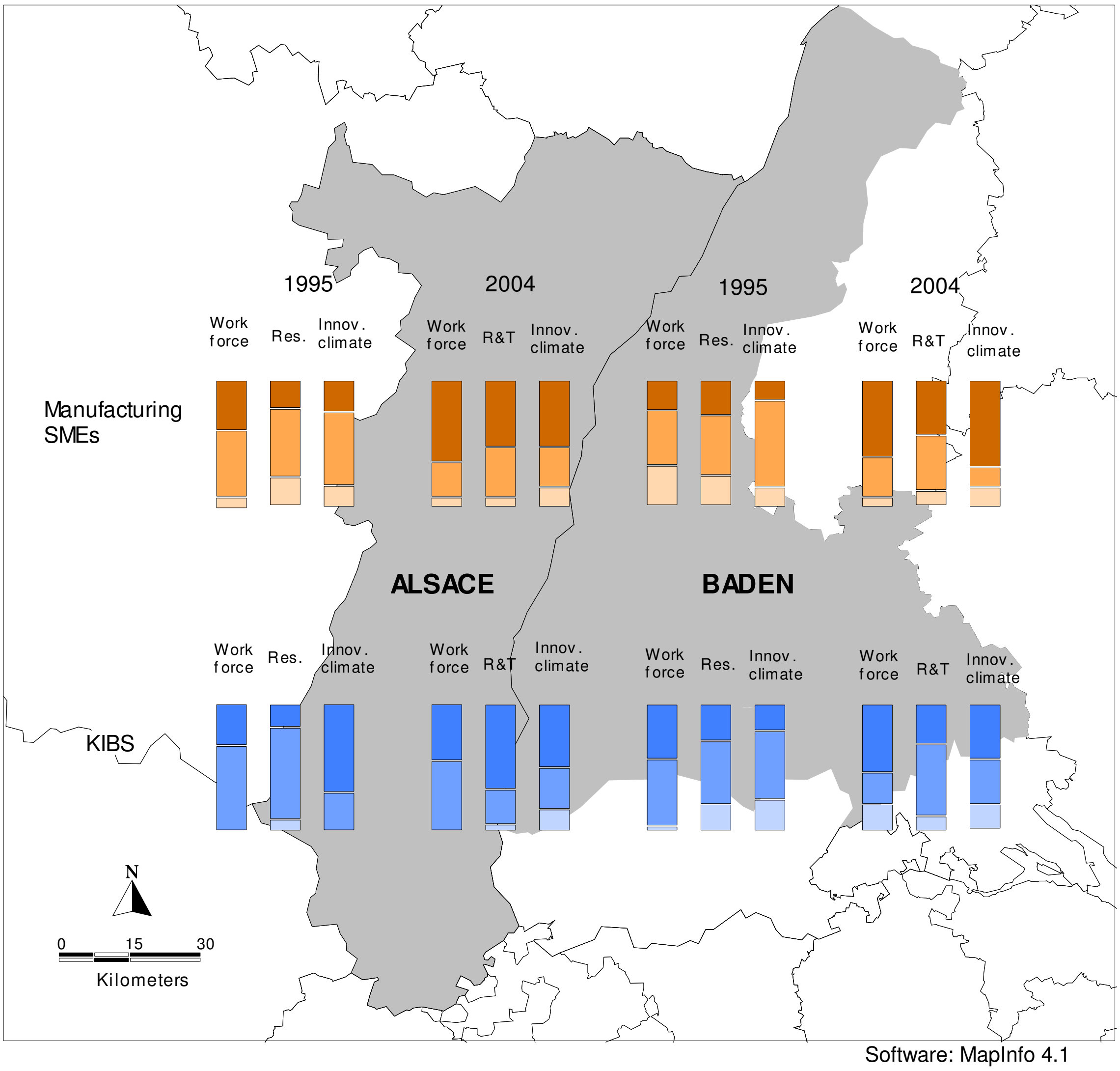
299 In 1995, 44.0 % of the Baden and 52.2 % of Alsatian manufacturing sample firms did not have a clear opinion concerning the regional workforce. The share of indistinct answers towards the research supply was 48.0 % in Baden and 54.5 % in Alsace whereas the innovation climate did not have an impact on 68.0 % of Baden and 58.3 % of Alsatian firms' innovation activities.

300 It could be argued that this shift in perception is due to the different regional definitions. However, the regions of the 1995 survey are part of the 2004 survey regions; differences would only result if firms in 1995 had diverging assessments concerning other *Kammerbezirke* or *départements* than their own. Moreover, as the analysis shows, the shift is not systematic, especially when considering KIBS. The innovation climate, for instance, receives lower shares of positive answers in 2004 than in 1995 among Alsatian KIBS, and the as-

Figure 28: Assessments of the regional workforce, research (and technology) and the regional innovation climate in 1995 and 2004 (Share of firms, %)



Answer categories manufacturing SMEs:

- rather unfavourable
- no impact
- rather favourable

Answer categories KIBS:

- rather unfavourable
- no impact
- rather favourable

sessments of the regional research and technology infrastructure given by Baden KIBS remains comparatively stable.

The results are slightly diverging when the sample KIBS are considered (cf. figure 28).[301] Concerning the impact of the regional workforce in the innovation context of the interviewed firms, the results "switched" from a peak of indecisive answers in 1995 (52.0 %) to a "rather favourable" answer peak in 2004 (54.2 %) in Baden. However, the share of "rather unfavourable" answers is also higher in 2004 than in 1995, indicating that the regional workforce is appropriate for a (larger) part, but not for all sample KIBS. In Alsace, the share of firms with a positive answer increased slightly between 1995 and 2004 (33.3 % in 1995 and 44.4 % in 2004), the highest share of firms however being not inclined to give a clear positive answer in both surveys. Neither in 1995 nor in 2004, negative assessments occurred among Alsatian KIBS. The regional workforce and its qualification seem to be appropriate for a part, but not for all Alsatian sample KIBS. As for manufacturing sample firms, Alsatian KIBS' perceptions of the research infrastructure in the region also enhanced between the surveys: While the supply of the research institutes has been rated favourably for internal innovation projects in 1995 by 18.2 %, 66.7 % of the sample KIBS attested research and technology transfer a favourable impact in 2004. This change in firms' perception could not be observed in Baden where the results remained quite stable. Given the fact that highly reputed higher education and research institutions are located in Alsace, this result indicates that these institutions are to an increasing extent positively perceived, i.e. that KIBS nowadays have a positive view of research institutes in their region. Concerning their perception of the innovation climate in their regions, Baden sample KIBS' answers are more positive in 2004 than in 1995. In 2004, 44.0 % rated the innovation climate rather favourably contrasted to 20.8 % in 1995. In Alsace, the share of firms with positive perceptions of the regional innovation climate decreased from 69.2 % in 1995 to 50.0 % in 2004.[302] This may lead to the assumption that innovation questions are of less relevance for Alsatian than for Baden KIBS. The results concerning KIBS may indicate different innovation patterns of Baden and of Alsatian KIBS.

Summarising, manufacturing firms in both surveyed regions currently have a slightly more positive image of their region concerning these selected innovation supporting factors than in the mid-1990s. This can have several reasons. First, the general framework conditions may have been strongly improved within this nearly 10-year-period, for

301 It has to be mentioned in this respect that the Alsatian KIBS sub-sample is smaller than the manufacturing SME one and that additionally, not all of the 2004 sample KIBS firms had answered the respective question in 1995. Thus, in 1995, there have been 11 (research), 12 (work force) and 13 (innovation climate) answers.

302 Saying this, it has to be kept in mind that from the 18 KIBS of the Alsace sub-sample, 13 had given an answer in 1995. It can be assumed that this question did not have a special relevance for the remaining five firms.

instance showing a better adaptation of the labour force to firms' needs or a higher degree of interaction between research and technology transfer institutes and SMEs, leading to knowledge transfer and more positive ratings of the research and technology transfer institutes. Co-operations between SMEs and research institutes may for example have been fostered by public project support. Secondly, firms may attribute innovation a higher position than in the mid-1990s, leading to clear (positive or negative) opinions instead of indistinct answers. Thirdly, communication on innovation and innovation support, as well as on regional transfer structures may have been increased during the last years. Innovation is perhaps now a more explicit topic than it was ten years ago; nowadays innovation is widely discussed and this "making explicit" may have had an impact on firms' perceptions (better: on focussing their view to innovation and the respective supportive conditions). Discussing about innovation matters raises their awareness for and susceptibility of innovation, innovation support and the role of the region which, in turn, favours the selection, adoption and processing of the respective information in firms. The fact that these general improvement effects can be observed in both regions in parallel supports the assumption that a rather "general" effect – the increasing importance of innovation, the visibility of innovation policy measures, as well as communication and perception – can be identified as reason for this intertemporal modification in firms' assessments.

The positive evolution of perceptions observed for the manufacturing sample firms can not completely be transferred to the sample KIBS. Striking is the finding that regional research and technology transfer increases in positive assessments among Alsatian sample KIBS whereas the regional workforce received slightly higher shares of positive ratings in 2004 compared to 1995. The share of positive assessments of the regional innovation climate decreased. These differing findings for Alsatian manufacturing sample firms and the sample KIBS lead to the assumption that the regional innovation-related aspects emphasised here seem to be more suited to manufacturing firms than to KIBS. Generally, policy measures seem to be rather tailored to manufacturing SMEs, understanding innovation rather in a technology-oriented, manufacturing perspective. Baden KIBS attribute the regional workforce the most positive ratings. Research and technology does not seem to play a distinct role in sample firms' positive perception structure, neither in 1995 nor in 2004. Baden KIBS thus seem to prefer to generate the needed knowledge in the frame of firm-internal processes. This finding is in line with the high shares of firms in the "high-tech" class concerning innovation expenditures, and also comparatively high median and mean values with respect to employees working on innovation preparing themes (cf. also figure 14 and figure 27).

5.2.6 Innovation and perception in the two different regional contexts of Alsace and Baden: Synthesis of results

The results indicate different innovation modes among the sample firms in the surveyed regions. Alsatian sample firms seem to engage to a lower extent in internal knowledge creation, i.e. through own research and development activities and specialised staff working in research or development. Instead, they seem to be rather inclined to acquire knowledge from external sources, particularly research and technology transfer institutions. This model seems to be especially pursued by KIBS. These results are in line with the general socio-economic situation in Alsace, characterised by rather moderate research and development engagement in the private business sector, but good patent performance (cf. section 4.2). The excellent research capacities in Alsace assume an important position for this innovation mode – a finding that could not in this degree be observed in 1995. The regional research and technology transfer facilities now have a more prominent position in Alsatian innovators' minds, i.e. firm-external research results and the possibilities of using these sources for firms' innovation activities are nowadays highly explicit for the sample firm representatives. This has not been the case in the mid-1990s. However, as the literature shows, firm-internal R&D activities are not only important for the creation of knowledge within the firm, but raise firms' absorptive capacity and its image as knowledge creating firm. Rosenberg (1990: 170) explains the performance of (basic) research in private firms as "… a ticket of admission to an information network" as well as a signal to improve their visibility and eligibility for obtaining (public) contracts (cf. for instance Cohen/ Levinthal 1990, Rosenberg 1990: 172, and also European Commission 2000: 24).

When synthesising the socio-economic structure and development in Alsace, i.e. below national private business R&D expenditures and R&D employees in Alsace as a whole (cf. table 2 and table 3) and the sample firms (cf. figure 13, figure 14), but good patent performance of the region (cf. table 4), and additionally considering that about one fifth of the Alsatian sample firms expect to increase their R&D efforts in the near future (cf. figure 20), it can be concluded that Alsatian sample firms in their majority have a rather reluctant attitude towards internal research activities.[303] This is also indicated when considering the development of R&D employees and R&D expenses during the time span considered: As figure 25, figure 26, and figure 27 show, the R&D engagement did not significantly increase between the mid-1990s and the mid-2000s. However, the good patent performance of Alsace in the French context and sample firms' anticipation

303 This said, it has to be kept in mind that the sample firms of both regions are firms with innovation experience which lifts their innovation-related indicators above the regional levels.

of their future economic development (in terms of turnover, cf. figure 20) leads to assume that innovation for Alsatian manufacturing sample firms is rather a production-related phenomenon, probably incremental inventions in existing production lines, rather than research-based innovation in new fields. Research and technology transfer institutes are an important source for innovation-related information for both Alsatian sub-sample firms, however with an even higher importance for the sample KIBS. Knowledge seems to be mainly acquired from regional organisations that are assessed as important innovation-related information source from about 60 % of Alsatian sample KIBS. These findings point at the importance of research and technology transfer for Alsatian manufacturing and knowledge-intensive business service firms, which has not been evident in the mid-1990s survey. Keeping in mind the changes in the regional economy and in regional policies towards innovation, since the beginning of the 2000s, the efforts of the regional research and technology transfer structure, aiming at diffusing regional research results and at implementing knowledge in firm processes, seem to be witnessed by these findings. Concerning the innovation climate in Alsace, manufacturing and KIBS sample firms seem to have quite similar perceptions: About half of firm representatives of each sub-sample had positive assessments. This result seems good, but with further potential to improve framework conditions for regional innovation. The regional workforce is assessed differently among Alsatian manufacturing and KIBS sample firms with 64.0 % of the former evaluating the regional workforce "rather favourably". This indicates that the regionally available human capital fits well to manufacturing firms' innovation activities. The KIBS results differ from these findings, the majority of KIBS representatives indicating that the regional workforce does not have an impact on their innovation activities. About 45 % assess the regional workforce rather favourably. This shows that a part of the Alsatian sample KIBS representatives appreciates the human capital in the region, whereas a higher share of this group does not seem to profit from the human capital available in close proximity. This supports the assumption that a part of Alsatian sample KIBS acquires necessary knowledge from external sources, instead of generating knowledge internally with a base of qualified staff.

The results for the Baden sample firms show a slightly differing picture. The answers of sample firm representatives lead to the conclusion that Baden sample firms rather prefer to build their own knowledge base for innovation, indicated by the higher engagement in internal research and development, through expenses and specialised workforce. Concerning their expectations for the development of their firms' R&D engagement, size and turnover, as in Alsace the highest share of firms expect their turnover to increase in the near future. Especially among manufacturing sample firms, the R&D increase rates important: More than 50 % of the respondents count with an increase in their firms' (already comparatively high) engagement in internal research and development efforts. Research and technology transfer institutions do not have the outstanding importance for the Baden sample firms as has been proven in Alsace; the former seem to prefer to rely on knowledge generated "in-house" instead of acquiring it from external sources. A considerable share of KIBS representatives even did not consider research and technology transfer organisations relevant for their firms (cf. figure 17). Qualification in Baden seems to be fairly good and well-fitted to more than 50 % of the regional sample firms' demand in terms of human capital (cf. figure 16). However, the general innovation climate is rather appreciated by manufacturing than by KIBS sample firms (cf. figure 18). From the indicators investigated here, it seems that the general innovation framework is rather tailored for manufacturing than for business firms. Furthermore, it has to be stressed that Alsatian sample firms rather rely on innovation-related information sources from their immediate regional environment than searching externally. This is completely different in Baden; here, regional and extra-regional knowledge sources are used complementarily with a focus on extra-regional sources (cf. figure 19).

As the overview of some innovation initiatives in Baden showed, (locally initiated) networks and initiatives tend to have a considerable importance. Initiatives as the *TechnologieRegion* or BioValley originate from collaboration between local and regional actors, actors from diverse 'sub-systems' of the regional innovation regime such as firms, research and education institutes, as well as policy actors. The *TechnologieRegion* for instance is a "bottom-up" measure with rather indirect link to innovation, but pointing at identification, internal and external representation of the region. Initiatives supporting mutual engagement of different regional actors have been introduced in France and Alsace with the *pôles de compétitivité* measure. The fact that Alsace has been attributed a *pôle de compétitivité à vocation mondiale* shows the engagement of regional actors and the strength and quality of regional research in chemistry and biology. As a whole, knowledge for innovation in Alsace rather seems to stem from (public) research and to be transferred to regional firms whereas knowledge tends to be created as an internal process in Baden firms. This is mirrored by the high degree of public and (partly) national agencies for innovation support and technology transfer in Alsace, and high R&D investments of the firms and a tradition of bottom-up and initiative-based measures in Baden.

Particularly when considering the manufacturing sample firms of both regions, it becomes obvious that their perceptions of the selected innovation-related regional indicators have been improved, and that the high shares of indistinct answers from the first survey have now been strongly replaced by explicit and rather positive perceptions. Among KIBS, particularly striking is the result concerning the assessments of regional research and technology transfer institutes in Alsace. This is different in Baden, where there are no large deviations between the 1995 and 2004 evaluations. The workforce in the respective regions is now evaluated slightly better compared to 1995. Diverging results are obtained in the surveyed regions concerning KIBS representatives' assessments of the regional innovation climate: Being improved among Baden KIBS' representatives – however not reaching the contentness that manufacturing sample firm representatives show – it is nowadays rated less positive in Alsace than about ten years ago. This might indicate that those characteristics which shape the general innovation sphere in both regions, are largely directed towards manufacturing firms. This seems to be to a larger extent the case in Alsace.

The shift in perceptions from high shares of "no impact" assessments to explicit and mostly "favourable" answers shows that innovation and innovation-related topics seem to have gained importance during the time span considered. The higher share of missing values in the 1995 survey also points in this direction: Sample firms in this case did not feel any relevance concerning the issues in question for their firms and thus did not give an answer at all.[304] Nowadays, innovation is a much discussed topic, and the "3 % goal", i.e. the objective to reach an R&D intensity of at least 3 % of the GDP for the EU as a whole until 2010, is widely communicated.[305] Moreover, the difficult economic situations in the 1990s (Baden) and the reduction of foreign direct investment in Alsace since the beginning of the 2000s effected an intensified dialogue about knowledge, technology, research and innovation. This generated more explicit cognitive representations in firm representatives concerning their innovation environment due to increased public support in innovation, increased communication about innovation and an increased openness of firms and their managers towards innovation. Innovators' subjective representations based on their perceptions are crucial, since they build the

304 This may be, on the other hand, also related to the survey method; personal interviews enable to shortly discuss about the questions, which is not possible when written questionnaires have been chosen as methodological frame. However, it can be assumed that firms whose representatives skipped the perception-related questions did this because the issue did not have any relevance for them; otherwise they would have chosen one of the answer categories.

305 The European Council of Heads of State and Government on 23 and 24 March 2000 in Lisbon developed a strategy for competitiveness and the transition to a knowledge-based economy, based on the aim of the European Union to become "the most competitive and dynamic knowledge-based economy in the world…" (Commission of the European Communities 2002: 3). The Barcelona European Council in 2002 agreed that investment for research and technological development in the European Union should be increased to 3 % of the GDP by 2010 (cf. Commission of the European Communities 2002: 3, http://ec.europa.eu/internal_market/smn/smn21/s21mn14.htm).

general cognitive framework in which innovation-related decisions in their territorial context are made.

So far, the descriptive analyses focused on crosstabulations both for manufacturing sample firms and for the sample KIBS, always between the variable in question and the geographical origin of the firms. The aim was to present the respective aspects for the firms located in different regional and national innovation systems. However, all the figures and maps of this chapter have in this first step been presented as independent findings. But it is possible that they are not independent, that there are structures and patterns in the data pointing at relationships and associations between variables and/ or variable categories which can hardly be derived from crosstables (cf. Gifi 1990: 44, Greenacre 1984: 3/4). An analysis trial of possible associations will be performed in the following section.

5.3 Perception, innovation and the region – analysis of associations

The preceding chapter gave an overview of the data gathered and compared innovation and perception as well as structural characteristics of manufacturing and knowledge-intensive business sample firms in the two surveyed regions. These analyses already gave some indications concerning innovation and regional perception in the sample. However, they focused on descriptive analyses of single variables, crosstabulated with the type of activity (KIBS/ manufacturing SMEs) and the region. The following chapter now aims at exploring possible associations between innovation, perception and the importance of the region through a simultaneous treatment of the respective variables.

5.3.1 Choice of the method to be applied

The questionnaire in the 2004 survey was strongly standardised and contained for the most questions pre-defined answer categories such as "rather unfavourable – no impact – rather favourable" or yes/no answers. Numerical data occurred only in a few cases, when the respondents have been asked to figure the share of their firms' innovation expenses, the number of employees or the turnover of their firms. Consequently, "classical" statistical multivariate methods referring to numerical continuous data and the normal distribution assumption are not suitable here (cf. also Nishisato 2004: 3). Instead, the method to be applied must be appropriate for categorical data on an ordinal or nominal measurement level. The aim is to get deeper insight into possible associations between the perception of the regional (innovation-oriented) environment and firms' innovation input behaviours as well as the importance sample firm representatives attribute to their regional versus extra-regional environment. However, these aspects are not assumed to be related in a direct, linear and uni-directional way. In this context, perception is not treated as a "hard" innovation input factor as for example firms' expenses for innovation preparing tasks or knowledge incorporation (e.g. via the human capital hired, internal knowledge generating activities such as research and development or co-operations with external partners), but rather as a "soft" factor with rather indirect relation to innovation behaviour, more precisely as factor shaping the context for firms' innovation activities to take place. In this general framework, analyses on dependencies between variables – for instance regression analysis – do not seem to be appropriate. Also, probabilistic estimation models are not chosen here either because the analyses do not aim at inferring the sample results to the whole firm population in the regions.[306] Instead, the type of analysis to be applied here should rather shed light into associations[307] or interdependencies of the variables or variable categories. This means that the procedure to be applied should be rather explorative and should respect the (categorical) data characteristics.[308] That is, an explorative analytical procedure which reveals structures of data with mixed measurement levels seems to be appropriate. In order to meet these requirements, a procedure of the optimal scal-

306 Rindskopf (2004: 137/138) differentiates between data description, exploration and inference in the frame of statistical analyses. While description answers the question "What's there?" by summarising the available information, exploration helps at hypotheses generation by focussing on important data features and treats the question "What might the data mean?". Inference is directed towards evidence in the data; the testing of hypotheses, the determination of confidence intervals, prediction, etc. Referring to this differentiation, the questions treated here clearly aim at the first (cf. preceding chapter) and the second parts, the latter being addressed in this section.

307 Associations represent relationships between categories, i.e. refer to categorical variables while correlations refer to numerical ones (cf. Hartung/ Elpelt 1999: 143).

308 "Explorative technique" in this context means "that it is primarily intended to reveal features in the data rather than to confirm or reject hypotheses about the underlying processes which generate the data. In order to explore data we need to make as few assumptions about the data as possible." (Greenacre/ Blasius 1994: vii). The procedure presented in the following aims at investigating the sample data and at delivering more information about associations between the variables and variable categories. This is in line with the understanding of Greenacre (1984: 4): "Of course, it would be possible to investigate the patterns which we suspect *a priori* to exist in the data, but we rather want an exploratory framework where the patterns reveal themselves." Consequently, statistical significance tests are not performed in the frame of this type of analysis (cf. Greenacre 1984: 73). Criticism concerning these methods is forwarded by the BMS (1994: 135): (i) the development of good models has an inferior position, (ii) the data treatment produces always certain results without the construction of hypotheses, (iii) neither the data type nor further knowledge about the methods to be applied is required (cf. the BMS 1994: 135).

ing type in the SPSS "Categories" module has been chosen.[309] The technique used here condenses the information of the dataset and produces graphical outputs that represent as much of the original information as possible on a few dimensions. This process facilitates interpretation of the original information and especially may disclose relationships and associations between variables and/or variable categories that are hardly evident when regarding the whole set of the (original) information or crosstabulations which refer to two variables. Optimal scaling procedures can account for data sets with few observations, many variables or many values per variable (cf. Meulman/ Heiser, SPSS Inc. 2001: 2 and 7) and are "eminently suited for analyses in which there are (many) more variables than objects." (Meulman et al. 2004: 67).

5.3.2 Features of the categorical principal components analysis

The most appropriate procedure for the requirements of this study seems to be categorical principal components analysis (CATPCA), a statistical procedure that simultaneously quantifies categorical variables and reduces the dimensionality of the data. Unlike standard principal components analysis, categorical principal components analysis does not require linear relationships between variables and the numerical character of variables. CATPCA can model nonlinear relationships between variables and – as the standard version – reduces the original information into a smaller set of (uncorrelated) components with a high share of the information of the original variables (cf. Meulman/ Heiser, SPSS Inc. 2001: 27). CATPCA deals with qualitative or categorical variables, i.e. variables which describe the objects (persons, firms, etc.) in a certain number of categories. This means that "[t]he zero point of these scales is uncertain, the relationships among the different categories is often unknown, and although frequently it can be assumed that the categories are ordered, their mutual distances might still be unknown." (Meulman et al. 2004: 49). This procedure has the goal to present objects and categories in a common representation in a space with a lower number of dimensions than the original data, but with as much information as possible.[310] Procedures

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309 Different procedures belong to this type of analysis: Besides multidimensional scaling and categorical regression, the module contains correspondence analysis which analyses two-way tables, multiple correspondence analysis or homogeneity analysis that can treat more than two variables, categorical principal components analysis that can process various variables of mixed measurement levels, and canonical principal components analysis which treats different sets of variables (cf. Meulman/ Heiser/ SPSS 2001: 7).

310 There is a trade-off between easiness of interpretability and completeness of information in the sense that a lower number of dimensions explains a smaller portion of the variability of the whole data set, but is much easier to interpret than a presentation of a high number of dimensions, but "[t]he usefulness of a technique like correspondence analysis is that the gain in interpretability far exceeds the loss in information, …" (Greenacre 1984: 7).

of this type are conceived to "… analyze data that are difficult or impossible for "standard" statistical procedures to analyze." (Meulman/ Heiser, SPSS Inc. 2001: 1) by plotting objects close to the categories they fall in and categories close to the objects to which they belong (cf. Meulman/ Heiser, SPSS Inc. 2001: 1, Michailidis/ de Leeuw 1998: 307/308). At the heart of this type of analysis is the optimal scaling[311] (or scoring) process which searches for numerical quantifications that are assigned to the variable categories, i.e. attributing quantitative values to qualitative scales. The optimality notion is relative since it always refers to the specific data set to be analysed. This then allows "standard" procedures to be applied. The original variable categories are replaced by numerical values which are determined via an iterative process that subsequently improves the solutions - the alternating least squares algorithm (cf. Meulman/ Heiser, SPSS Inc. 2001: 1).[312]

When applying a procedure of this type, the proceeding differs in some points from "classical" statistical analysis. As detailed above, it is an explorative and not an inferential technique whose outputs are not parameter estimates, but graphical displays. The first difference concerns the measurement level of the variables: While it usually refers to the scale on which the variables have been collected (nominal, ordinal, numerical), it here gives an indication about how the optimal scaling process will be performed, about the scaling level of the variables.[313] The second difference to "classical" princi-

311 or "dual scaling", cf. Nishisato 2004: 3.

312 This process is continued until a stopping criterion is met. Besides transformations with alternating least squares (ALS) which originates from multidimensional scaling techniques, optimal spline transformations defining piecewise polynomials joined at specific points (knots), are available in CATPCA. Spline transformations rely on fewer parameters and are generally more robust and smoother, but result in a less goodness of fit (cf. Meulman et al. 2004: 50 and 54, Meulman et al. 2002: 209 and Gower/ Blasius 2005: 359 and 361. Cf. also Young et al. 1978: 280). Optimisation of the transformation functions then is realised by minimising the central least squares loss function (cf. Meulman et al. 2002: 209) Gifi explains the loss function as follows: "If we have a model that is formulated in terms of a finite number of inequalities that must be true (or even a finite number of equations that must be true), then we can measure loss by counting the number of inequalities and/or equations that are not true for a particular representation, and we can find our representation in such a way that the number of violations is minimized." (Gifi 1990: 154).

313 Monotonic transformation keeps the order in the original (ordinal or ordered categorical) data while nonmonotonic transformation is applied for categorical data without an intrinsic order (nominal). The nominal or nonmonotonic quantification maintains the membership of objects in a category. If a nominal scale is chosen, the category points are fitted on a line through the origin whose direction is determined by the component loadings (cf. Meulman et al. 2004: 54). Multiple nominal transformation only keeps the grouping of objects in categories information. Contrary to the single nominal level, quantifications based on the multiple nominal transformation produce different quantification sets for each dimension. The resulting category points are plotted as centroid of the associated objects. The ordinal scale implies a certain order of the categories to be kept in the frame of the nonlinear trans-

pal components analysis - the "reference" procedure to CATPCA - is the necessity to specify the number of dimensions to be calculated in advance. The scores are then calculated in order to give the best results with respect to the number of dimensions chosen.[314] Since the solutions of a categorical principal components analysis are not necessarily nested,[315] results for the first dimensions differ when solutions with different numbers of dimensions are calculated and compared (cf. Gower/ Blasius 2005: 360 and 365). Besides those "practical" differences in the application of categorical data analysis, the basic concepts differ from standard multivariate analysis: While classical multivariate analysis focuses on the correlations among variables, the categorical type of analysis treated here has the objects (persons, firms, etc.) in its focus, mapping them in a few dimensions and keeping the original dissimilarities between them in the best possible way. Additionally, objects and variables are represented in a common space with few dimensions.[316] However, despite the differences to "classical" statistical methods, optimal scaling procedures can also complement them and give additional indications through their graphical representations. (cf. Meulman/ Heiser/ SPSS 2001: 2, Meulman et al. 2004: 51).

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formation process. Besides these "basic measurement levels", spline nominal and ordinal transformations can be selected. The transformation then is based on piecewise polynomials. However, in some cases, there are several possibilities how to transform the original data depending on the goal of the analysis. Thus, it may be senseful to analyse data on other levels than the "obvious" one. So ordinal variables can also be attributed non-monotonic transformation, for instance in cases where the categories are assumed not to be in linear order. Transformations of this kind are also possible for continuous (numeric) variables. It may then prove appropriate to merge them in categories (cf. Meulman/ Heiser, SPSS Inc. 2001: 2/3 and 30, Meulman et al. 2004: 50).

314 "… the scores are chosen to give a best PCA [Principal Components Analysis; added by the author] in some *specified* number, *r*, of dimensions […] by maximizing the sum of the *r* principal eigenvalues relative to the total trace, *p*." (Gower/ Blasius 2005: 365). Or: "CATPCA finds category quantifications that are optimal in the sense that the overall variance accounted for in the transformed variables, given the number of components, is maximized. In the optimal scaling process, information in the original categorical data is retained in the optimal quantifications, depending upon the optimal scaling level that can be chosen for each variable separately […]." (Manisera et al. 2005: 11).

315 This is in contrast to homogeneity analysis (cf. Michailidis/ de Leeuw 1998: 310) where the results for a given number of dimensions remain stable, independently of the number of dimensions chosen (i.e. the results for a two-dimensional solution are identical to those of the first and the second dimension in a five-dimensional solution). On the contrary, in CATPCA, the first two eigenvalues of a three-dimensional solution are not identical to the eigenvalues of a two-dimensional one (cf. Meulman/ Heiser, SPSS Inc. 2001: 116, Meulman et al. 2004: 67).

316 Thus, Meulman et al. (2004: 51) consider these techniques rather from a multidimensional scaling perspective (cf. also page 203). Alternative proceedings are based on the *analyse des correspondances* technique, widely used and made popular by French researchers (cf. Benzécri and collaborators 1976a, b).

5.3.3 Central outputs of the categorical principal components analysis

Graphical outputs are central in categorical principal components and related analyses. They display objects and variables in a joint space of lower dimensionality than the original variable set. In the graphical output of CATPCA, vectors may represent the variables in the low-dimensional principal component space. Viewing the variable as a set of category points, these are located on a line. The direction of this line is represented by the component loadings which incorporate the variable coordinates for each dimension. The angles between vectors are approximations of the correlations between the variables. This kind of presentation (vector model) is based on a – nonmonotonic (nominal) or a monotonic (ordinal) – quantification of the variable categories. Alternatively, the category points can also be presented as points in the centroids of the associated object points (centroid model). The centroid model – i.e. the representation of a categorical variable as points in the centroid of the objects of the associated categories – requires a multiple nominal quantification, i.e. separate quantifications for each dimension without assuming an order of the categories (cf. Meulman et al. 2004: 52-54 and 59).[317] Contrary to the projection-based vector model, the centroid model focuses on the distances between object and category points by assigning coordinates to each category which represent the category and the objects in the same space. Thus, category points of different variables associated with the same objects are plotted close together whereas categories of the same variable are plotted far apart (cf. Meulman et al. 2002: 213). This ability to simultaneously fit the vector and the centroid model for different variables is one of the special features of CATPCA. A further feature is the option to assign different weights to the variables. Additionally, though the method aims at analysing categorical variables (on a nominal and ordinal scale), continuous variables can also be integrated, thus allowing the analysis of variables with different measurement levels. Further characteristics of CATPCA are different options for the treatment of missing values, and different normalisation options to display objects and variables. The standard option, variable principal, displays objects in an orthonormal (orthogonal to each other) cloud of object points. The first dimension accounts for the largest part of the fit, and the following dimensions show a decreasing share of the fit.[318] Pertinent for the following empirical analysis of perception and inno-

[317] This model has its origin in multiple correspondence analysis. Here, a set of category points represents a nominal variable. These category points are positioned in the centroids of the respective clouds of objects (cf. Meulman et al. 2004: 52).

[318] The choice of the variable principal normalisation contributes to optimise the association between variables. Since the component loadings correspond to the correlations of the

vation is CATPCA's further feature to allow the introduction of supplementary objects and/ or variables into the analysis. These are not included into the main analysis, but afterwards fitted into the representation. Thus external information on the objects can be integrated in the representation. CATPCA offers different plotting options: (i) the standard biplot of points representing objects and vectors representing variables in a joint space, (ii) the graphical presentation of centroids of the objects according to classification variables, and (iii) graphical displays of groups of objects and variables. These options can be combined in triplots (cf. Meulman et al. 2004: 51-54, Meulman et al. 2002: 208-211).

5.3.4 The proceeding of a categorical principal components analysis

The proceeding of a CATPCA is as follows (cf. Meulman et al. 2002: 212/213): A centroid model is fitted for each variable in the course of which associated category points – more precisely category points of different variables which are associated to identical objects – are displayed in close neighbourhood. Those centroids are afterwards projected on a (best fitting) vector through the origin in the case the vector model is chosen. The resulting vector thus represents the respective variable jointly with the objects in a common space. The component loadings determine the direction of the vectors.[319] Ordinally scaled variables receive monotonic quantifications that keep the original category order. The component loadings and their sum of squares are the base for the variance accounted for and display thus the goodness of fit of the model, the degree of a model's explanation of the total variance. Based on the central purpose of the CATPCA method – the exploration of the interdependence of the variables, maximised through the nonlinear transformation – the eigenvalues, i.e. the total variance accounted for in the transformed variables, are the central goodness-of-fit index.[320] Eigenvalues are displayed for every dimension, and their sum equals the total variance

variables with the dimensions, the choice of this method is supposed to emphasise the correlation between the variables (cf. Meulman/ Heiser/ SPSS Inc. 2001: 39).

319 The variables are associated with component loadings for each dimension that deliver the variable coordinates for their representation in the principal components space. Component loadings are correlations between variables and principal components; the sum of the squared component loadings in each dimension results in the eigenvalues. The squared vector length gives the percentage of variance accounted for and represents the sum of squares of the component loadings across the dimensions (cf. Meulman et al. 2004: 52). Further details are given in annex 3.

320 Eigenvalues measure the variance of a solution, cf. Nishisato 2004: 8: "The variance of solution *k* is called the eigenvalue ρ_k^2 , which is a measure of information conveyed by solution *k*."

accounted for of the transformed variables. The variance accounted for is computed for each variable and each dimension and is equal to the squared component loading (which, in turn, represents the correlation between the transformed variable and the principal component in the dimensions). The internal consistency of the solution is measured by Cronbach's α which is defined as:

$$\alpha = \frac{M(\lambda - 1)}{(M - 1)\lambda}$$

with M characterising the number of variables in the analysis and λ the eigenvalues (cf. Meulman et al. 2004: 55/56). "The VAF [variance accounted for, added by the author] per dimension is equal to the sum of squares of the component loadings and equal to the associated eigenvalue of the correlation matrix between the optimally transformed variables. Note that the value of α for a particular dimension becomes negative when the associated eigenvalue is less than 1.0." (cf. Meulman et al. 2004: 56).[321]

Related methods to analyse and present categorical data – mainly correspondence analysis or *analyse des correspondances* that study relationships between two categorical variables – have been developed by researchers from different fields and largely used in French statistics, mainly based on the work of Benzécri and his collaborators (cf. Greenacre 1984: 9, Benzécri et al. 1976a, b. For examples in the linguistic and other fields see Benzécri 1969: 39ff.).[322] Benzécri et al. used this explorative and descriptive, comprehensive data summary to reveal information about associations and relationships that two-way continengency tables cannot provide, but without modelling

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321 Cf. also annex 3.

322 Benzécri and his group used the *analyse des correspondances* in the linguistics domain. With their induction-based philosophy, the French researchers place the dataset in the centre and reject hypothesis testing as well as mathematical or probabilistic modelling: "*Le modèle doit suivre les données, non l'inverse*." (Benzécri et al. 1976b: 6; emphasis taken over from the original text. See also Benzécri 1969: 36). Further features are the geometric character of the technique which transforms the original data to sets of points in a multidimensional space, thus visual representations, and finally the specific algebraic syntax. The crucial point in data analysis, according to Benzécri and his collaborators (1976b: 6), is "… une méthode rigoureuse qui extraie des structures à partir des données" (cf. Benzécri et al. 1976b: 3-17 and the discussion in Greenacre 1984: 9/10, Gifi 1990: 25/26). The French perspective of correspondence analysis is emphasised by the publishers of the *Bulletin de Methodologie Sociologique* (The BMS 1994). Greenacre (1984: 7ff.) as well as Meulman et al. (2004: 50/51) give an overview of the historical development of correspondence analysis.

and hypotheses testing, and remaining on the descriptive, explorative level.[323] Greenacre pleads for thorough descriptive summaries as a first step of data analysis and favours graphical methods since they can summarise large amounts of data, and thus provide a rather global view of the phenomena studied. Moreover, their interpretation is facilitated by men's "natural ability to absorb visual images": "… graphical displays provide the best summaries of data – a picture is worth a thousand numbers. A graphical description is more easily assimilated and interpreted than a numerical one …" (Greenacre 1984: 3). Generally, an association-oriented method such as categorical principal components analysis seems to be well suited to the analysis of rather qualitative aspects such as behaviours and perceptions.[324]

5.3.5 Variables and features of the categorical principal components analysis 2004

The categorical principal components analysis follows the aim to look simultaneously at the objects – the sample firms - and their characteristics in order to search for possible patterns and relationships between innovation, perception and regions. The analysis is based on the following variables:

A. Innovation input

- Share of R&D employees, i.e. share of the total personnel working on research and development or innovation preparing projects (full time equivalent), in classes
  - No R&D employees
  - 0.1 – 4.9 % R&D employees
  - 5.0 – 10.0 % R&D employees
  - More than 10 % R&D employees

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323 Greenacre (1984: 1/2) discusses model-based statistics and descriptive analyses: "It is unfortunate that so much emphasis is placed on a model as a representation of reality, which is usually unjustified, with little or no attention paid to its ability to describe data meaningfully. In fact, the whole question of data description has not been given the attention it deserves […]. Often the data set at hand is the one-and-only set of observations available, the "sampling units" constitute the population and the study is never to be repeated. In such a case the description of the data is of supreme importance."

324 Meulman et al. (2004: 51/52) explain the frequent use of factor analysis, a comparable "classical" method of multivariate data analysis, in behavioural sciences, as well as differences to methods of the multidimensional analysis domain such as CATPCA. While the display of objects, usually persons, is difficult in the factor analysis representation, categorical principal components analysis jointly represents variables and objects (persons, firms) in a common space. This latter technique is viewed in the context of the multidimensional scaling (MDS) techniques (rather than considered as technique of the classical multivariate analysis field). MDS is based on representations in a space of low dimensionality according to proximities between objects (cf. Meulman et al. 2004: 51).

– R&D intensity, i.e. share of turnover spent for research and development or innovation (%)
  - 0 – 1 % R&D expenses
  - 1.1 – 3.5 % R&D expenses
  - 3.6 – 8 % R&D expenses
  - More than 8 % R&D expenses

B. Regional perception variables

– Perception of the regional workforce
  - rather unfavourable
  - no impact
  - rather favourable

– Perception of research and technology
  - rather unfavourable
  - no impact
  - rather favourable

– Perception of the regional innovation climate
  - rather unfavourable
  - no impact
  - rather favourable

C. Impact of the region

– Mainly regional sources for innovation-related information
  - yes
  - no

D. Structural variables: Firm characteristics

– Activity and location of the sample firms
  - Alsace manufacturing SMEs
  - Alsace KIBS
  - Baden manufacturing SMEs
  - Baden KIBS

E. Origin of innovation-related information

– Innovation-related information from clients
  - yes
  - no

– Innovation-related information from competitors
  - yes
  - no

– Innovation-related information from research and technology
  - yes
  - no.

The underlying model for the categorical principal components analysis is conceived as consisting of a core and a structural part. The innovation input, the perception and the regional variables (A, B, C) build the core of the analysis. Since these variables are considered crucial for the analysis, they have been chosen to define the dimensions of the output. The structural part (D, E) consists of variables representing characteristics of the sample firms in terms of their regional location and type of activity, and innovation-related information sources. These structural variables have been defined as supplementary variables, i.e. they have not been involved in the categorical principal component analysis as such, but have been fitted in the solution afterwards (cf. Meulman et al. 2004: 50).

A further characteristic is the conception of a combined vector and centroid model with the core variables being represented as vectors and the structural ones having the centroid model characteristics. The idea behind this proceeding is to have the core variables attributed a certain order – either by keeping the succession of categories (innovation input variables) or by inviting the procedure to impose a certain order to the categories (perception variables) – and thus defining the dimensions, while the category points of the structural variables are freely arranged in the resulting space. Contrary to the descriptive analysis in the preceding section which excluded missing values, the categorical principal components analysis uses a specific strategy for the treatment of missing values, relying on a mixed model of attribution to categories on the one hand and of reference to SPSS options for the treatment of missing values on the other hand: In the case the respondents could not give a distinct evaluation of their perception, these missings have been interpreted as "no impact" or "no relevance for the firm" answer. It is thus assumed that firm representatives did not consider the question as relevant for their firms; otherwise they would have given a distinct positive or negative (or "no impact") evaluation (one case in 2004, but 26 missings in 1995). If firm representatives could not figure the R&D employees or the R&D expenses of their firms, the SPSS option "exclude missing values" option has been chosen. Here, objects with missing values have been excluded from the analysis of the considered variable.[325] 'Variable Principal' has been chosen as normalisation method; this option maximises the association between variables. As mentioned above, the number of resulting dimensions has to be determined before, an indication of the appropriate number being the eigenvalues and Cronbach's α. Thus, an iterative proceeding has been

325 Alternatively, SPSS may exclude objects with missing values from the analysis, or may impute missing values through the mode or a user-defined category (cf. Meulman/ Heiser/ SPSS Inc. 2001: 33). There are nine missing cases for R&D expenses and two for R&D employees in 2004.

chosen: In a first step, five dimensions have been requested. This resulted in eigenvalues below 1 and negative values for Cronbach's α from the forth dimension on, thus indicating three dimensions as appropriate solution.[326]

5.3.6 Analysis of interdependencies in the 2004 investigation

5.3.6.1 The model and the model options

According to the main goal of this study, the innovation input, perceptions and the regional variable form the central part of the categorical principal components analysis whereas structural firm and sample characteristics have been introduced as supplementary variables.[327] For the innovation input – i.e. share of expenses for R&D or innovation and share of R&D employees – an ordinal transformation has been chosen in order to keep the intrinsic order of the categories (without assuming equal distances between the categories, cf. Zeijl et al. 2001: 385).[328] For the perception variables – workforce, innovation climate and research and technology – as well as the region-oriented variable, the nominal scaling level has been chosen in order to let the procedure find an order of the categories. This implies that the (transformed) categories may not always been plotted in the unfavourable – no impact – favourable order.[329] Finally, the structural (supplementary) variables have been introduced as multiple nominal ones and are interpreted in the frame of the centroid model.[330] As for the nominal level, the grouping of objects in the categories is the only information the procedure keeps from the original data. This transformation results in category points in the low-

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326 Meulman/ Heiser/ SPSS Inc. (2001: 110) propose to use the eigenvalues as indication for the appropriate number of dimensions. For the case analysed here, i.e. for single nominal or ordinal variables (in the core model), the eigenvalue of a dimension should exceed 1, producing positive values for Cronbach's α.

327 Supplementary variables do not influence the analysis, they "… may be used to link different data sets in a single representation." (Meulman et al. 2002: 207). A supplementary variables' quantifications "… are computed afterwards to establish its relationship with the solution obtained." (Meulman et al. 2004: 59). For each supplementary variable, the respondents of the same variable category are displayed by a single point. In the case heterogeneous respondents belong to a specific category, the respective category point – i.e. the centroid of the individual points – is plotted near to the origin of the matrix. This means that the individual points are dispersed all over the diagram (cf. Meulman et al. 2004: 59).

328 This is based on the fact that the (numerical) answers of the respondents have been categorised, also to compare them to the 1995 data.

329 Instead: "A variable is treated as *single nominal* if y_j can be anywhere in k_j-space (only the normalization requirements are used)." (Gifi 1990: 163).

330 Examples for the application of CATPCA with different measurement scales and/or supplementary variables give for instance Meulman et al. 2004, Zeijl et al. 2001, Huwer 2003.

dimensional space which are plotted in the centroids of the objects belonging to that category. The resulting points are dispersed all over the geometric space since different sets of quantifications are calculated for each dimension (cf. Meulman/ Heiser/ SPSS 2001: 30). The correlations between the ordinal and nominal variables with the principal components are plotted as vectors. Important is the vector length because it displays the amount of variance accounted for after optimal scaling. According to the centroid model, the structural variables are represented as points whereby the points mark the centroids or averages of the scores of the respective subgroups. Points being plotted in neighbourhood represent firm groups with similar response structures (cf. Zeijl et al. 2001: 385).

5.3.6.2 Goodness-of-fit and component loadings of the model

The chosen model results in a three-dimensional output with a total eigenvalue of 4.365. The first dimension has an eigenvalue of 1.867, the second corresponds to 1.338 and the third to 1.160 (cf. table 15).[331]

Table 15: Model summary of the categorical principal components analysis with the perception, structural and innovation behaviour variables 2004

Dimension	Cronbach's α	Variance accounted for Total (Eigenvalue)
1	0.557	1.867
2	0.303	1.338
3	0.166	1.160
Total	**0.925***	**4.365**

* The sum of Cronbach's α is based on the sum of the eigenvalues.

Source: Selected from CATPCA output, SPSS 11.0

Table 16 shows the component loadings of the core model variables 2004. Since the additional variables are fitted in the obtained results afterwards and do not contribute to the solution, they do not receive component loadings. Component loadings represent the coordinates of the vectors, the graphical representation of nominal or ordinal variables after the optimal quantification process. Component loadings embody "… corre-

331 Since the (core) model consists of six variables, the maximal eigenvalue would be 6. A total eigenvalue of 4.365 corresponds to more than 70 % of this maximum eigenvalue. Further details concerning the procedure and the results of the calculations are given in annex 3.

lations between the variables and the *P* dimensions of the space fitted to the objects." (Meulman et al. 2004: 52).

Table 16: Component loadings of the categorical principal components analysis 2004

	Dimension		
	1	2	3
Share of R&D employees 04 (% of employees, classes)	,796	,210	,125
R&D/Innovation expenses 04 (% of turnover, classes)	,808	,250	,086
Perception of regional human capital 2004	-,310	,754	-,044
Perception of regional innovation climate 2004	-,186	,794	-,232
Perception of research and technology 2004	,119	,179	,908
Mainly regional information sources for innovation 2004	,660	-,014	-,507
Normalisierung mit Variablen-Prinzipal.			

Source: Selected from CATPCA output, SPSS 11.0

As indicated in table 16, the innovation input variables – share of employees working in research and development and firms' expenses for R&D – both score highly and in the same direction on the first dimension. Also on the first dimension, but to a slightly lower degree, scores the regional variable.[332] Sample firms' evaluations of the regional workforce (the 'human capital' variable) also have a certain contribution to the first dimension with the opposite direction to the innovation input variables. Thus higher innovation inputs are supposed to be associated to negative assessments of the regional human capital. The second dimension is mainly characterised by two perception variables: Firms' evaluations of the workforce and the innovation climate in their respective regional environments. They have been attributed the same (positive) sign, so their vectors are expected to have the same direction. The third dimension, finally, is mainly built by the third perception variable concerning research and technology in the region. A smaller, but noticeable influence is also exerted by the regional variable. Consequently, the following three principal components can be identified as resulting from the chosen model: The first one related to innovation input, the second one associated to firms' evaluations of the workforce and the innovation climate in their regional environ-

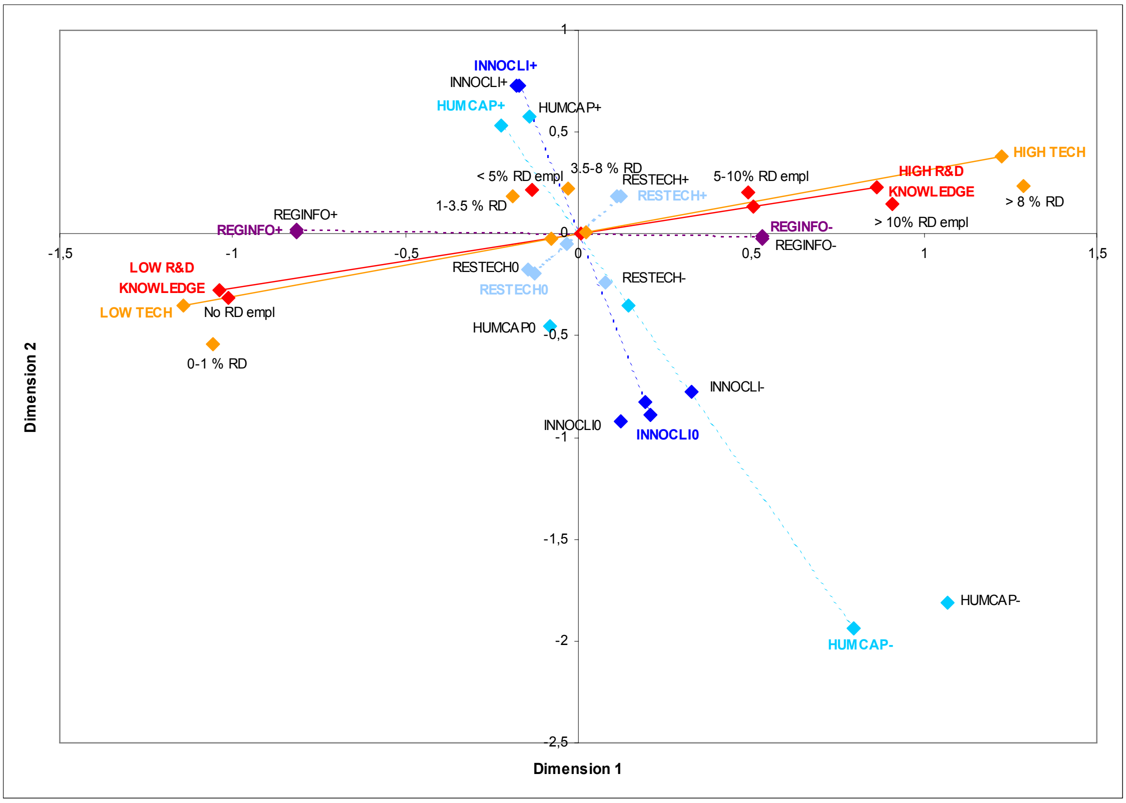
332 Since the regional variable has the same (positive) sign as the innovation input variables, the resulting vector has the same direction. However, due to the increasing coding of the regional variable with 1=yes (i.e. mainly regional sources for innovation-related information) and 2=no, the "no"-part of the vector is expected to be oriented towards the higher innovation input categories.

ments, thus rather 'broad' or 'general' innovation conditions, and the third one with respect to the perception of research and technology in the surveyed regions, thus with a rather specific innovation-related feature. The importance of the regional environment shows relationships to the innovation input and (inversely) to research and technology.

5.3.6.3 The graphical result for the "core model": A joint representation of vectors and centroids

The following figures present the graphical results of the categorical principal components analysis, whereby figure 29, figure 30, and figure 31 show in a first step the variables of the "core model", including the centroids – which are calculated first according to the measurement level chosen for the optimal quantification process (cf. Meulman et al. 2002: 212) – and the vector, i.e. "… a best fitting line (vector) through the origin." (Meulman et al. 2002: 212). This procedure may result in centroid and vector points with very similar coordinates such as in the case for the regional variable or in visible distances between them as for example in the case of the human capital variable. In the frame of the vector model, the category quantifications of the variables with ordinal transformation are plotted on a straight line through the origin, whereby the original order of the categories is kept. This is principally also the case for nominally defined variables, but without keeping an internal order. The vector model points are represented in different colours; different types of blue for the perception variables, pink for the regional and orange/ red for the innovation input variables. The respective end points of the vectors are labelled according to the category quantifications; high R&D expenses are labelled 'high tech' and accordingly 'low tech' describes low R&D expenses, whereas the endpoints of the share of R&D employees is labelled with 'high R&D knowledge' and 'low R&D knowledge' respectively. The endpoints of the perceptions and regional variables indicate positive, negative or neutral evaluations. The centroids are presented in the same colours, but are labelled in black. Dashed lines indicate the nominal quantification level of the variables.

Figure 29: Categorical principal components analysis 2004: The "core model" with innovation input, regional and perception variables (dimensions 1 and 2)



Legend:

Technology intensity of the firms (R&D expenses: Share of turnover spent for R&D)
R&D knowledge intensity of the firms (Share of employees working in R&D)
Perception of research and technology in the region
Perception of the regional workforce
Perception of the regional innovation climate
Mainly regional information sources for innovation

Figure 29 shows that the innovation input variables score highly on the first dimension. Concerning the share of R&D employees, the vector opposes the 'no R&D employees' category in the eastern part of the graph to the categories '5-10 % R&D employees' and '>10 % R&D employees' in the eastern part. The category '<5 % R&D employees' is plotted very close to the origin which is already indicated in the transformation plot (cf. figure 40, annex 3). A quite similar representation is given for the innovation expenses variable whose vector opposes the category '0-1 % R&D expenses' and '1-3.5 % R&D expenses', i.e. rather low internal efforts for research and development activities (the latter category plotted near the origin), in the west-southwestern part to the categories indicating more than 8 % R&D input in the east-northeastern part of the output, with the '3.6 – 8 % R&D expenditures' category being plotted close to the origin. The R&D expenses vector is slightly longer than the R&D employee one, thus indicating a higher correlation of the transformed variable with the principal component.[333] The regional variable indicating the importance of the region as source for innovation-related information also scores highly on the first dimension, though with lower contribution than the variables related to firms' internal knowledge production (mirrored by a shorter vector than for R&D employees and especially for R&D expenses). Higher knowledge and R&D intensities are related to supra-regional information sources – i.e. negative answers to the question "Are your information sources for innovation mainly located in your region?" Accordingly, REGINFO+, i.e. positive answers to this question are associated to low tech and low R&D knowledge. Evaluations of the regional workforce and the innovation climate both score highly on the second dimension with the workforce variable also showing a certain score on the first dimension (cf. also table 16). The vectors of both variables show the neutral and negative assessments in the south-southeastern part of the output whereas the vector ends with positive evaluations point to the north-northwest direction.[334] Those perception variable vectors are nearly orthogonal to the innovation input variables which means that their 'high' or 'positive' endpoints are not pointing in the same direction.[335]

The first dimension is crossed with the third in figure 30. The category points on the first dimension are plotted in the same positions as in figure 29, but are combined with the third dimension coordinates which produces diverging directions of the vectors. The research and technology perception variable scores highly on this third dimension.[336] Figure 30 also clearly shows that the regional variable vector has high scores on the first and the third dimension: It has a north-south and a west-east orientation. In the first dimension, the positive category is associated to lower innovation input whereas it is related to positive perceptions of research and technology in the region on the third dimension.

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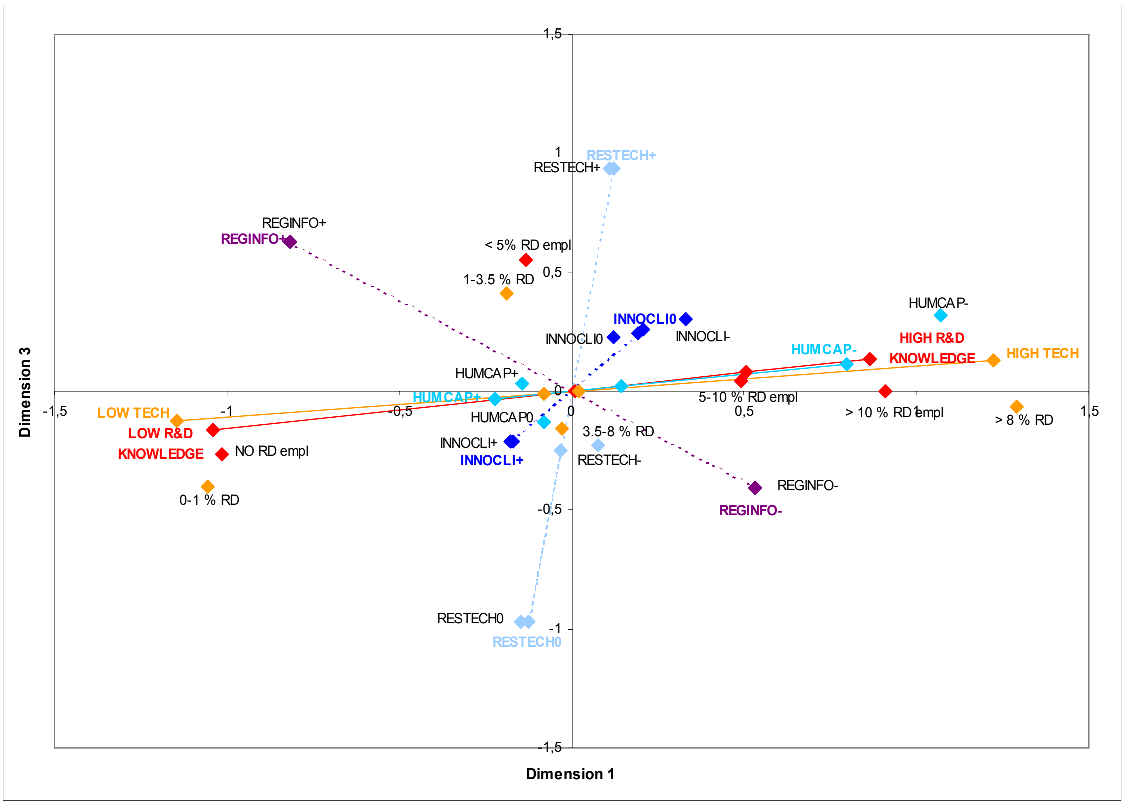
333 This is mirrored in the component loadings for the first dimension which are slightly higher for R&D expenses than for R&D employees (cf. table 16).

334 However, the innovation climate vector shows the neutral and the negative category quantifications in close neighbourhood, cf. also the transformation plot in figure 43 (annex 3).

335 Orthogonality means: "Two vectors are orthogonal if their scalar product is zero, in other words neither vector has a component in the direction of the other – they are at "right-angles". (Greenacre 1984: 27)

336 This is at first sight not mirrored by a respective vector length. However, as figure 44 (annex 3) shows, the transformation results in an V-shaped plot which can only be indicated in figure 30, since the vector part between RESTECH- and RESTECH0 is plotted behind the visible part of the vector between RESTECH0 and RESTECH+.

Figure 30: Categorical principal components analysis 2004: The "core model" with innovation input, regional and perception variables (dimensions 1 and 3)



Legend:

- Technology intensity of the firms (R&D expenses: Share of turnover spent for R&D)
- R&D knowledge intensity of the firms (Share of employees working in R&D)
- Perception of research and technology in the region
- Perception of the regional workforce
- Perception of the regional innovation climate
- Mainly regional information sources for innovation

Figure 31 shows the graphical results of the vector model in dimensions 2 and 3. While the human capital and the innovation climate perception variables score highly on the second dimension, the third dimension is mainly determined by the perception of the research and technology in the region and the regional variable: Mainly regional information sources are plotted close to favourable evaluations of research and technology in the region.[337]

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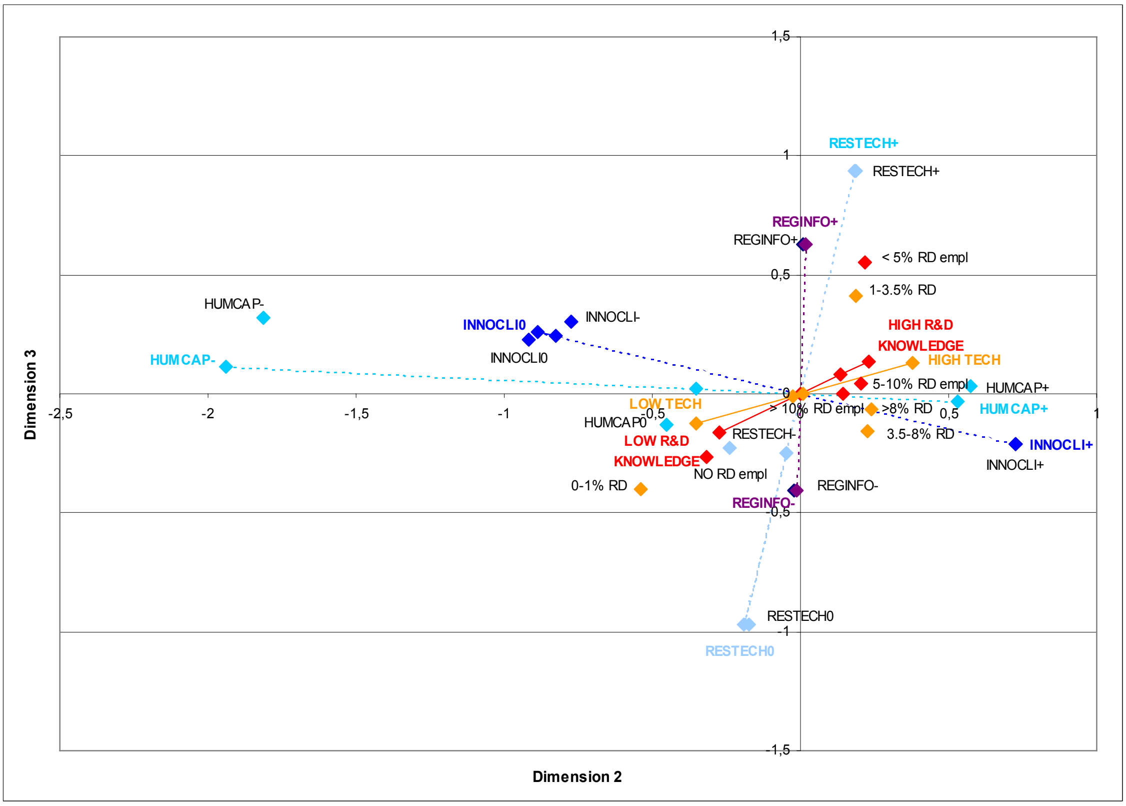
[337] Contrary to the component loadings with opposing signs for these variables (cf. table 16), figure 31 displays the positive endpoints in the northern direction. This is due to the coding of the regional variable (1: positive answer, 2 negative one) whereas the perception vari-

Figure 31: Categorical principal components analysis 2004: The "core model" with innovation input, regional and perception variables (dimensions 2 and 3)



Legend:

- Technology intensity of the firms (R&D expenses: Share of turnover spent for R&D)
- R&D knowledge intensity of the firms (Share of employees working in R&D)
- Perception of research and technology in the region
- Perception of the regional workforce
- Perception of the regional innovation climate
- Mainly regional information sources for innovation

5.3.6.4 The graphical result for the complete model 2004: Innovation input, perceptions and the region according to the sample firm characteristics

Figure 32, figure 33 and figure 34 now show the complete model: Joint outputs of the "core model" – here limited to the vector representations – and the supplementary variables characterising the firms and their activities related to information acquisition. The

ables are coded 1: unfavourable, 2: no impact, 3: favourable, thus displaying the positive evaluation in the highest category.

R&D input variables score highly on the first dimension; figure 32 and figure 33 show their vectors pointing in the same direction. The category points are plotted in the same positions referring to the x-axis, i.e. the first dimension, but combining these results with the (transformed) categories in dimension 2 (figure 32) and dimension 3 (figure 33). The innovation input variables show the lower categories in the western part of the first dimension (cf. figure 32 and figure 33) and the higher categories in the eastern part. In parallel, the REGINFO variable and the human capital perception variables have a considerable score on the first dimension with the positive category of the regional variable – i.e. mainly regional information sources – and positive perceptions of the regional workforce directed towards the lower innovation input categories and *vice versa*. Figure 32 and figure 33 present Alsatian firms in the western and Baden firms in the eastern part, thus associating Alsatian firms with rather moderate innovation input and Baden firms rather with the medium innovation input categories. Figure 32 and figure 33 clearly differentiate the sample firms according to their regional location. This interregional differentiation is resulting from different innovation input patterns between the sample firms in Alsace and Baden. Innovation inputs are thus the outstanding characteristics that – according to the underlying CATPCA model options – explain the highest share of the variance and differentiate the regional sub-samples on the first dimension.

The second dimension is mainly determined by two perception variables: Firms' evaluations of the regional innovation climate and the regional workforce, with the positive endpoints in the north-western part and the neutral and negative perceptions in the south-eastern part whereas the neutral and negative category points of the innovation climate variable are plotted in close neighbourhood.[338] Baden manufacturing firms are plotted in the northern part of figure 32, indicating rather positive perceptions of the Baden innovation climate and the regional workforce.[339]

Baden KIBS are plotted more southly, indicating slightly less positive assessments of the 'general perception variables' HUMCAP and INNOCLI, however still plotted near the positive or positive-neutral parts of the vectors. At the same time, the Baden KIBS category is plotted more easterly than the manufacturing category, pointing at higher innovation input than their manufacturing counterparts. Both Baden firm type categories are represented near the negative category point of the REGINFO vector, i.e. the negation of mainly regional information sources for innovation.

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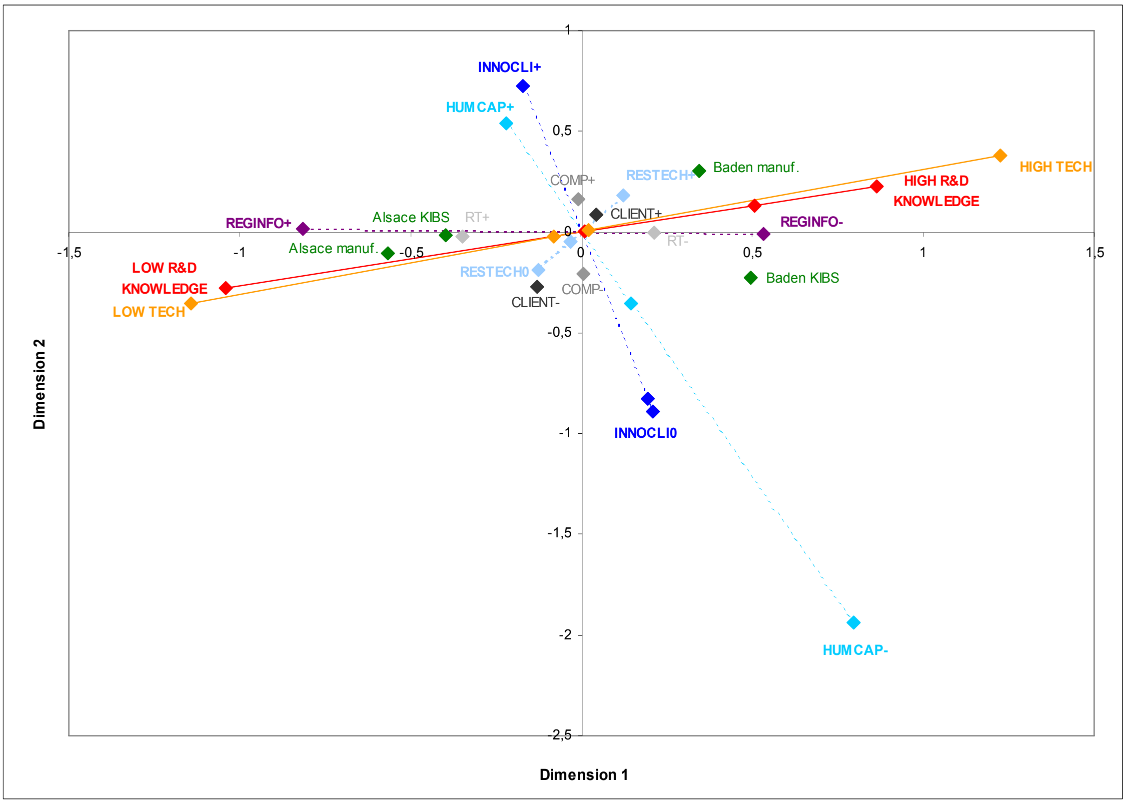
338 The close quantifications are apparent in the transformation plot (cf. figure 43).

339 This becomes even clearer in figure 34.

Figure 32: Results of the categorical principal components analysis 2004 (dimensions 1 and 2)



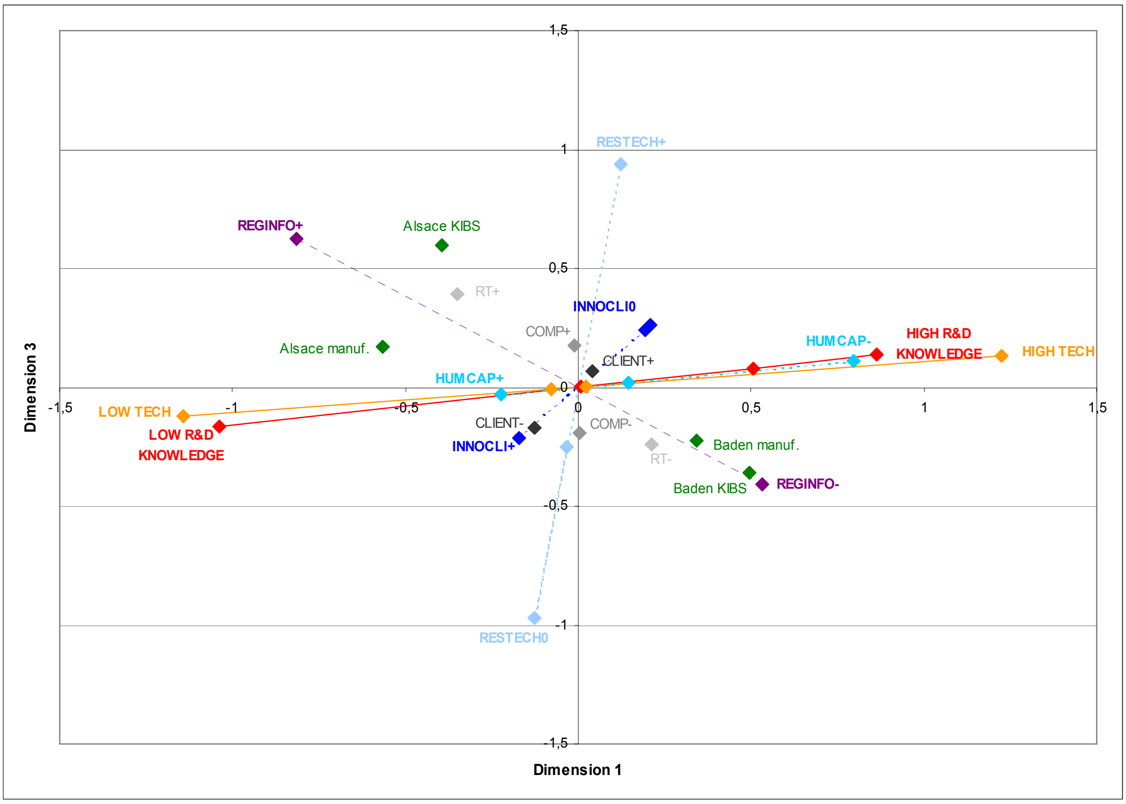
Legend:

Technology intensity of the firms (R&D expenses: Share of turnover spent for R&D)
R&D knowledge intensity of the firms (Share of employees working in R&D)
Perception of research and technology in the region
Perception of the regional workforce
Perception of the regional innovation climate
Mainly regional information sources for innovation
Innovation-related information from clients
Innovation-related information from competitors
Innovation-related information from research and technology
Firm structures

Both Alsatian firm type category points are shown in comparatively close relationship, with KIBS displaying slightly higher innovation inputs than manufacturing firms. Concerning the orientation of the category points in north-south direction, i.e. related to the INNOCLI and HUMCAP perception variables, they do not vary very much, and are rather associated with the relatively positive parts of both vectors. However, both Alsatian firm type category points are displayed in neighbourhood to the positive endpoint of the REGINFO vector, thus being associated to the appreciation of regional information sources. Baden firms rather tend to rely on clients and competitors as information sources for their innovation projects than Alsatian sample firms, which, in turn, are rather associated to positive answers concerning research and technology transfer institutions as innovation-related information source.

Figure 33 combines dimensions 1 and 3 with similar results for the representation on the first dimension, but combined with the results of the third one, i.e. combining the low-high innovation input opposition with the estimation of the research and technology and also the importance of the region as location for innovation-related information sources. Contrary to the innovation input variables that seem to be closely related, the REGINFO and RESTECH variables result in different directions of their vectors. This is due to the fact that the REGINFO variables also has a considerable score on the first dimension (resulting in a northwest – southeast direction of the vector) whereas the RESTECH variable mainly scores on the third dimension, resulting in a higher north-south direction of the vector. Figure 33 clearly associates the Baden category points to the negative endpoint of the REGINFO vector. Considering Baden firms with respect to the RESTECH vector, their reluctant assessments of research and technology supply becomes evident. Contrary to figure 32, Alsatian sample firms are now more separated due to the association of KIBS to the higher positive part of the RESTECH vector. Both Alsatian firm type category points can be found to be associated to the positive endpoint of the REGINFO vector, displaying the general positive assessments of the region as source for innovation-related information.

Figure 33: Results of the categorical principal components analysis 2004 (dimensions 1 and 3)



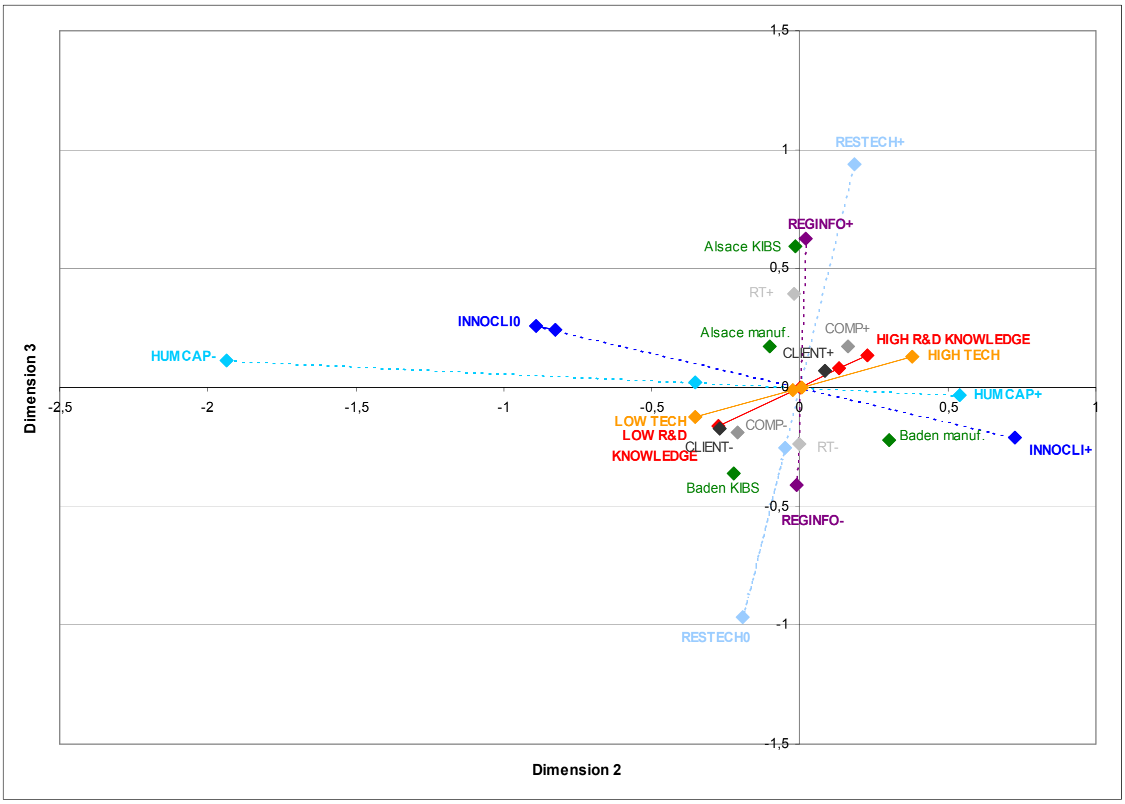
Legend:

- Technology intensity of the firms (R&D expenses: Share of turnover spent for R&D)
- R&D knowledge intensity of the firms (Share of employees working in R&D)
- Perception of research and technology in the region
- Perception of the regional workforce
- Perception of the regional innovation climate
- Mainly regional information sources for innovation
- Innovation-related information from clients
- Innovation-related information from competitors
- Innovation-related information from research and technology
- Firm structures

Figure 34 shows the combined results for the second and the third dimensions, thus focusing on the differentiating effect of the innovation climate and human capital perception variables (dimension 2) and the regional and the research perception ones (dimension 3). The positive evaluations of the regional workforce and the innovation climate are plotted in the eastern part, opposed to neutral and negative categories, whereas the positive evaluation of research and technology in the region and mainly regional information sources for innovation are the northern endpoints of the respective vectors, opposed to negative/ neutral category points in the southern part. As in figure

33, this figure also places Alsatian firm category points in the northern and Baden firm category points in the southern part of the graph. It shows that Alsatian firm points rather differentiate in north-south direction, while having low distances in west-east direction. This points at more distinct assessment differences with respect to research and technology, allocating Alsatian KIBS to the more positive part of the RESTECH vector. The results for the Baden firms point at the opposite: The firm types seem to differ more in their evaluations of the more general perception variables INNOCLI and HUMCAP than concerning the RESTECH and the REGINFO ones. Baden manufacturing sample firms are plotted in closer neighbourhood to the more positive parts of the HUMCAP and INNOCLI vectors. Again, Alsatian sample firms are rather related to positive assessments of the region-related variable, and Baden sample firms to the negative part, with the KIBS of both regions connected to the vector ends, and the manufacturing sample firms being represented between them. Finally, the CATPCA output confirms that the French sample firms are plotted in close neighbourhood to positive evaluations of research and technology as important innovation-related information source, whereas the German sample firms are more reluctant concerning this information source for their innovation projects.

Figure 34: Results of the categorical principal components analysis 2004 (dimensions 2 and 3)



Legend:

- Technology intensity of the firms (R&D expenses: Share of turnover spent for R&D)
- R&D knowledge intensity of the firms (Share of employees working in R&D)
- Perception of research and technology in the region
- Perception of the regional workforce
- Perception of the regional innovation climate
- Mainly regional information sources for innovation
- Innovation-related information from clients
- Innovation-related information from competitors
- Innovation-related information from research and technology
- Firm structures

Switching again back to figure 32, the interpretation may be facilitated by drawing (fictive) lines along the bundle of vectors representing the principal components which are not completely identical with the dimensions. This results from the fact that the variables do not score exclusively on one dimension. Figure 35 gives a more schematic overview of the first two dimensions, which, according to the general model options, explain a high portion of the variance.

Figure 35: Schematic presentation of firm structures in the first and the second dimensions

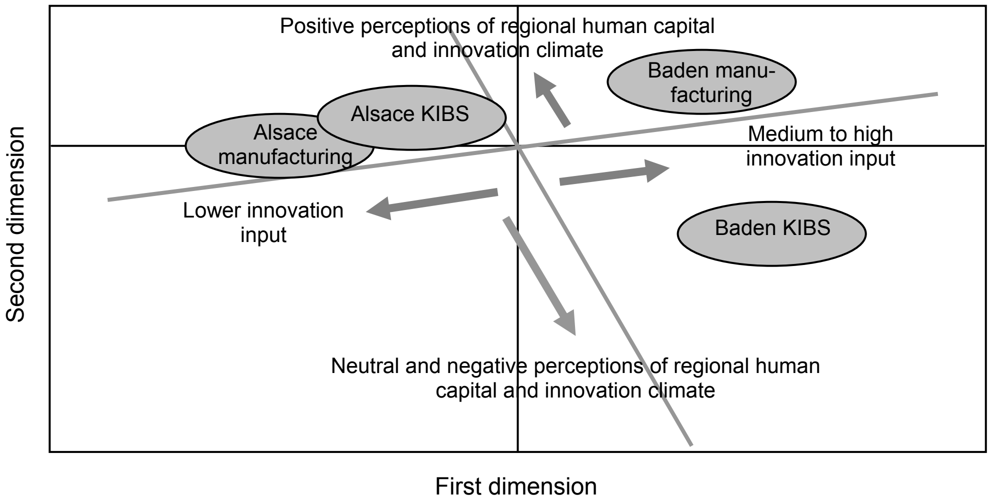


Figure 35 clearly distinguishes between Alsatian and Baden sample firms, and also graphically associates Baden KIBS to slightly less positive evaluations of the workforce and the innovation climate in Baden (however not to the negative vector parts). Alsatian sample firms of both activity types can thus be associated to rather modest internal knowledge creation activities in terms of expenses and employees for R&D, but tend to be comparatively content with the available human capital and the innovation climate in Alsace. Concerning the Baden sample firms, they are generally rather attributed to the higher innovation input categories, with Baden manufacturing firms being the most satisfied firm type concerning workforce and innovation climate. Baden KIBS tend to be the firm type with highest innovation inputs.

5.3.7 Main results of the 2004 analysis of associations

Summarising, the innovation input variables with their high scores on the first dimension explain the highest share of the variance of the model. Lower innovation input is associated to a high relevance of the regional environment for acquiring innovation-related information and *vice versa*. Considering variables and objects, i.e. firm groups, in parallel, the resulting output plots Alsatian firms in the western and Baden ones in the eastern part, thus associating Alsatian sample firms with generally lower innovation input than the Baden ones. The region of Alsace seems to be of higher importance as location for innovation-related information for Alsatian sample firms than this is the case in Baden; here, firms rely on regional and – to a higher extent – on supra-regional information sources. The second dimension is mainly determined by the innovation climate and workforce perception variables, opposing the positive category points to the neutral and negative ones. Here, Baden manufacturing firms are plotted nearest to the positive category points. On the opposite side are Baden KIBS with Alsatian sample firm category points plotted between them. However, the general assessments of these issues are largely positive since all firm groups are located between the positive and the neutral category points, and the distances between the firms type category points in north-south direction are moderate. The third principal component mainly relies on the perceptions of research and technology in the sample regions and – though to a smaller degree – to the regional variable, associating particularly Alsatian KIBS to the positive parts of the vectors. Alsatian manufacturing firms are also plotted near the positive vector parts, however less clear than Alsatian KIBS. Baden firms of both types are rather associated to the opposed parts of the vectors.

The results of the CATPCA contributes to distinguish the following principal components: The first one relates to the innovation input in terms of expenses and human capital devoted to research and development or innovation preparing tasks, whereas the second one can be circumscribed as representing the more general innovation conditions of the regional workforce and the innovation climate. The third component refers to the more specific aspect of research and technology and its evaluations by firm representatives. It refers to knowledge in the form of research results or technology in the innovation process; research and technology seem to be specific in the sense that certain aspects of the innovation process are concerned. But it is also specific from another viewpoint: Research and technology may not be an important input for every innovating firm; the impact of science and research is related to the research intensity of the activity performed.

According to the theoretical and mathematical base of this procedure, the vectors of the (transformed) variables defining the dimensions are orthonormal to those of the other dimensions. R&D expenses and R&D employees are highly correlated and define the first principal component. The regional innovation climate and workforce variables determine the second, and the research and technology variable the third component. This can be interpreted in the sense that the evaluations of the workforce, the innovation climate and research and technology in the region are not – or only to a small part – directly linked to innovation input (for instance in the sense that positive perceptions are associated to high innovation input and *vice versa*). Instead, perceptions and innovation inputs are associated through the sample firms, their innovation behaviours and the assessments of their representatives. General positive perceptions in 2004 characterise firms of both regional sub-samples that are mainly distinguished according to their innovation input. This leads to the orthonormality of the innovation input and general perception vectors. The regional variable is mainly associated with the innovation input variables, relating low innovation input with a high importance of regional information sources for innovation and *vice versa*. On the opposite part, the sample firms plotted on the higher innovation input parts of the vectors seem to base their innovation activities on internal knowledge generation processes as well as regional and – to a higher degree – supra-regional information sources.

The analysis shows that the evaluations of the general framework conditions – the regional innovation climate and the workforce – are rather positively assessed; the firm group centroids are rather found in the positive to neutral parts of the respecting vectors. The evaluations of research and technology in the regions further distinguish Alsatian from Baden sample firms, the former being characterised by more positive assessments than their Baden counterparts. This is also the case concerning the regional variable which may be imagined as mediating the innovation input and the research and technology perception variables (since it scores high on the first and the third dimensions). The positive endpoint of the REGINFO vector is clearly associated to Alsatian firms, thus relating comparatively lower innovation inputs with positive scorings concerning the research and technology perception variable. The opposite seems to be the case in Baden: Here, the sample firms report higher investments for innovation but have a more critical opinion concerning research-related innovation support in their region. Generally, they search for innovation-related knowledge – particularly from clients and competitors – mainly beyond the Baden borders. This indicates knowledge acquisition based on production and market-related sources.

The categorical principal components analysis clearly differentiates the sample firms according to their regional location in Alsace and Baden. Innovation projects seem to differ on both sides of the Rhine: Alsatian firms, particularly KIBS, tend to acquire knowledge from external (regional) research sources rather than generating it internally. This is in line with the aims of Alsatian technology transfer agencies, focusing on the transfer of regionally created scientific and technological knowledge to the private business sector. Baden firms are less oriented towards firm-external knowledge sources; they seem to prefer the internal generation of knowledge. The German sample firms have generally medium to high innovation inputs and evaluate the general innovation conditions more positively than the specific one.

Concluding, a relationship in the sense "positive perceptions correspond to higher innovation input, i.e. stronger engagement in innovation" cannot be established, at least not in this general sense and not for the sample firms of this analysis. The relations between innovation input, perception and regional variables seem to be more complex and pointing at diverging innovation modes of the sample firms. These are rather region-specific, thus embedded in their specific socio-economic, historical and cultural environments. The results of the CATPCA, supplemented by the regional characteristics and the main features of the regional and national innovation regimes (cf. chapter 4), seem to point at an innovation model with generally less internal innovation efforts among the Alsatian manufacturing sample firms. A considerable part of Alsatian sample KIBS seems to engage in knowledge-related activities, this knowledge being acquired from firm-external, but regional sources. Baden firms, on the contrary, follow a path of internal constitution of problem-solving capacities. This path can be expected to be further pursued, since higher shares of Baden than of Alsatian firm representatives expect increasing R&D activities of their firms in the near future. Baden firms additionally attribute externally produced knowledge a lower importance, and search regionally and supra-regionally for innovation-related information.

5.3.8 Analysis of interdependencies in the 1995 investigation

The following chapter aims at performing a similar analysis for the same firms, but with their evaluations and characteristics about ten years earlier. This intertemporal investigation will give further insight about innovation and perception patterns during this time period.

5.3.8.1 Variables and features of the categorical principal components analysis 1995

This intertemporal examination is based on a confrontation of identical methodological proceedings for identical firms at two points in time. Differences in the survey method and in some variables prevent complete comparability, so that the results for both surveys are presented in parallel, instead of computing intertemporal changes in the variables. However, the variables of the "core model" are widely comparable to the 2004 ones. The variable "Share of R&D employees" has not been asked in the mid-1990s survey to knowledge-intensive business service firms. However, it has been introduced in the 1995 analysis, but with a distinct missing value strategy: Objects with missing values have not been included in the analysis of this specific variable. Thus, it has to be kept in mind that the R&D employee variable results can only be interpreted for manufacturing sample firms. The perception variables have been considered in a slightly differing manner, too: First of all, these variables have been asked in the context of a broader question "How do you assess the regional framework conditions for innovation?", encompassing a list of nine categories – among which are the workforce, the innovation climate and the research supply – to be assessed. Furthermore, respondents have been asked to refer to the *Kammerbezirk* (district of the chambers of commerce, corresponding to the *Raumordnungsregion*, cf. chapter 4.1) or *département* which is a smaller scale than the regions of Alsace and Baden (cf. also page 187). A further difference concerns the impact of the regional variable. A comparable question to the 2004 one had been asked to KIBS in 1995.[340] For the CATPCA, a positive category has been coded when one of the three information sources proposed in 2004 (clients, competitors, research institutes) had been positively evaluated in the *Land / Région*. For manufacturing firms, this topic has not been asked in a comparable way. Though firm representatives have been asked to mention their sources for innovation motivation (for product and process innovation), this question did not contain a spatial component. Subsequent questions referred to crucial co-operations with other actors (clients, suppliers, business service firms, further firms, and universities/ research institutes / transfer agencies), to the type and intensity of those co-operations, the number of co-operation partners and the intensity of co-operation as well as the location of those partners. Thus, for manufacturing sample firms, the regional variable has been coded as follows: Firms with "very intensive co-operations" with clients or research institutes[341] either in the *Kammerbezirk / département* or in the *Land / région* received a positive coding. This means that the 'region' here refers to a larger territorial unit on the German side: To the whole *Land* of Baden-Württemberg.

The relevance of clients, competitors and research institutes as information sources for innovative activities has been derived from the 1995 investigation as follows: The KIBS questionnaire combined the information source with its location (see above). A positive coding has been attributed to firms whose representatives indicated the relevance of clients,[342] competitors or research institutes, i.e. who gave an answer other than "no impact", independently from their location. For manufacturing firms, the respective question focused on the information source and the importance of the knowledge acquired (important/ very important/ unimportant). Respondents have been asked to give distinct evaluations for their product and their process innovations. Positive codings have been attributed to firms whose representatives considered the information source as "important" or "very important" for their product or their process innovations.

Even though these variable codings differ slightly from the type of question asked in 2004, it has to be considered that the "core model" refers to nearly identical variables, an exception being the regional variable. The importance of clients, competitors and research institutes belong to the supplementary variables, are thus not considered in determining the principal components. The model options are identical to the 2004 investigation.

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340 In 1995, KIBS had been asked to tick the sources of innovation stimuli during the preceding three years. Respondents were asked to evaluate seven possible information sources and their territorial origin: the *Land / Région*, further regions of their country, and abroad. Further, they had been given the possibility to mark "no impact".

341 The 1995 questionnaire did not contain competitors as category.

342 This question referred to KIBS' industrial clients.

5.3.8.2 Goodness-of-fit and component loadings of the model

The three-dimensional solution of the 1995 model has a total eigenvalue of 4.527 which is slightly higher than for the similar 2005 model. The first dimension has an eigenvalue of 1.687, the second corresponds to 1.561 and the third to 1.278 (cf. table 17).[343]

The component loadings of the 1995 analysis show that the first dimension is explained by the share of R&D employees and R&D expenses, thus the innovation input of the sample firms (cf. table 18). However, both variables have a visible (negative) loading on the third, and the R&D expenses variable also on the second dimension. The second dimension is mainly based on the perception of the research supply in the region and of the regional innovation climate – the latter also has a distinct, negative, impact on the first dimension – whereas the third dimension is highly influenced by the regional variable, though with considerable contribution of both innovation input and the regional workforce variables. On the first dimension, the innovation input variables have the same sign as the human capital one, and are opposed to the innovation climate variable. This means that the high categories of R&D expenses and R&D employees point in the same direction as the positive evaluation of the regional workforce and the 'unfavourable' category of the innovation climate variable (cf. also figure 46, annex 4).

Table 17: Model summary of the categorical principal components analysis with the perception, structural and innovation behaviour variables 1995

Dimension	Cronbach's α	Variance accounted for Total (Eigenvalue)
1	0.489	1.687
2	0.432	1.561
3	0.261	1.278
Total	**0.935***	**4.527**

* The sum of Cronbach's α is based on the sum of the eigenvalues.

Source: Selected from CATPCA output, SPSS 11.0

343 Further information concerning the 1995 CATPCA results are given in annex 4.

Table 18: Component loadings of the categorical principal components analysis 1995

	Dimension		
	1	2	3
Share of R&D employees 95 (% of employees, classes)	,726	,027	-,425
R&D/Innovation expenses 95 (% of turnover, classes)	,661	,369	-,446
Perception of regional human capital 1995	,554	,363	,540
Perception of regional innovation climate 1995	-,513	,687	-,031
Perception of research supply 1995	,002	,859	,250
Very intensive co-operation with clients or research inst. in *Kammerbez./ Département* or *Land/ Région* (manuf.) or location of clients, competitors or research in the *Land/ Région* (KIBS)	,391	-,290	,737
Normalisierung mit Variablen-Prinzipal.			

Source: Selected from CATPCA output, SPSS 11.0

Since the (transformed) variables do generally not exclusively score on one dimension, the principal components are not congruent with the x- and y-axis of the graphical output. The first one can be explained by innovation input and the general perception variables[344] whereas the second component is mainly determined by the specific perception variable (research supply) and additionally the evaluation of the regional innovation climate. The third component strongly refers to the regional variable, with further contributions of the human capital variable and the innovation input (i.e. similar associations as in 2004 on the first dimension). Here, the innovation input variables differ in their sign from the regional variable, indicating that higher innovation inputs are associated to mainly supra-regional co-operation and information patterns.

5.3.8.3 The graphical results for the complete model 1995

Figure 36, figure 37, and figure 38 show the graphical results of the categorical principal components analysis 1995. As for the 2004 analysis, the innovation input variables contribute highest to the first dimension, however their vectors are less close to each other than in the 2004 analysis. This may be due to the fact that the "R&D employee" vector is exclusively determined by manufacturing firms.

As figure 36 shows, both innovation input related variables have the low categories in the western and the highest categories in the eastern part of the graphic: The western

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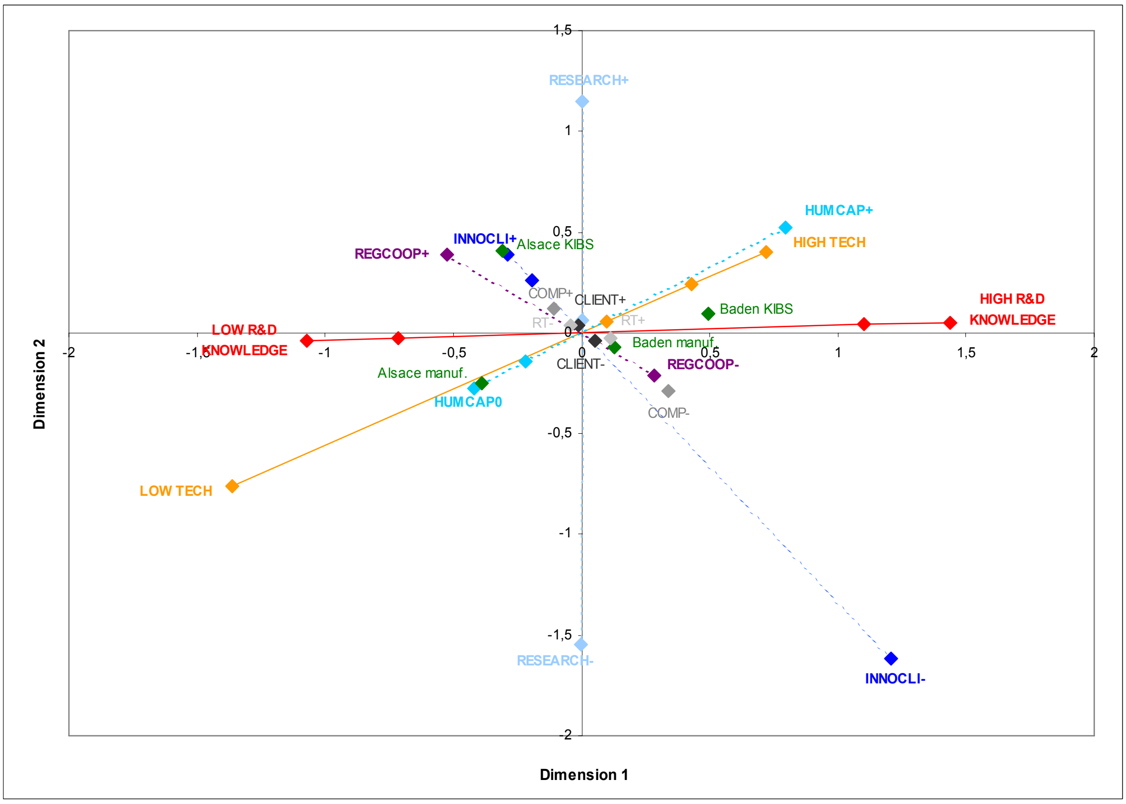
344 This first overview indicates that innovation input and perceptions are not as clearly separated as in the 2004 CATPCA.

part refers to R&D expenses up to 1 % of firms' turnovers and R&D employees up to 5 % of the total employees. Further contributions on the first dimension are made by the perception of the regional workforce – in the sense that higher innovation inputs and positive perceptions point towards the eastern part of the graph – and the innovation climate in the region. This latter variable points in the opposing direction, with the negative evaluation pointing in the eastern part of the graph. The second dimension is significantly determined by the perception of research and technology in the respective regions; the resulting vector is nearly congruent with the y-axis. A further important contribution is the perception of the regional innovation climate, resulting in a vector in northwest-southeast direction – together with the scoring on the first dimension – thus "mediating" innovation input and research perception. The research supply and innovation climate variable vectors have positive signs, i.e. their positive endpoints are directed towards the northern / north-western part of the graph while their negative ends point to the south / southeast. The positive and neutral categories of the INNOCLI variable are plotted in close neighbourhood. Visible, but lower contributions to the second dimension are made by the R&D expenses and the perception of the human capital in the region; since both variables have positive component loadings, i.e. positive correlations with the dimension, their high (here: 'favourable' and 'high tech') ends point towards the higher scales of the y-axis. Figure 36 and figure 38 contrast manufacturing and KIBS sample firms on the second dimension, though to a higher extent among Alsatian than among Baden firms. Among the sample firms, Alsatian KIBS are most attached to research. The position of Alsatian KIBS in the graphical presentations is further explained by positive assessments of the innovation climate; a variable that also shows high scores on the second dimension.

Figure 36: Results of the categorical principal components analysis 1995 (dimensions 1 and 2)



Legend:

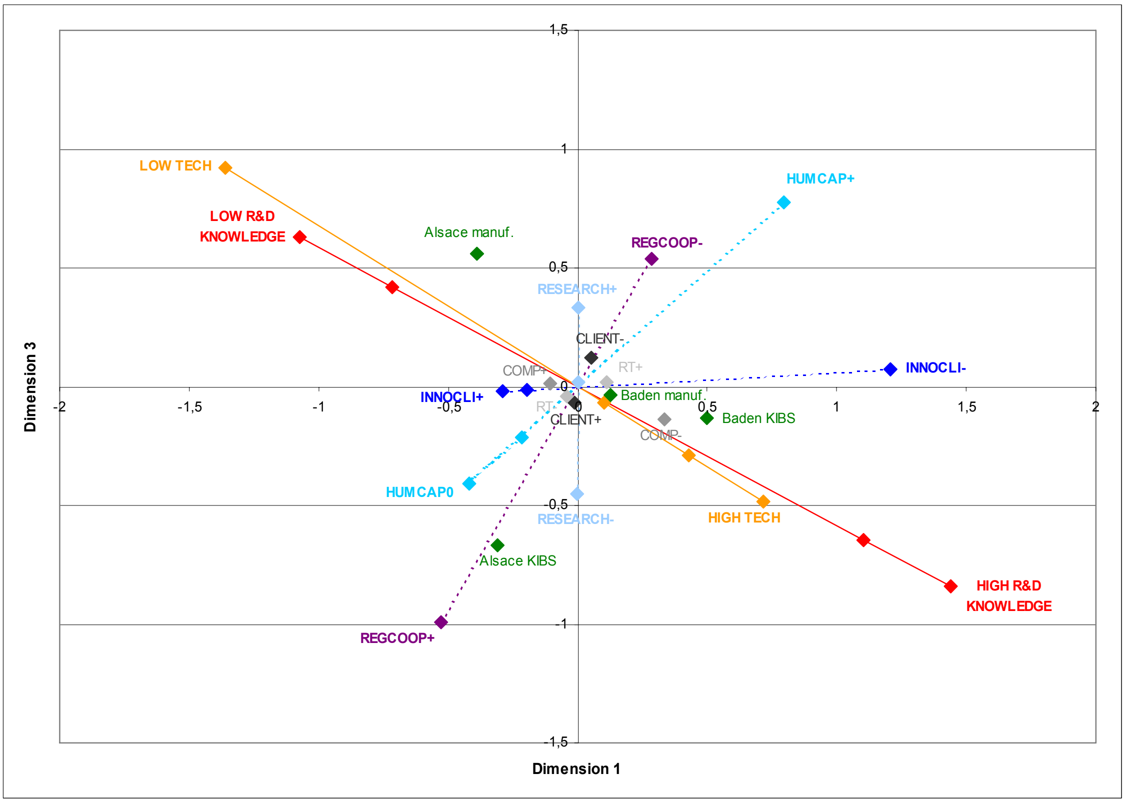
- Technology intensity of the firms (R&D expenses: Share of turnover spent for R&D)
- R&D knowledge intensity of the firms (Share of employees working in R&D)
- Perception of research and technology in the region
- Perception of the regional workforce
- Perception of the regional innovation climate
- Mainly regional information sources for innovation
- Innovation-related information from clients
- Innovation-related information from competitors
- Innovation-related information from research and technology
- Firm structures

Contrary to the 2004 results, the 1995 analysis differentiates slightly less between innovation input and perception variables. The INNOCLI vector mediates the regional research perception and the innovation input; it has high scores on the first dimension, which is strongly related to firms' innovation input, and the second dimension that is to a high degree shaped by the perception of the regional research supply.[345] The

[345] As figure 28 shows, the innovation climate and the research supply received quite similar ratings by the sample firms, except by Alsatian KIBS.

HUMCAP variable, on the other hand, scores highly on the first and the third dimensions, thus associates innovation input and the regional variable, in the sense that positive evaluations of the regional workforce are associated to comparatively higher innovation inputs (first dimension), and also to non-positive assessments of regional co-operation or information sources.

Figure 37: Results of the categorical principal components analysis 1995 (dimensions 1 and 3)

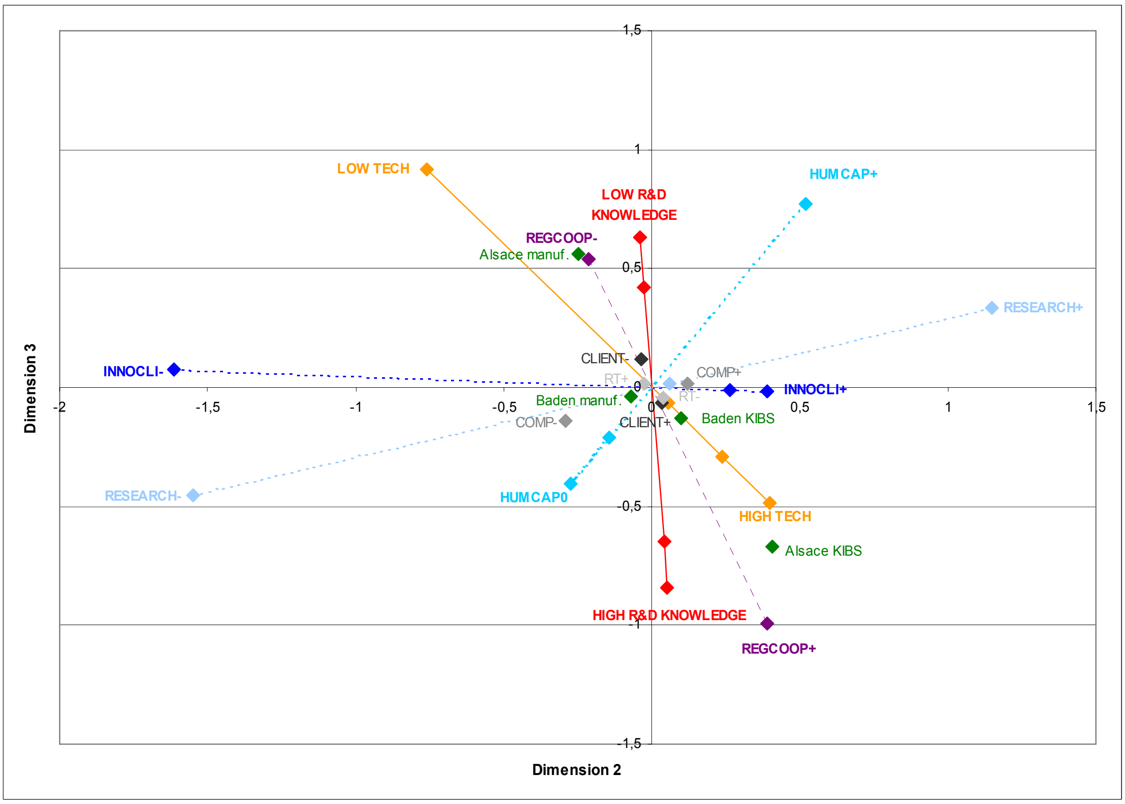


Legend:

- Technology intensity of the firms (R&D expenses: Share of turnover spent for R&D)
- R&D knowledge intensity of the firms (Share of employees working in R&D)
- Perception of research and technology in the region
- Perception of the regional workforce
- Perception of the regional innovation climate
- Mainly regional information sources for innovation
- Innovation-related information from clients
- Innovation-related information from competitors
- Innovation-related information from research and technology
- Firm structures

Figure 36 distinguishes between Alsatian in the western and Baden firms in the eastern part of the output. Alsatian firms thus tend to have lower innovation inputs in terms of expenses and – concerning manufacturing sample firms – employees devoted to research and development or related activities. Furthermore, Alsatian sample KIBS are associated to positive assessments of the regional innovation climate, whereas Alsatian manufacturing firms are plotted close to neutral assessments of the HUMCAP variable. Baden sample firms are plotted in the eastern part of the graph, i.e. tend to have higher innovation inputs with KIBS being closer associated to the higher categories. Baden manufacturing firms are plotted closer to the origin, i.e. comparatively distant to clear positive or negative assessments of the regional innovation aspects selected for this analysis. Figure 37 confirms these findings, associating Baden sample firms to comparatively higher innovation inputs, rather sceptic assessments of the innovation climate, and more positive – particularly Baden KIBS – assessments of the regional workforce. Alsatian sample firm category points can be found in the "rather low innovation input" part of the plot, with a very marked relation of Alsatian KIBS to REGCOOP+. The regional variable differentiates Alsatian KIBS from their manufacturing counterparts, since the latter are associated to the non-positive endpoint of the REGCOOP vector (cf. more clearly in figure 38), indicating no and/ or no regional cooperations with research institutes or clients in Alsace. Baden firms of both types are located in between the endpoints. Concerning research and technology, the sample firms mostly uttered no distinct positive or negative evaluation. With the west-east presentation of the RESEARCH vector, figure 38 shows all firm groups plotted around the neutral category point. Generally, the CATPCA results reflect that the 'no impact' category received high shares of answers in 1995. An exception is the innovation climate which points at more positive perceptions of Alsatian KIBS than for the other firm types (cf. figure 36).

Figure 38: Results of the categorical principal components analysis 1995 (dimensions 2 and 3)



Legend:

- Technology intensity of the firms (R&D expenses: Share of turnover spent for R&D)
- R&D knowledge intensity of the firms (Share of employees working in R&D)
- Perception of research and technology in the region
- Perception of the regional workforce
- Perception of the regional innovation climate
- Mainly regional information sources for innovation
- Innovation-related information from clients
- Innovation-related information from competitors
- Innovation-related information from research and technology
- Firm structures

5.3.9 Main results of the 1995 analysis of associations

The analysis of associations with the help of a categorical principal components analysis for the 1995 data results in a three-dimensional solution with the first principal component being determined by innovation input and the more general perception variables (regional workforce and innovation climate). The second component is mainly determined by the variable 'perception of the research supply', additionally having a rather high contribution of the 'regional innovation climate' variable. The positive and negative vector endpoints have similar orientations, but the positive and neutral categories of the innovation climate vector are plotted relatively near to each other (cf. also the transformation plot in figure 50 which attributes close scores to the 'no impact' and 'rather favourable' categories). The third dimension finally mainly relies on the regional variable, but is to a considerable extent associated to the impact of the regional human capital variable and the innovation input. The general perception variables HUMCAP and INNOCLI show high scores on the first dimension, though the innovation climate proves to be closer associated to the research and technology supply with the positive and negative endpoints being plotted in the same directions (second dimension). Positive assessments of the regionally available human capital seem to be associated to higher innovation input on the one hand (first dimension), and to the negative endpoint of the REGCOOP vector, thus being associated to a comparatively low relevance of regional co-operation partners. Generally, the firm type category points are comparatively close to the neutral category points of the perception variables, reflecting the high share of "no impact" answers and effecting that the firm type category points are plotted not too distant from the origin of the graph.

The innovation input variables effect a representation of Alsatian firms in association to the rather lower categories of the vectors whereas Baden firms rather seem to be related to the higher innovation input part. Concerning the perception variables, the comparatively high shares of 'no impact' answers could indicate that the factors mentioned have not been considered relevant for firms' activities in the mid-1990s. Generally, the CATPCA procedure separates the sample firm types first and foremost according to their innovation input characteristics. Especially Alsatian KIBS seem to have a strong regional orientation concerning innovation-related information, and they appreciate the innovation climate in Alsace. This distinguishes them from their manufacturing counterparts that have rather "non-positive" ratings concerning the importance of regional co-operation partners for innovation. Concerning the evaluations of regional research institutes, all firm type category points are highly associated to the 'no impact' area of the vector.

Baden sample firm types, particularly KIBS, tend to be associated to higher innovation inputs, to rather neutral assessments of the research supply and the innovation climate, and to rather "non-positive" answers concerning co-operations with partners from the region. The innovation climate is rather sceptically evaluated. Baden firm type category points are plotted in closer neighbourhood than the firm types of the Alsatian sub-samples, indicating more homogeneous characteristics and perceptions than sample firm types in Alsace. Though mainly plotted near the origin of the graph, the information sources of clients and competitors can rather be associated to KIBS.

5.3.10 Summary of the CATPCA results in the mid-1990s and 2000s

The analyses of innovation, perception and the region in the mid-1990s and the mid-2000s in the frame of the chosen vector-centroid and core-supplementary model reveal some basic characteristics of selected innovation and perception patterns of manufacturing and knowledge-intensive business service firms in Alsace and Baden at two different points in time. They show that the innovation input variables explain the highest share of the variance, since they are attributed the highest scorings on the first dimension, which - according to the general model options - has the highest explanatory power of the model. This finding proves to be stable at the two points in time considered. The results of the 1995 CATPCA reveal slightly closer associations between innovation input and the rather general perception variables (human capital, innovation climate), the latter seemingly "mediating" the innovation input and the research supply (INNOCLI) as well as innovation input and the regional variable (HUMCAP). Generally, the high shares of "no impact" answers in 1995 are mirrored by plotting the firm groups close to the origin, rather than being associated to positive or negative evaluations. Manufacturing sample firms of both regions are plotted in comparatively close neighbourhood on the second dimension, referring to similar perceptions of the research supply and the innovation climate on both sides of the Rhine, but being related to interregional differences in the innovation input. The 2004 analysis points at comparable perception patterns of the sample firms, in the sense that firms uttered generally higher levels of contentness, but Alsatian and Baden firms still differ in their innovation inputs. These features led to orthonormal vectors of innovation input and (general) perception patterns in 2004.

The intertemporal results indicate crucial features of the sample firms: Firstly, the shift towards rather distinct – mainly positive – assessments of the perception variables between the mid-1990s and the mid-2000s, and secondly the comparative stability of innovation input patterns between the two points in time. This supports the argument that firms behave according to established routines, or that self-reproduction takes place through existing elements. Firms' evaluations of the regional innovation-related framework conditions, on the other hand, indicate different perception patterns of sample firm representatives between the two points in time, pointing at the more evolutive character of perceptions. The perceptions of firm representatives seem to have been improved between the mid-1990s and the mid-2000s: While the firm groups have mainly been associated to the neutral categories in 1995, positive assessments dominate in 2004, however with slightly more pessimistic tendencies of the Baden firms (i.e. with respect to research and technology). Besides the general improvement of firm representatives' perceptions, a very important result is the high appreciation of regional research and technology by Alsatian sample firms in 2004, especially KIBS. They thus seem to use firm-external, but regionally, produced knowledge for their innovations, and also spend parts of their turnover for innovation activities. This characteristic of Alsatian KIBS' innovation mode could not be revealed in 1995; thus it can be assumed that (a part of) French sample KIBS changed their strategy for knowledge acquisition between the two points in time.

The analyses show that interregional differences between Alsatian and Baden sample firms are mainly due to different innovation input characteristics. This indicates that innovation input behaviours tend to be rooted in firm strategies, in innovators' attitudes towards risk-taking and innovation,[346] in the history of and the general culture towards innovation, in the specific political, institutional setting and economic context, in short in firm-internal characteristics and the interplay of region-specific factors. Territory thus "seems to matter" in that firms' innovation models are region-specific and rooted in the general context of their environments. Both regions can be considered as prosperous. Economic development in Alsace is to a remarkable extent related to foreign direct investment, and to rather modest innovation expenses, but good patent performance, framed by innovation policies of the French state and its regional agencies, as well as innovation supporting measures on the regional scale. The analyses show slightly diverging innovation modes and patterns between Alsatian manufacturing sample firms and the sample KIBS. Alsatian KIBS tend to be slightly more knowledge oriented, thus display higher investment for firm-internal knowledge creation than their manufacturing regional counterparts, and show more favourable evaluations of the research supply. This could be understood as potential for regional development: To further support KIBS' activities and to give incentives for them to network with other actors could have a supportive impact on the innovation performance of the regional actors as a whole. The moderate assessments of the innovation climate – which weakened in relation to the 1995 evaluations – give an indication that there are still potentials for improving the innovation conditions for Alsatian KIBS. Baden firms seem to have developed an innovation mode based on internal knowledge generation. They are embedded in an innovation regime with influences from the national level and the federal state of Baden-Württemberg as a strong sub-national governance level. In addition to innovation policies on these levels, bottom-up initiatives with a strong local character have been de-

346 To recall section 2.3, attitudes refer to certain predispositions to respond in a consistent way concerning a certain issue. Attitudes are longer-lasting than perceptions. Though this investigation did not measure firm representatives' attitudes towards innovation, the innovation input behaviours may allow to state that innovation based on firm-internal knowledge creation activities is less an important topic for Alsatian than for Baden firms.

veloped. However, Baden sample firms are not exclusively oriented towards their region when searching for innovation-related information.

The impact of the regions as locations of information sources or co-operation partners with respect to firms' internal innovation activities is assessed differently: The 1995 results show that particularly Alsatian KIBS rate regional information sources pertinent which does not seem to be the case for manufacturing sample firms.[347] The 2004 analysis reveals that Alsatian firm representatives consider Alsace as important main reference for their co-operation and information acquisition activities, while Baden firms rely also on regional, but mainly on extra-regional information sources.[348] The theoretical part evoked the question of mood and creativity, presenting arguments for an inverse relationship between mood and creative efforts. If this is transferred to the context treated here, i.e. if the perceptions concerning the regional innovation climate are contrasted to firms' innovation inputs, the 1995 results show that Alsatian sample firms, in comparison with the Baden ones, have slightly more positive evaluations (also in the sense of less negative ratings) concerning the selected innovation-related variables, but lower innovation inputs than the Baden sample firms. In 2004, Baden KIBS report the highest innovation input, but the most positive ratings concerning the innovation climate are given by Baden manufacturing sample firms. For Baden KIBS in comparison to their manufacturing counterparts then, a tendency towards higher innovation input is observed in parallel to innovation climate assessments below the "top evaluation group". This inverse relationship could be interpreted in the mood/ creativity sense as evoked in section 2.4. At least, as the analysis reveals, positive perceptions are not necessarily related to higher innovation inputs, despite high intensities of innovation-supporting actors and initiatives in both regions. In 2004, generally more favourable perception patterns are attributed by both Alsatian and Baden sample firms, related to differing innovation input behaviours.

Generally, complementing the look at firms' internal innovation activities and at the regional innovation-related infrastructure through the perception perspective allows insights into the structure of regional innovation, and into the 'behavioural environments' in which the sample firms act and innovate. With the integration of the perception perspective, the innovation input behaviour and the view of external observers – research-

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347 This may be partly due to differences in the variable constitution.

348 In his analyses of the German ERIS firms' innovation intensity in relation to their networking structures, Koschatzky (1999: 753) finds that service firms, compared to their manufacturing counterparts, to a higher extent use external knowledge for their innovation activities. This is explained by their generally smaller size which makes it difficult for them to organise innovation preparing tasks internally.

ers or policy-makers – are complemented by the view of firm representatives concerning their regional environment. This component can deliver additional information for the understanding of innovation in its regional context, because perceptions add another dimension in tracing innovation patterns of different firm types in different regions. Regional policy-makers can get information about the way regional firms and their representatives perceive innovation support and the innovation atmosphere in the region. Though the regional innovation conditions are influenced by different governance levels – cf. chapter 4 concerning the national and regional dimensions in Alsace and Baden – and are not completely influenceable by regional policies, the perceptions perspective can help to understand if innovation supporting organisations are part of firms' images of their environment, and if their services are linked to firms' innovation activities. Knowledge about perception processes can be interpreted as a means to link the regional conditions with internal viewpoints in innovative regional firms, and may effect to get a broader picture of firms' innovation processes and activities. This can finally contribute to better embed policy-making in the regional conditions. Crucial seems to be if and how regional firms perceive innovation supporting measures and organisations, and this depends on the matching of firms' innovation activities and the external supporting conditions.

Concluding, despite different survey methods, in some case slightly differing questions and the limited firm sample, the analyses could show that perceptions and innovation inputs are associated through the innovating sample firms and their innovation patterns as well as their cognitive representations of their environments. However, the proceeding chosen here does not allow concluding that the perceptions of the innovation climate, the workforce as well as research and technology in the reference regions have a quantifiable direct and linear influence on firms' innovation inputs. Rather, the revealed patterns lead to draw conclusions about innovation modes of the sample firms in their regional contexts. Further analyses on innovation and perception could contribute to verify the results and to check for the transferability to a larger group of regional firms.

6 Main findings and implications

This analysis tried to complement the issue of innovation and the region – a widely discussed topic in regional economy and geography, in social sciences and economics – by a perception-based approach. It gave an overview of current topics in regional sciences focusing on innovation. Perceptions have been discussed from the psychological and the sociological points of view. Perception and behavioural geographical approaches introduced the spatial reference. Understanding innovation as interactive and social process, the question was raised if perceptions in relation to sample firms' innovation inputs are region specific, or if possible patterns can rather be attributed to the types of activity (manufacturing/ knowledge-intensive business service firms). A further question was if perceptions are rather stable or if they change over time – the empirical part referred to innovation and perception patterns of the same firms (often the same respondents) in 1995 and 2004, and could thus draw two pictures of regional perceptions in time. Both innovation characteristics and perceptions, as well as their development in time allow to deduce specific innovation modes in Alsace and Baden.

Interregional differences of innovation and perception and different innovation modes of the firm types

The analyses detected diverging innovation input and perception patterns in the surveyed regions. Interregional differences proved to be stronger than firm-type specific characteristics; location thus "outperforms" type of activity. Thus, despite some structural similarities such as the strong industrial character of both regions with a focus on advanced technologies, but to a less extent on high-tech (though emerging), as well as the high, but below national shares of service employment, the importance of research, and good patent performances, and the dense net of regional innovation support, the sample firms in their different regional (and national) settings display diverging innovation and (partly) perception patterns. The categorical principal components analyses with innovation input, perception and a regional variable, differentiated Alsatian and Baden sample firms first and foremost according to their innovation input characteristics. Both firm types in the two surveyed regions could then be characterised with respect to outstanding assessments concerning the workforce, the innovation climate and research and technology supply in their regions. These results confirm the assumption of region-specific innovation patterns as well as of the social and context-shaped character of perceptions: Both seem to be territorially rooted, in the sense that innovation and perception patterns are specific in the surveyed territorial settings. The socio-economic, political and institutional frameworks, the cultural characteristics of firms' environments as well as the historical development seem to have an impact on innovators' perceptions and their innovation mentalities.

Both categorical principal components analyses produced solutions with Alsatian firms associated to rather moderate firm-internal innovation inputs and Baden firms to the other side of the high-tech/ high R&D knowledge – low tech/ low R&D knowledge vector. This result is consistent over the time span considered, thus indicating stable innovation-related patterns. However, in both regions, KIBS reported higher investments in innovation preparing tasks than their respective manufacturing counterparts. This tendency of high innovation input can also be confirmed for R&D employees in Baden KIBS, but only in a restricted way for Alsatian ones: In Baden, higher shares of persons working on innovation-related knowledge creation seems to be characteristic for a part of the sample KIBS (2004). Generally, a considerable share of the sample firms nowadays seems to be fairly satisfied with the selected regional conditions for their innovation projects. But the analysis revealed interregional differences in firm representatives' assessments: The perception variables showed the most striking interregional difference with respect to firm representatives' evaluations of research and technology supply in the surveyed regions, which are more positive in Alsace, particularly among KIBS, than in Baden. In Baden, the "best" assessments – in terms of shares of "rather favourable" answers – have been given for the innovation climate (manufacturing sample firms) and the regional workforce (both firm types). In Alsace, the regional workforce received the highest share of positive evaluations among manufacturing sample firms' representatives, while research and technology transfer was rated highest by KIBS. Consequently and also referring to the share of approval of research and technology as innovation-related information, Alsatian KIBS seem to use regional research institutes to a higher degree as information source for their innovative projects than their manufacturing regional counterparts. The region of Alsace does not host an extraordinary high share of knowledge-intensive business service firms, but the sample KIBS seem to have more close relations to regional research institutes than the manufacturing sample firms located in Alsace. This is an advantage for the region as a whole due to the high importance of KIBS as knowledge mediators and processors, as creators of employment and wealth – a higher share of Alsatian sample KIBS expects an increase of their firm size in the medium term – and as 'co-innovators' for regional manufacturing firms. It is also a potential which could be further exploited through a regional focus on KIBS attraction, and innovation support, as well as on KIBS - manufacturing firms' co-operations.

The analysis leads to deduce diverging conclusions for Alsatian manufacturing sample firms. Innovation inputs in terms of expenses and of employees are on average more modest than reported Alsatian sample KIBS. Additionally, the importance of research and technology transfer institutions as well as the perceptions of research and technology supply are less positive than among KIBS. This leads to the conclusion that external knowledge acquisition instead of internal generation is of inferior importance when compared to KIBS. When also considering the past innovation input and firm representatives' expectations for the medium-term evolution of R&D in their firms, it can be concluded that Alsatian manufacturing sample firms have a rather reluctant attitude – here understood as longer-lasting disposition towards innovation – to larger scale innovation activities. More detailed knowledge concerning hampering factors would be necessary to conceive measures for supporting firms' innovation activities. Interlinkages with regional KIBS and/ or research institutes for instance could be successful, but the most challenging factor seems to be related to firms' attitudes towards innovation.

Baden sample firms seem to follow a diverging strategy concerning the acquisition of innovation-related knowledge. They rather generate it internally, through own research and development efforts, than acquiring it from external sources. They mainly rely on clients and also competitors as information sources for their innovative projects. However, these sources are mainly located outside their immediate environment; they thus gather their information and knowledge from region-internal and (mainly) from external sources. The feature of comparatively higher R&D and innovation inputs of Baden sample firms is also supposed to be continued in future; at least considerable shares of the sample firms plan to increase their R&D activities. KIBS representatives report the highest innovation inputs, but Baden manufacturing sample firms witnessed high increases in their R&D staff between the mid-1990s and the mid-2000s. The high shares of positive assessments of the innovation climate in Baden lead to suggest that Baden manufacturing sample firms are satisfied with the innovation conditions in their region. Positive assessments of the regional innovation climate by Baden KIBS are not uttered as often as among manufacturing sample firms. This leads to conclude that the general innovation atmosphere in Baden seems to be more stimulating for manufacturing firms' than for KIBS' innovative activities – a finding that seems to have parallels in Alsace.

Intertemporal changes of perceptions towards higher degrees of contentment

The analysis showed changes in the perceptive structures between the mid-1990s and the mid-2000s. Two marked results have been identified: First, the degree of distinct perceptions among the respondents, i.e. the shift from high shares of indecisive answers in 1995 to high shares of distinct answers in 2004. This can be interpreted as an increase in conscious perception of specific regional innovation-related aspects, or awareness raising concerning the selected innovation-related aspects of firms' environments. According to the theoretical and conceptual approaches in perception research as well as behavioural approaches in geography, aspects with indecisive assessments can be interpreted as not being considered relevant in the 1990s. This said and referring to the phenomenon that "man sees only what he wants to see"

(Walmsley/ Lewis 1985: 64), it can be concluded that considerable shares of firms and their representatives, though innovating, did not consciously include the regional workforce and research institutions as core elements of their innovation strategies in 1995. Nowadays, innovation is widely discussed which incites firms to deal with this topic, and which widens their view on innovation-related matters. So innovators integrate to a higher extent innovation-related issues in their thinking. They are more aware of innovation as a crucial topic and have more clear evaluations of innovation-related aspects in their environment than ten years before. This points at the importance of communication, the necessity of continuous interaction between members of the regional setting. Communication and dialogue processes also contribute to make peoples' subjective representations more explicit.

Secondly, the general improvement of firm representatives' perceptions of the selected regional innovation-related issues has been marked. The innovation environment – measured through the three selected variables – is generally considered more favourably for the sample firms' innovation activities in 2004. The shift in innovators' perceptions may partly be attributed to the changing character of innovation policies. In both regions, policies and initiatives follow a rather 'bottom-up' and networked approach, though with a more recent orientation in Alsace. In both regions, new technologies, such as biotechnology, are focused on. Small and medium-sized enterprises are increasingly integrated in innovation policies, and confronted with innovation issues. However, this shift in perception did not necessarily entail higher innovation input efforts in terms of expenses for internal research and development activities and employees. This points at a specific feature of the Alsatian sample firms: The respondents are rather satisfied with the current situation, and engage to a limited extent in risky innovation projects. Thus, in the case of Alsatian sample firms, associations between positive evaluations of the selected innovation-related characteristics and high engagement in innovation activities cannot be detected at the moment. This leads to the conclusion that high degrees of satisfaction are not necessarily an expression of high engagement in innovation, at least not in high innovation input.

Higher intertemporal stability of innovation input than of perceptive patterns

Generally, the analyses showed that innovation input characteristics are more stable in time than perceptions. The stability of innovation behaviours seems to be rooted in the "path dependency" of innovation features: The departure from the established development path requires high efforts, and it can rarely be expected that firms change their innovation behaviour unless they have striking reasons to do so. As long as their firms succeed on the market, they are more inclined to pursue their established and approved paths of innovative activity, instead of engaging in risky innovation projects whose outcome is uncertain. Heidenreich (2004: 363) terms this phenomenon 'the dilemma of innovation' and concludes: "These problems reflect the fundamental dilemma of innovation: satisfying (even if not optimal) results can be obtained with previous routines, products, technologies, and institutions, while new routines, products, technologies, and institutions require extraordinary investments and the outcomes remain uncertain."

Perceptions, on the other hand, witnessed changes within the nearly ten-year-period considered. This can be explained by the way perceptions emerge and develop, through continuous mental interchanges between perceiver and environment, leading to cognitive processes, which, in turn, frame newly incoming information. It can thus be assumed that perceptions change in time, and, as the analyses have shown, they seem to change more quickly than innovation-related behaviours. As the observation of the sample firms in the mid-1990s and the mid-2000s revealed, the perception pattern developed towards a more distinct view of regional factors related to firms' internal innovation activities. The sample firms and their representatives nowadays rather link their region and the selected innovation-related factors to their internal innovation activities than about ten years ago.

This more favourable representation of the regional settings by innovators can be interpreted as a positive answer to communication processes and policy efforts in the last years. Even though there is a considerable share of firms with indecisive or negative assessments of the selected regional aspects, the sample firms nowadays seem to be more satisfied with the innovation-related conditions of their regions than in the mid-1990s. The detailed reasons for this shift in perceptions, as well as possible implications for innovation support would be subject of further research. It would be interesting to pursue the innovation behaviours and perception structures of the sample firms, and to conclude if the patterns detected here are either stable or are going to change in the future. Further research on the image firm representatives have of their environment, as well as on firms' attitudes towards innovation could complement the findings obtained here. Detailed interviews with selected participants to the surveys could result in a deeper understanding of perception, innovation characteristics and the impact of the region.

In any case, the results obtained point at diverging innovation and perception patterns in the different regions and also with respect to the type of activity of the sample firms. This pleads for a thorough investigation of the specific firm characteristics, and for adapted supporting measures, instead of a general strategy for the whole regional fabric. The results further showed that the sample firm groups seem to pursue their specific paths of innovation-related development: Baden firms with their "innovation tradition", tend to be rather oriented towards the generation of necessary knowledge with their own and internal means, whereas Alsatian KIBS, to a considerable extent (also) rely on externally (but regionally) produced knowledge. Alsatian manufacturing sample firms, finally, can be described as rather modestly engaging in large-scale innovative projects. They seem to pursue a strategy towards incremental innovation rather than breakthrough invention, a strategy which proved to be successful in the past. Finally, it can be concluded that clear positive or negative evaluations of regional conditions are indications for (conscious) perceptions of innovation policies and measures, as well as innovation supporting institutions; preconditions for the use of their services. Thus continuous communication about innovation within the region as well as engagement in network initiatives can be assumed to contribute to raise firms' and innovators' awareness for creativity and innovation.

References

Abbott, B. (2003): Cognitive dissonance theory. Online: http://www.ciadvertising.org/sa/fall_03/adv382J/mbabbott/index.htm (04.10.2006).

Ajzen, I. (2001): Nature and Operation of Attitudes. *Annual Review of Psychology*, 52, 27-58.

Ajzen, I./ Fishbein, M. (1980): *Understanding Attitudes and Predicting Social Behavior*. Englewood Cliffs, New Jersey: Prentice-Hall Inc.

Albrecht, S. (2002): Glossar zur "Bevölkerungs- und Sozialgeographie". Universität Stuttgart. Online: http://www.geographie.uni-stuttgart.de/anthropo/sozial/Glossar_Bevoelkerungs_und_Sozialgeographie.pdf (03.10.2006).

Amin, A./ Cohendet, P. (2004): *Architectures of knowledge*. Firms, capabilities, and communities. New York: Oxford University Press.

Anderson, N./ de Dreu, C.K.W./ Nijstad, B.A: (2004): The routinization of innovation research: a constructively critical review of the state-of-the-science. *Journal of Organizational Behavior*, 25, 147-173.

Asheim, B./ Coenen, L./ Moodysson, J./ Vang, J. (2005): *Regional Innovation System Policy: a Knowledge-based Approach.* Center for Innovation, Research and Competence in the Learning Economy (CIRCLE). CIRCLE Electronic Working Paper Series, paper no. 2005/13. Online: http://www.circle.lu.se/Publications/WP200513.pdf (30.11.2005).

Asheim, B.T./ Herstad, S.J. (2003): Regional innovation systems and the globalising world economy. SPACES, *Spatial Aspects Concerning Economic Structures*. Edited by Bathelt, H./ Strambach, S., Philipps-University of Marburg, Germany, Economic Geography, Faculty of Geography. Online: http://www.geographie.uni-marburg.de/spaces/SPACES_2003-12_Asheim-Herstad.pdf (30.11.2005).

Asheim, B. T./ Cooke, P. (1998): Localized Innovation Networks in a Global Economy: A Comparative Analysis of Endogenous and Exogenous Regional Development Approaches. *Comparative Social Research*, 17, 199-240.

Assemblée Nationale (2005): *La décentralisation (1789 - 2002)*. Online: http://www.assemblee-nationale.fr/histoire/decentralisation.asp (06.06. and 18.10.2006).

Audretsch, D.B./ Lehmann, E.E./ Warning, S. (2005): University spillovers and new firm location. *Research Policy*, 34, 1113-1122.

Audretsch, D.B./ Feldman, M.P. (1996): R&D Spillovers and the Geography of Innovation and Production. *The American Economic Review*, 86(3), 630-640.

Autio, E. (1998): Evaluation of RTD in Regional Systems of Innovation. *European Planning Studies*, 6(2), 131-140.

Bach, L./ Héraud, J.-A. (2003): *Caractéristiques du Système d'Innovation de la Région Alsace.* Presentation at Cycle de Séminaires Vicente Pérez Plaza, Valencia, 27 and 28 February 2003. Online: http://www.ingenio.upv.es/ webingenio/img_semi/bach.pdf (05.06.2006).

Bailly, A.S. (1984): Images de l'espace et pratiques commerciales: l'apport de la géographie de la perception. *Annales de géographie* 93, Paris: Colin.

Bathelt, H. (2005): Cluster Relations in the Media Industry: Exploring the 'Distanced Neighbour' Paradox in Leipzig. *Regional Studies*, 39(1), 105-127.

Bathelt, H./ Glückler, J. (2002): *Wirtschaftsgeographie. Ökonomische Beziehungen in räumlicher Perspektive*. Stuttgart: Eugen Ulmer.

Beffa, J.-L. (2005): *Pour une nouvelle politique industrielle.* Online: http://lesrapports.ladocumentationfrancaise.fr/BRP/054000044/0000.pdf (8.8.2006).

Bem, D. (1972): Self-Perception Theory. Reprint from: *Advances in Experimental Social Psychology*, 6. Online: http://www.dbem.ws/SP%20Theory.pdf (26.8.2006).

Benzécri, J.-P. & Collaborateurs (1976a): *L'Analyse des Données. I La Taxonomie.* Paris: Dunod. Second edition.

Benzécri, J.-P. & Collaborateurs (1976b): *L'Analyse des Données. II L'Analyse des Correspondances.* Paris: Dunod. Second edition.

Benzécri, J.-P. (1969): Statistical Analysis as a Tool to Make Patterns Emerge from Data. In: Watanabe, S. (Ed.): *Methodologies of Pattern Recognition.* The Proceedings of the International Conference on Methodologies of Pattern Recognition. Held at Honolulu, Hawaii, January 24-26, 1968. New York, London: Academic Press, 35-74.

Bernard, G. (1990): Auto-Organisation. In: *Encyclopédie Philosophique Universelle*, Vol. *Notions*, tome 1, PUF, Paris, 215/216. Online: http://www.ai.univ-paris8.fr/CSAR/Hdr.GB/Vol2Trav/11AutoOr.pdf (03.09.2006).

BioValley, The Life Sciences Network (2004a): *Pôle de Compétitivité. Innovations Thérapeutiques. Dossier de candidature à l'appel à projets du CIADT du 15 novembre 2004*. Porteurs du projet: Chambon, P./ Lehn, J.-M./ Marescaux, J./ Neuville, P./ Woler, C. Online: http://www.alsace-biovalley.com/images_messages/image1/63.pdf (19.10.2006).

BioValley (Ed.) (2004b): *About BioValley.* Online: http://www.biovalley.com/dn_about_biovalley/ (6.8.2006).

Blasius, J./ Gower, J.C. (2005): Multivariate Prediction with Nonlinear Principal Components Analysis: Application. *Quality & Quantity*, 39: 373-390.

The BMS (van Meter, K.M./ Schiltz, M.-A./ Cibois, P./ Mounier, L.) (1994): Correspondence Analysis: A History and French Sociological Perspective. In: Greenacre, M./ Blasius, J. (Eds.): *Correspondence Analysis in the Social Sciences. Recent Developments and Applications.* London, San Diego: Academic Press, 128-137.

Boschma, R.A. (2005): Proximity and Innovation: A Critical Assessment. *Regional Studies*, 39(1), 61-74.

Boschma, R.A./ Lambooy, J.G. (1999): Evolutionary economics and economic geography. *Journal of Evolutionary Economics*, 9, 411-429.

Braczyk, H.-J./ Heidenreich, M. (1998): Regional governance structures in a globalized world. In: Braczyk, H.-J./ Cooke, P./ Heidenreich, M. (Eds.): *Regional Innovation Systems*. London, Bristol: UCL Press, 414-440.

Braczyk, H.-J./ Cooke, P./ Heidenreich, M. (Eds.) (1998): *Regional Innovation Systems*. London, Bristol: UCL Press.

Brunet, M. (no year given): *Des Parcs Technologiques, aux Pôles de compétitivité. Le modèle Français d'Innovation Technologique.* Attaché pour la Sciences et la Technologie, Consulat Général de France à São Paulo. Online: http://www.ambafrance.org.br/saopaulo/francais/presence_francaise/innovation_modele_francais.doc (18.10.2006).

Bundesamt für Bauwesen und Raumordnung, Statistische Ämter des Bundes und der Länder (Eds.) (2005): INKAR. Indikatoren und Karten zur Raumentwicklung. Ausgabe 2004. Bonn.

Bundesministerium für Bildung und Forschung [BMBF] (Ed.) (2006a): *Die technologische Leistungsfähigkeit Deutschlands.* Prepared by Niedersächsisches Institut für Wirtschaftsforschung (NIW) Hannover, Bundesinstitut für Berufsbildung (BIBB) Bonn, Deutsches Institut für Wirtschaftsforschung (DIW) Berlin, Forschungsinstitut für Bildungs- und Sozialökonomie (FiBS) Köln, Hochschul-Informations-System (HIS) Hannover, Fraunhofer-Institut für System- und Innovationsforschung (ISI) Karlsruhe, Wissenschaftsstatistik im Stifterverband für die Deutsche Wissenschaft (WSV) Essen and Zentrum für Europäische Wirtschaftsforschung (ZEW) Mannheim. Authors: H. Legler, B. Gehrke. Online: http://www.bmbf.de/pub/tlf_2006.pdf (25.07.2006).

Bundesministerium für Bildung und Forschung [BMBF] (Ed.) (2006b): *Ideen zünden. Die Hightech-Strategie für Deutschland.* Bonn, Berlin. Online: http://www.bundesregierung.de/Content/DE/Artikel/2006/08/__Anlagen/2006-08-30-bmbf-langfassung,property=publicationFile.pdf (21.10.2006).

Bundesministerium für Bildung und Forschung [BMBF] (Ed.) (2003): Futur: Der deutsche Forschungsdialog. Eine erste Bilanz. Bonn. Online: http://www.bmbf.de/pub/futur_eine_erste_bilanz.pdf (24.11.2006).

Bureth, A./ Héraud, J.-A. (2001): Institutions of Technological Infrastructure (ITI) and the Generation and Diffusion of Knowledge. In: Koschatzky, K./ Kulicke, M./ Zenker, A. (Eds.): *Innovation Networks. Concepts and Challenges in the European Perspective*. Technology, Innovation and Policy Series of the Fraunhofer Institute for Systems and Innovation Research (ISI), Vol. 12. Heidelberg: Physica-Verlag, 69-91.

Butzin, B. (2000): Netzwerke, *Kreative Milieus* und *Lernende Region*: Perspektiven für die regionale Entwicklungsplanung? *Zeitschrift für Wirtschaftsgeographie*, 44(3/4), 149-166.

Camagni, R.P. (1991a): Technological Change, Uncertainty and Innovation Networks: Towards a Dynamic Theory of Economic Space. In: Boyce, D.E. (Ed.): *Regional science: Retrospect and prospect*. Berlin: Springer, 211-249.

Camagni, R. (1991b): Local 'milieu', uncertainty and innovation networks: towards a new dynamic theory of economic space. In: Camagni, R. (Ed.): *Innovation Networks: Spatial Perspectives*. London: Belhaven, 121-142.

Capgemini Consulting, Technology, Outsourcing (2004): *BioValley Cluster Analysis.* Executive Summary. October 2004. Online: http://www.de.capgemini.com/m/de/tl/BioValley_Cluster_Analysis_-_Executive_Summary_October_2004.pdf (13.8.2006).

Centre National de la Recherche Scientifique [CNRS], Délégation Alsace (2005): *Le CNRS en Alsace. Chiffres 2004.* Online: http://www.alsace.cnrs.fr/communication/images/chiffres_2004.pdf (06.06.2006).

Chambre de Commerce et d'Industrie de Strasbourg et du Bas-Rhin (2005): *Chiffres-Clés pour l'Alsace.* Online: http://information.strasbourg.cci.fr/chiffres/CC-alsace-FR-2005.pdf (03.07.2006).

Chesnais, F. (1993): The French National System of Innovation. In: Nelson, R.R. (Ed.): *National Innovation Systems. A Comparative Analysis.* New York, Oxford: Oxford University Press, 192-229.

Cohen, W./ Levinthal, D.A. (1990): Absorptive capacity. A new perspective on learning and innovation. *Administrative Science Quarterly,* 35, 128-152.

Commission of the European Communities (2006): *Putting knowledge into practice: A broad-based innovation strategy for the EU.* Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions. COM(2006) 502 final, Brussels, 13.9.2006. Online: http://www.europe-innova.org/exportedcontent/docs/6/6206/en/EN%20502%20-%20original.doc (13.10.2006).

Commission of the European Communities (2002): More Research for Europe. Towards 3 % of GDP. Communication from the Commission, COM(2002) 499 final. Brussels. Online: http://www.belspo.be/belspo/3percent/pdf/com2002_0499en01.pdf (16.12.2006).

Cooke, P. (2004): Introduction. Regional innovation systems – an evolutionary approach. In: Cooke, P./ Heidenreich, M./ Braczyk, H.-J. (Eds.): *Regional Innovation Systems. The role of governance in a globalized world.* 2nd edition. London, New York: Routledge, 1-18.

Cooke, P. (1998): Introduction: origins of the concept. In: Braczyk, H.-J./ Cooke, P./ Heidenreich, M. (Eds.): Regional Innovation Systems. London: UCL Press, London, 2-25.

Cooke, P. (1992): Regional Innovation Systems: Competitive Regulation in the New Europe. *Geoforum*, 23(3), 365-382.

Cooke, P./ Heidenreich, M./ Braczyk, H.-J. (Eds.) (2004): *Regional Innovation Systems. The role of governance in a globalized world.* 2nd edition. London, New York: Routledge.

Cooke, P./ Gomez Uranga, M./ Etxebarria, G. (1997): Regional innovation systems: Institutional and organisational dimensions. *Research Policy*, 26, 475-491. Reprinted in: Edquist, C./ McKelvey, M. (Eds.) (2000): *Systems of Innovation: Growth, Competitiveness and Employment*. Volume I. Cheltenham, UK, Northampton, MA, USA: Elgar Reference Collection, 156-172.

Cowan, R./ Foray, D. (1997): The Economics of Codification and the Diffusion of Knowledge. *Industrial and Corporate Change*, 6(3), 595-622.

Crano, W.D./ Prislin, R. (2006): Attitudes and Persuasion. *Annual Review of Psychology*, 57, 345-374.

Debus C. (2002): Routine und Innovation. Management langfristigen Wachstums etablierter Unternehmungen. Publikation des Marburger Förderzentrums für Existenzgründer aus der Universität Mafex, Band 4. Online: http://archiv.ub.uni-marburg.de/diss/z2003/0297/pdf/debus.pdf (28.12.2006).

Dicken, P. / Malmberg, A. (2001): Firms in Territories: A Relational Perspective. *Economic Geography*, 77, 345-363.

Direction régionale du commerce extérieur (2006): *L'économie de la région. Fiche d'identité de la région.* Online: http://www.missioneco.org/Alsace/documents.asp?IDdocument=6027&F=HTML&rub=3 (17.10.2006).

Dispan, J./ Stieler, S. (2005): Perspektiven der Technologiepolitik und Innovationsförderung in Baden-Württemberg. In: Krumbein, W./ Ziegler, A. (Eds.): *Perspektiven der Technologie- und Innovationsförderung in Deutschland. Impulse und Erfahrungen der Innovations- und Technologiepolitik in den Bundesländern.* Marburg: Schüren Verlag, 51-77.

Dosi, G. (1988): The Nature of the Innovative Process. In: Dosi, G./ Freeman, C./ Nelson, R./ Silverberg, G./ Soete, L. (Eds.): Technical Change and Economic Theory, chapter 10. London, New York: Pinter Publishers, 221-238. Reprinted in: Edquist, C./ McKelvey, M. (Eds.) (2000): *Systems of Innovation: Growth, Competitiveness and Employment*. Volume II. Cheltenham, UK, Northampton, MA, USA: Elgar Reference Collection, 122-139.

Downs, R.M. (1976): Personal constructions of personal construct theory. In: Moore, G.T./ Golledge, R.G. (Eds.): *Environmental Knowing*. Dowden, Hutchinson & Ross, Stroudsburg, 72-87.

Downs, R.M./ Stea, D. (1974a): Theory. In: Downs, R.M./ Stea, D. (Eds.): *Image and Environment. Cognitive Mapping and Spatial Behavior.* Chicago: Aldine Publishing Company, 1-7.

Downs, R.M./ Stea, D. (1974b): Cognitive Maps and Spatial Behavior: Process and Products. In: Downs, R.M./ Stea, D. (Eds.): *Image and Environment. Cognitive Mapping and Spatial Behavior.* Chicago: Aldine Publishing Company, 8-26.

Drucker, P.F. (1985): *Innovation and Entrepreneurship. Practice and Principles.* London: Heinemann.

Eagly, A. H./ Chaiken, S. (1984): Cognitive Theories of Persuasion. In: Berkowitz. L. (Ed.): *Advances in Experimental Social Psychology*, Vol. 17. New York: Academic Press, 268-359.

Eckerle, E. (2000): *Zur Verkörperung von Wahrnehmung durch Gestaltung*. Vortrag an der Universität Karlsruhe, 12.10.2000. Online: http://www.eberhard-eckerle.de/theo_im.html (July 2005).

Edquist, C. (1997): Systems of Innovation Approaches – Their Emergence and Characteristics. In: Edquist, C. (Ed.): *Systems of Innovation: Technologies, Institutions and Organizations*. London, Washington: Pinter, 1-35. Reprinted in: Edquist, C./ McKelvey, M. (Eds.) (2000): *Systems of Innovation: Growth, Competitiveness and Employment*. Volume I. Cheltenham, UK, Northampton, MA, USA: Elgar Reference Collection, 3-37.

Entreprises Territoires et Développement (ETD) (2003): *Contractualisation. Le volet territorial des CPER.* Online: http://www.projetdeterritoire.com/spip/dossier.php3?id_rubrique=14 (10.07.2006).

European Commission, Enterprise & Industry Directorate General, Innovation Policy Development unit (Ed.) (2005a): *Annual Innovation Policy Trends and Appraisal Report Germany 2004-2005.* European Trend Chart on Innovation. Country Report 2005 for Germany. Report prepared by Christian Rammer, Centre for European Economic Research (ZEW), Mannheim. Online: http://trendchart.cordis.lu/reports/documents/Country_Report_Germany_2005.pdf (26.07.2006).

European Commission, Enterprise & Industry Directorate General, Innovation Policy Development unit (Ed.) (2005b): *Annual Innovation Policy Trends and Appraisal Report France 2004-2005.* European Trend Chart on Innovation. Country Report 2005 for France. Report prepared by Katharina Warta, Sophie Bussillet, Aurélie Tricoire, Technopolis France. Online: http://trendchart.cordis.lu/reports/documents/Country_Report_France_2005.pdf (11.07.2006).

European Commission (Ed.) (2000): *Innovation Policy in a Knowledge-Based Economy.* A MERIT Study Commissioned by the European Commission, Enterprise Directorate-General, EUR 17023.

Eurostat (Ed.) (2006): *European regional and urban statistics – Reference guide*. 2006 Edition. European Commission, Theme General and regional statistics. Online: http://www.eds-destatis.de/Onlines/publ/en1_regio_urban_ref_guide.pdf (13.8.2006).

Fallgatter, M./ Koch, L.T. (2000): Ausgewählte Argumentationslinien erkenntnis-relativistischer Organisationsforschung. Bestandsaufnahme und Perspektiven. In: Hejl, P./ Stahl, H.K. (Eds.): *Management und Wirklichkeit. Das Konstruieren von Unternehmen, Märkten und Zukünften*. Heidelberg: Carl-Auer-Systeme Verlag, 77-99.

Feldman, M. (1999): The New Economics of Innovation, Spillovers and Agglomeration: A Review of Empirical Studies. *Economics, Innovation and New Technology*, 8, 5-25.

Fenrich, H., Oberbürgermeister der Stadt Karlsruhe, Vorsitzender der Gesellschaft TechnologieRegion Karlsruhe (2005): Leitlinien. *TechnologieRegion Karlsruhe*. Hightech trifft Lebensart. Online: http://www.*TechnologieRegion*-karlsruhe.de/ueber/standort/leitlinien (5.8.2006).

Fier, A. (2002): *Staatliche Förderung industrieller Forschung in Deutschland. Eine empirische Wirkungsanalyse der direkten Projektförderung des Bundes*. Schriftenreihe des Zentrums für Europäische Wirtschaftsforschung (ZEW) Mannheim, Band 62. Baden-Baden: Nomos Verlagsgesellschaft.

Fishbein. M./ Ajzen, I. (1975): *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research.* Reading, Massachusetts et al.: Addison-Wesley Publ.

Fliedner, D. (1993): *Sozialgeographie.* Berlin, New York: de Gruyter.

Florida, R./ Tinagli, I. (2004): *Europe in the Creative Age.* Carnegie Mellon Software Industry Center. Co-published in Europe with Demos. Online: http://www.creativeclass.org/acrobat/Europe_in_the_Creative_Age_2004.pdf (05.10.2006).

Florida, R. (2002): The Economic Geography of Talent. *Annals of the Association of American Geographers*, 92(4), 743-755.

Florida, R. (1995): Toward the Learning Region. *Futures,* 27(5), 527-536.

Fraunhofer-Institut für Systemtechnik und Innovationsforschung (ISI), Deutsches Institut für Wirtschaftsforschung (DIW), Institut für Weltwirtschaft (IfW), Niedersächsisches Institut für Wirtschaftsforschung (NIW) (2000): *Regionale Verteilung von Innovations- und Technologiepotentialen in Deutschland und Europa.* Endbericht an das Bundesministerium für Bildung und Forschung, Referat Z 25. Online available at http://www.isi.fhg.de/r/regionalstudie/studie.htm.

Freeman, C. (1995): The 'National System of Innovation' in historical perspective. *Cambridge Journal of Economics*, 19, 5-25. Reprinted in: Edquist, C./ McKelvey, M. (Eds.) (2000): *Systems of Innovation: Growth, Competitiveness and Employment*. Volume I. Cheltenham, UK, Northampton, MA, USA: Elgar Reference Collection, 41-60.

Freeman, C. (1992): Formal Scientific and Technical Institutions in the National System of Innovation. In: Lundvall, B.-Å. (Ed.): *National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning*. London: Pinter Publishers, 169-187.

Fritsch, M./ Koschatzky, K./ Schätzl, L./ Sternberg, R. (1998): Regionale Innovationspotentiale und innovative Netzwerke. *Raumforschung und Raumordnung*, 4, 243-252.

Fromhold-Eisebith, M. (1999): Das "kreative Milieu" – nur theoretisches Konzept oder Instrument der Regionalentwicklung? *Raumforschung und Raumordnung*, 5, 168-175.

Gagnol, L./ Héraud, J.-A. (2001): Impact économique régional d'un pôle universitaire: Application au cas Strasbourgeois. *Revue d'Économie Régionale et Urbaine* n° 4, 581-604.

George, J.M./ Zhou, J. (2002): Understanding When Bad Moods Foster Creativity and Good Ones Don't: The Role of Context and Clarity of Feelings. *Journal of Applied Psychology*, 87(4), 687-697.

Gifi, A. (1990): *Nonlinear Multivariate Analysis*. Edited by Heiser, W./ Meulman, J./ van den Berg, G. Chichester et al.: Wiley.

Goetz, M. (2003): *La politique de la Région Alsace dans le domaine de l'innovation*. Presentation at Cycle de Séminaires Vicente Pérez Plaza, Valencia, 27 and 28 February 2003. Online: http://www.ingenio.upv.es/webingenio/img_semi/goetz.pdf (05.06.2006).

Gold, J.R. (1980): *An Introduction to Behavioural Geography*. New York: Oxford University Press.

Golledge, R.G./ Stimson, R.J. (1990): *Analytical Behavioural Geography*. London: Routledge. Reprint, first published 1987 by Croom Helm.

Gould, P.R. (1974): On Mental Maps. In: Downs, R.M./ Stea, D. (Eds.): *Image and Environment. Cognitive Mapping and Spatial Behavior.* Chicago: Aldine Publishing Company, 182-220.

Gower, J. C./ Blasius, J. (2005): Multivariate Prediction with Nonlinear Principal Components Analysis: Theory. *Quality & Quantity*, 39, 359-372.

Greenacre, M. J. (1984): *Theory and Applications of Correspondence Analysis.* London, Orlando: Academic Press.

Greenacre, M/ Blasius, J. (Eds.) (1994): Correspondence Analysis in the Social Sciences. Recent Developments and Applications. London, San Diego: Academic Press.

Greenwald, A.G. (1990): What cognitive representations underlie social attitudes? *Bulletin of the Psychonomic Society*, 28(3), 254-260.

Greif, S. (2000): *Regionale Verteilung von Innovations- und Technologiepotentialen in Deutschland im Spiegel von Patenten*. Sonderauswertung im Rahmen der Studie "Regionale Verteilung von Innovations- und Technologiepotentialen in Deutschland und Europa" (Fraunhofer ISI et al. 2000). Online available at http://www.isi.fhg.de/r/regionalstudie/studie.htm.

Greif, S./ Schmiedl, D. (2002): Patentatlas Deutschland, Ausgabe 2002. Dynamik und Strukturen der Erfindungstätigkeit. München: Deutsches Patent- und Markenamt.

Grenzmann, C./ Marquardt, R. (2005): Forschung mit angezogener Bremse. FuE in Deutschland. In: Stifterverband für die Deutsche Wissenschaft (Ed.): *FuE Info* 2/2005, 2-7.

Grupp, H. (1997): *Messung und Erklärung des Technischen Wandels. Grundzüge einer empirischen Innovationsökonomik.* Berlin, Heidelberg: Springer.

Grupp, H./ Schmoch, U./ Koschatzky, K. (1998): Science and Technology Infrastructure in Baden-Wuerttemberg and Its Orientation towards Future Regional Development. *Journal of the American Society for Information Science*, 49(1), 18-29.

Hajos, A. (1972): *Wahrnehmungspsychologie. Psychophysik und Wahrnehmungsforschung.* Stuttgart, Berlin, Köln, Mainz: Kohlhammer.

Hansen, H.K./ Vang, J./ Asheim, B.T. (2005): The Creative Class and Regional Growth: Towards a Knowledge Based Approach. CIRCLE Electronic Working Paper Series, Paper no. 2005/15, Sweden. Online: http://www.circle.lu.se/Publications/WP200515.pdf (31.11.2005).

Harding, R. (2001): Competition and Collaboration in German Technology Transfer. *Industrial and Corporate Change*, 10(2), 389-417.

Harré, R. (2002): *Cognitive Science. A Philosophical Introduction.* London, Thousand Oaks, New Delhi: Sage.

Hart, R.A./ Moore, G.T. (1974): The Development of Spatial Cognition: A Review. In: Downs, R.M./ Stea, D. (Eds.): *Image and Environment. Cognitive Mapping and Spatial Behavior.* Chicago: Aldine Publishing Company, 246-288.

Hartung, J./ Elpelt, B. (1999): *Multivariate Statistik. Lehr- und Handbuch der angewandten Statistik.* München, Wien: Oldenbourg.

Hassink, R. (1996): Regional Technology Policies in the Old and New Länder of Germany: Case-studies from Baden-Württemberg and Thuringia. *European Urban and Regional Studies*, 3(4), 287-303.

Heidenreich, M. (2004): Conclusion. The dilemmas of regional innovation systems. In: Cooke, P./ Heidenreich, M./ Braczyk, H.-J. (Eds.): *Regional Innovation Systems. The role of governance in a globalized world.* Second edition. London, New York: Routledge, 363-389.

Heidenreich, M./ Krauss, G. (2004): The Baden-Württemberg production and innovation regime. In: Cooke, P./ Heidenreich, M./ Braczyk, H.-J. (Eds.): *Regional Innovation Systems. The role of governance in a globalized world.* Second edition. London, New York: Routledge, 186-213.

Hejl, P.M. (2000): Das Ende der Eindeutigkeit. Einladung zum erkenntnistheoretischen Konstruktivismus. In: Hejl, P./ Stahl, H.K. (Eds.): *Management und Wirklichkeit. Das Konstruieren von Unternehmen, Märkten und Zukünften*. Heidelberg: Carl-Auer-Systeme Verlag, 33-64.

Hejl, P.M./ Stahl, H.K. (2000): Einleitung. Acht Thesen zu Unternehmen aus konstruktivistischer Sicht. In: Hejl, P./ Stahl, H.K. (Eds.): *Management und Wirklichkeit. Das Konstruieren von Unternehmen, Märkten und Zukünften*. Heidelberg: Carl-Auer-Systeme Verlag, 13-29.

Hejl, P.M. (1994): Soziale Konstruktion von Wirklichkeit. In: Merten, K./ Schmidt, S.J./ Weischenberg, S. (Eds.): *Die Wirklichkeit der Medien. Eine Einführung in die Kommunikationswissenschaft*. Opladen: Westdeutscher Verlag, 43-59.

Héraud, J.A. (2004): *Science, Technology and Innovation Policy: New governance schemes in Europe, in France and at regional level.* Paper written on the basis of a contribution to the Symposium "Developments and Policies on Advanced Technologies", organised by the Centre of Advanced Policy Science (CAPS), Toyo University. Tokyo, 24 Sept 2004. Online: http://cournot2.u-strasbg.fr/users/beta/divers/ArticlepourToyo(def-8dec04).pdf (05.06.2006).

Héraud, J.-A./ Kahn, R./ Muller, E./ Sander, A./ Zenker, A. (2000): *Institutions and regional innovation capabilities: a functional mapping of knowledge interactions in the case of Alsace and Baden*. Paper prepared under the scope of the CONVERGE project, supported by the European Commission, DG XII, TSER programme and presented at the 3rd CONVERGE meeting, CSIC, Madrid, 5 Oct. 2000. Online available at http://pascal.iseg.utl.pt/~converge/pdfs/(3).pdf.

Hilpert, M. (2001): Regionaldarwinismus – Evolution von High-Tech-Regionen. *Zeitschrift für Wirtschaftsgeographie*, 45(2), 73-84.

Hilpert, M. (2000): Beschäftigungseffekte lokaler Technologiepolitik. Die Beispiele Ulm und Karlsruhe. *STANDORT – Zeitschrift für Angewandte Geographie* 4, 10-15.

Hirsch, S. (1967): *Location of Industry and International Competitiveness*. Oxford: Clarendon Press.

Huwer, U. (2003): *Kombinierte Mobilität gestalten: Die Schnittstelle ÖPNV – CarSharing. Dissertation, Universität Kaiserslautern*. Online: http://kluedo.ub.uni-kl.de/volltexte/2003/1537/pdf/kluedo-1537.pdf, URN: urn:nbn:de:bsz:386-kluedo-15370 (18.03.2006).

Iammarino, S. (2005): An Evolutionary Integrated View of Regional Systems of Innovation: Concepts, Measures and Historical Perspectives. *European Planning Studies*, 13(4), 497-519.

Industrie- und Handelskammer Karlsruhe (2005): Der Wirtschaftsraum *TechnologieRegion Karlsruhe* 2005. Online: http://www.karlsruhe.ihk24.de/produktmarken/standortpolitik/zahlenundfakten/Verborgene_Dateien_Zahlen/Wirtschaftsraum_*TechnologieRegion*_Karlsruhe_2005.pdf (17.8.2006).

Industrie- und Handelskammer Karlsruhe (Ed.) (2003): Die *TechnologieRegion Karlsruhe* aus Unternehmenssicht der Medien- und IT-Wirtschaft. Vergleichende Analysen einer Unternehmensbefragung im Jahre 2002 mit Ergebnissen des Jahres 2000. Vorgelegt vom Fraunhofer-Institut für Systemtechnik und Innovationsforschung, Peter Zoche. Karlsruhe: IHK. Online: http://www.karlsruhe.ihk24.de/KAIHK24/KAIHK24/produktmarken/innovation/Verborgene_Dateien_Innovation_und_Umwelt/Anlagen_Innovation_und_Umwelt/IT_Studie.pdf (4.8.2006).

Industrie- und Handelskammer Region Stuttgart (Ed.) (2003): *Die Stärken stärken. Region Stuttgart: Baden-Württembergs Motor für die Wirtschaft. Daten und Fakten für die Wirtschaftspolitik.* Stuttgart. Online: http://www.stuttgart.ihk24.de/servicemarken/aktuell/Versteckte_Dateien/Broschueren/Motor_der_Wirtschaft.pdf (17.11.2006).

Industrie- und Handelskammer Ostwürttemberg (Ed.) (2006): *Bruttoinlandsprodukt (BIP). Kreis- und Regionaldaten.* Heidenheim Online: http://www.ostwuerttemberg.info/shared/upload/bip_63.pdf (17.11.2006).

Institut National de la Statistique et des Études Économiques [INSEE] Alsace (no year given): Alsace. Zoom sur un territoire. Online: http://www.insee.fr/fr/insee_regions/alsace/zoom/alsaceenlignes.htm (06.06.2006).

Jakle, J.A./ Brunn, S./ Roseman, C.C. (1985): *Human spatial behavior: a social geography*. New York: Oxford University Press.

Johnson, B. (1992): Institutional Learning. In: Lundvall, B.-Å. (Ed.): *National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning*. London: Pinter Publishers, 23-44.

Johnson-Laird, P.N. (1983): *Mental Models. Towards a Cognitive Science of Language, Inference and Consciousness*. Cambridge et al.: Cambridge University Press.

Kaplan, S. (1974): Cognitive Maps in Perception and Thought. In: Downs, R.M./ Stea, D. (Eds.): *Image and Environment. Cognitive Mapping and Spatial Behavior.* Chicago: Aldine Publishing Company, 63-78.

Kaufmann, G. (2003): The Effect of Mood on Creativity in the Innovative Process. In: Shavinina, L.V. (Ed.): *The International Handbook on Innovation.* Amsterdam et al.: Elsevier Science, 191-203.

Keck, O. (1993): The National System for Technical Innovation in Germany. In: Nelson, R.R. (Ed.): *National Innovation Systems. A Comparative Analysis*. New York, Oxford: Oxford University Press, 115-157.

Kleinschmager, R. (1999a): Das Elsass zwischen Deutschland und Europa. *Geographische Rundschau*, 51(2), 116-122.

Kleinschmager, R. (1999b): L'Alsace entre développement et dépendance. *Regio Basiliensis*, 40(1), 3-8.

Kline, S.J./ Rosenberg, N. (1986): An Overview of Innovation. In: Landau, R./ Rosenberg, N. (Eds.): *The Positive Sum Strategy: Harnessing Technology for Economic Growth.* Washington D.C.: National Academy Press, 275-305.

Knorr Cetina, K. (1997): Konstruktivismus in der Soziologie. In: Müller, A./ Müller, K.H./ Stadler, F. (Eds.): *Konstruktivismus und Kognitionswissenschaft. Kulturelle Wurzeln und Ergebnisse.* Heinz von Foerster gewidmet. Wien, New York: Springer, 125-149.

Knox, P.L./ Marston, S.A. (2001): *Humangeographie*. Edited by H. Gebhardt, P. Meusburger, D. Wastl-Walter. Heidelberg, Berlin: Spektrum Akademischer Verlag.

Koschatzky, K. (2001): *Räumliche Aspekte im Innovationsprozess. Ein Beitrag zur neuen Wirtschaftsgeographie aus Sicht der regionalen Innovationsforschung.* Münster: LIT.

Koschatzky, K. (2000a): *The Regionalisation of Innovation Policy in Germany – Theoretical Foundations and Recent Experience.* Working Papers Firms and Region No. R1/2000. Karlsruhe: Fraunhofer ISI.

Koschatzky, K. (2000b): A River is a River – Cross-Border Networking Between Baden and Alsace. *European Planning Studies*, 8(4), 429-449.

Koschatzky, K. (1999): Innovation Networks of Industry and Business-Related Services – Relations Between Innovation Intensity of Firms and Regional Inter-Firm Cooperation. *European Planning Studies*, 7(6), 737-757.

Koschatzky, K. (1998a): Innovationspotentiale und Innovationsnetzwerke in grenzüberschreitender Perspektive. Die Regionen Baden und Elsaß. *Raumforschung und Raumordnung*, 4, 277-287.

Koschatzky, K. (1998b): Firm innovation and region: The role of space in innovation processes. *International Journal of Innovation Management*, 2(4), 383-408.

Koschatzky, K. (1997): *Entwicklungs- und Innovationspotentiale von unternehmensnahen Dienstleistungsbetrieben in Baden. Ergebnisse einer Unternehmensbefragung.* Arbeitspapier Regionalforschung Nr. 10. Karlsruhe: Fraunhofer ISI.

Koschatzky, K./ Merkle, C./ Berger, M./ Meyer, V. (2001): *Innovation und Kooperation bei unternehmensnahen Dienstleistern in Baden, Gironde und Südholland.* Arbeitspapier Unternehmen und Region Nr. R1/2001. Karlsruhe: Fraunhofer ISI.

Koschatzky, K./ Frenkel, A./ Walter, G.H./ Shefer, D. (2000): Regional Concentration and Dynamics of Fast-growing Industries in Baden-Württemberg and Israel. *International Planning Studies*, 5(2), 237-255.

Koschatzky, K./ Traxel, H. (1997): *Entwicklungs- und Innovationspotentiale der Industrie in Baden. Erste Ergebnisse einer Unternehmensbefragung.* Arbeitspapier Regionalforschung Nr. 5. Karlsruhe: Fraunhofer ISI.

Koschatzky, K./ Héraud, J.-A./ Broß, U./ Bureth, A./ Demissy, M./ Muller, E. (1996): *Institutions of Technological Infrastructure*. Final Report to Eurostat. Karlsruhe: Fraunhofer ISI.

Kruse, P./ Stadler, M. (1994): Der psychische Apparat des Menschen. In: Merten, K./ Schmidt, S.J./ Weischenberg, S. (Eds.): *Die Wirklichkeit der Medien. Eine Einführung in die Kommunikationswissenschaft*. Opladen: Westdeutscher Verlag, 20-42.

Lambooy, J.G./ Boschma, R.A. (2001): Evolutionary economics and regional policy. *The Annals of Regional Science*, 35, 113-131.

Lambooy, J.G./ Boschma, R.A. (1998): *Evolutionary Economics and Regional Policy.* Paper presented at the 38th Congress of the European Regional Science Association (ERSA), 28 August-1 September, Vienna/Austria.

Landabaso, M./ Oughton, C./ Morgan, K. (2001): Innovation Networks and Regional Policy in Europe. In: Koschatzky, K./ Kulicke, M./ Zenker, A. (Eds.): *Innovation Networks. Concepts and Challenges in the European Perspective*. Heidelberg: Physica-Verlag, 243-273.

Landabaso, M./ Oughton, C./ Morgan, K. (1999): *Learning Regions in Europe: Theory, Policy and Practice Through the RIS Experience.* Paper presented at the 3rd International Conference on Technology and Innovation Policy: Assessment, Commercialisation and Application of Science and Technology and the Management of Knowledge. Austin/USA, 30 August – 2 September 1999.

Larédo, P./ Mustar, P. (2001): French Research and Innovation Policy: Two Decades of Transformation. In: Larédo, P./ Mustar, P. (Eds.): *Research and Innovation Policies in the New Global Economy. An International Comparative Analysis.* Cheltenham, UK, Northampton MA, USA: Edward Elgar, 447-496.

Lawson, C. (1999): Towards a Competence Theory of the Region. *Cambridge Journal of Economics*, 23, 151-166.

Lawson, C./ Lorenz, E. (1999): Collective Learning, Tacit Knowledge and Regional Innovative Capacity. *Regional Studies*, 33(4), 305-317.

Ledig, C. (2005): *Innovation the role of, and challenges facing SMEs.* Presentation by Alsace of the instruments available within the region to support awareness raising activities and the development of SMEs towards innovation. Presentation at the Open Days, European Commission Directorate General Regional Policy. European Week of Regions and Cities, Brussels 11 October. Online: http://ec.europa.eu/regional_policy/opendays/CD/doc/ledig.ppt (05.07.2006).

Léglise, D. (2001): Entreprende en Alsace. *Chiffres pour l'Alsace*, revue no 3. INSEE Alsace, juillet 2001. Online: http://www.insee.fr/fr/insee_regions/alsace/rfc/docs/cpar03_2.pdf (06.06.2006).

Lévy, R. (2004): *The role of University-Industry relationships at the regional level: Application to University Louis Pasteur in Strasbourg.* Présentation aux Quatrièmes Journées de la proximité: proximité, réseaux et coordination. Marseille, June 17-18. Online: http://139.124.177.94/proxim/viewpaper.php?id=13 (05.07.2006).

Liebeskind, J.P. (1996): Knowledge, Strategy, and the Theory of the Firm. *Strategic Management Journal*, 17 (Winter Special Issue), 93-107.

Lien, N. (2001): Elaboration Likelihood Model in Consumer Research: A Review. *Proceedings of the National Science Council*, 11(4), 301-310. Online: http://nr.stic.gov.tw/ejournal/ProceedingC/v11n4/301-310.pdf (05.10.2006).

Lorenzen, M. (2001): Localized Learning and Policy: Academic Advice on Enhancing Regional Competitiveness through Learning. *European Planning Studies*, 9(2), 163-185.

Luhmann, N. (1994): Warum "Systemtheorie"? In: Boronoev, A. (Ed.): *Probleme der theoretischen Soziologie.* St. Petersburg, 25-42. Internet version: http://www.soc.pu.ru/materials/golovin/reader/luhmann/d_luhmann2.html (02.10.2006).

Lundvall, B.-Å. (Ed.) (1992a): *National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning*. London: Pinter Publishers.

Lundvall, B.-Å. (1992b): Introduction. In: Lundvall, B.-Å. (Ed.): *National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning*. Pinter Publishers: London, 1-19.

Lundvall, B.-Å. (1992c): User-Producer Relationships, National Systems of Innovation and Internationalisation. In: Lundvall, B.-Å. (Ed.): *National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning*. Pinter Publishers: London, 45-67.

Lundvall, B.-Å./ Johnson, B./ Andersen, E.S/ Dalum, B. (2002): National systems of production, innovation and competence building. *Research Policy*, 31(2), 213-231.

Lundvall, B.-Å./ Johnson, B. (1994): The Learning Economy. *Journal of Industry Studies*, 1(2), 23-42.

Lynch, K. (1960): *The image of the city.* Cambridge, Mass.: The M.I.T. Press & Harvard University Press.

Maillat, D./ Kebir, L. (1999): "Learning Region" et Systèmes Territoriaux de Production. *Revue d'Économie Régionale et Urbaine*, 3, 429-448.

Malerba, F. (2004a): Introduction. In: Malerba, F. (Ed.): *Sectoral Systems of Innovation. Concepts, Issues and Analyses of Six Major Sectors in Europe*. Cambridge: Cambridge University Press, 1-5.

Malerba (2004b): Sectoral systems of innovation: basic concepts. In Malerba, F. (Ed.): *Sectoral Systems of Innovation. Concepts, Issues and Analyses of Six Major Sectors in Europe*. Cambridge: Cambridge University Press, 9-41.

Malerba, F. (2002): Sectoral systems of innovation and production. *Research Policy*, 31, 247-264.

Manisera, M./ Dusseldorp, E./ van der Kooij, A. (2005): *Component structure of job satisfaction based on Herzberg's theory.* Online: http://www.datatheory.nl/pages/fullmanuscript_final_epm.pdf (31.08.2006).

Marinova, D./ Phillimore, J. (2003): Models of Innovation. In: Shavinina, L.V. (Ed.): *The International Handbook on Innovation*. Amsterdam et al.: Elsevier Science, 44-53.

Marshall, A. (1920): *Principles of Economics.* Philadelphia: Porcupine Press.

Maturana, H.R. (2002): Autopoiesis, Structural Coupling and Cognition: A history of these and other notions in the biology of cognition. *Cybernetics & Human Knowing*, 9(3-4), 5-34.

Maturana, H.R. (1970): Biology of Cognition. Biological Computer Laboratory Research Report BCL 9.0. Urbana IL: University of Illinois. Reprinted in: *Autopoiesis and Cognition: The Realization of the Living*. Dordrecht: D. Reidel Publishing Co., 1980, 5-58. Provided by Observer Web Archive Editions, Dr. Randall Whitaker. Online: http://www.enolagaia.com/M70-80BoC.html (22.09.2006).

McKelvey, M. (1997): Using Evolutionary Theory to Define Systems of Innovation. In: Edquist, C. (Ed.): *Systems of Innovation: Technologies, Institutions and Organizations*. London, Washington: Pinter, 200-222. Reprinted in: Edquist, C./ McKelvey, M. (Eds.) (2000): *Systems of Innovation: Growth, Competitiveness and Employment*. Volume II. Cheltenham, UK, Northampton, MA, USA: Elgar Reference Collection, 140-162.

Meulman, J.J./ Heiser, W.J., SPSS Inc. (2001): *SPSS Categories 11.0.* Chicago: SPSS Inc.

Meulman, J.J./ van der Kooij, A./ Heiser, W.J. (2004): Principal Components Analysis With Nonlinear Optimal Scaling Transformations for Ordinal and Nominal Data. In: Kaplan, D. (Ed.): *The Sage Handbook of Quantitative Methodology for the Social Sciences.* Thousand Oaks, London, New Delhi: Sage Publications, 49-70.

Meulman, J.J./ van der Kooij, A.J./ Babinec, A. (2002): New Features of Categorical Principal Components Analysis for Complicated Data Sets, Including Data Mining. In: Gaul, W./ Ritter, G. (Eds.): *Classification, Automation, and New Media.* Proceedings of the 24th Annual Conference of the Gesellschaft für Klassifikation e.V., University of Passau, March 15-17, 2000. Berlin, Heidelberg, New York: Springer, 207-217.

Meyer-Krahmer, F. (2001): The German Innovation System. In: Larédo, P./ Mustar, P. (Eds.): *Research and Innovation Policies in the New Global Economy. An International Comparative Analysis.* Cheltenham, UK, Northampton MA, USA: Edward Elgar, 205-252.

Michailidis, G./ de Leeuw, J. (1998): The Gifi System of Descriptive Multivariate Analysis. *Statistical Science*, 13(4), 307-336.

Ministère de l'Economie, des Finances et de l'Industrie (2006a): *Pôles de competitivité.* Online: http://www.industrie.gouv.fr/portail/politiques/index_polecompet.html (09.07.2006).

Ministère de l'Economie, des Finances et de l'Industrie (2006b): *Tableau de bord de l'innovation.* 14e édition. Online: http://www.industrie.gouv.fr/observat/innov/pdf/tbi14.pdf (09.07.2006).

Ministère délégué à la Recherche et aux Nouvelles Technologies, Ministère de l'Économie, des Finances et de l'Industrie (no year given): Politique en faveur de l'innovation. Online: http://www.recherche.gouv.fr/plan-innovation/index.htm (09.07.2006).

Ministerium für Wissenschaft, Forschung und Kunst des Landes Baden-Württemberg (2000): *Strategien der baden-württembergischen Forschungspolitik. Die Zukunft beginnt heute: Aktuelle Handlungsoptionen.* Online: http://www.mwk.baden-wuerttemberg.de/fileadmin/pdf/forschung/Forschungskonzeption.pdf (06.08.2006).

Morawa, E. (no year given): *Eine Einführung in die Systemtheorie selbstreferentieller Systeme nach Niklas Luhmann.* Online: http://www.syflow.de/Ressourcen/Hintergr/System_A/Systemtheorie/Selbstreferentielle_Systeme.pdf (02.10.2006).

Morgan, K. (2004): The exaggerated death of geography: learning, proximity and territorial innovation systems. *Journal of Economic Geography*, 4, 3-21.

Morgan, K. (1997): The Learning Region: Institutions, Innovation and Regional Renewal. *Regional Studies*, 31(5), 491-503.

Morgan, K./ Nauwelaers, C. (Eds.) (1999): *Regional innovation strategies. The challenge for less favoured regions*. London: The Stationary Office.

Müller, A./ Müller, K.H./ Stadler, F. (Eds.) (1997): *Konstruktivismus und Kognitionswissenschaft. Kulturelle Wurzeln und Ergebnisse.* Heinz von Foerster gewidmet. Wien, New York: Springer.

Muller, E. (2001): *Innovation Interactions between Knowledge-Intensive Business Services and Small and Medium-Sized Enterprises. An Analysis in Terms of Evolution, Knowledge and Territories.* Heidelberg: Physica.

Muller, E. (1999): *There is no territorial fatality! (or how innovation interactions between KIBS and SMEs may modify the development patterns of peripheral regions).* Working Papers Firms and Region No. R3/1999. Karlsruhe: Fraunhofer ISI.

Muller, E./ de la Paix, R./ Héraud, J.-A./ Hugo, I./ Kahn, R./ Koschatzky, K./ Munier, F./ Shapira, P./ Zenker, A. (2001): *RETINE. REgional Typology of Innovation NEeds.* Report to the European Commission DG Research, Directorate C – Competitive and Sustainable Growth. Karlsruhe: Fraunhofer ISI and Université Louis Pasteur, Bureau d'Economie Théorique et Appliquée.

Muller, E./ Zenker, A. (2001): Business services as actors of knowledge transformation: the role of KIBS in regional and national innovation systems. *Research Policy*, 30, 1501-1516.

Muller, E./ Schneider, R. (1997): *Analyse von innovationsorientierten Beziehungen zwischen industriellen KMU und hochwertigen Unternehmensdienstleistern. Theoretische Überlegungen und empirische Hinweise.* Arbeitspapier Regionalforschung Nr. 9. Karlsruhe: Fraunhofer ISI.

Muller, E./ Traxel, H. (1997): *Entwicklungs- und Innovationspotentiale der Industrie im Elsaß.* Arbeitspapier Regionalforschung Nr. 8. Karlsruhe: Fraunhofer ISI.

Munier, F./ Rondé, P. (2001): Densité scientifique des régions et compétences pour innover des entreprises: une mise en perspective du concept de "*Learning region*". *Revue d'Économie Régionale et Urbaine*, no. 4, 515-538.

Mustar, P./ Larédo, P. (2002): Innovation and Research Policy in France (1980-2000) or the disappearance of the Colbertist state. *Research Policy*, 31(1), 55-72.

Nelson, R.R./ Rosenberg, N. (1993): Technical Innovation and National Systems. In: Nelson, R.R. (Ed.): *National Innovation Systems. A Comparative Analysis*. New York, Oxford: Oxford University Press, 3-21.

Nelson, R.R./ Winter, S.G. (1982): *An Evolutionary Theory of Economic Change.* Cambridge, Mass.: Harvard University Press.

Nelson, R.R./ Winter, S.G. (1977): In Search of Useful Theory of Innovation. Research Policy, 6, 36-76. Reprinted in: Edquist, C./ McKelvey, M. (Eds.) (2000): *Systems of Innovation: Growth, Competitiveness and Employment*. Volume II. Cheltenham, UK, Northampton, MA, USA: Elgar Reference Collection, 81-121.

Neves, C. Eckert Baeta/ Neves, F. Monteiro (2006): What is complex in the complex world? Niklas Luhmann and the Theory of Social Systems. Translated by Marcelo Severo. *Sociologias*, Vol. 1, Special Edition, 1-14. ISSN 1517-4522. Online: http://socialsciences.scielo.org/scielo.php?script=sci_arttext&pid=S1517-45222006000100004&lng=en&nrm=iso (02.10.2006).

Niosi, J./ Saviotti, P./ Bellon, B./ Crow, M. (1993): National Systems of Innovation: In Search of a Workable Concept. *Technology in Society*, 15(2), 207-227. Reprinted in: Edquist, C./ McKelvey, M. (Eds.) (2000): *Systems of Innovation: Growth, Competitiveness and Employment*. Volume I. Cheltenham, UK, Northampton, MA, USA: Elgar Reference Collection, 101-121.

Nishisato, S. (2004): Dual Scaling. In: Kaplan, D. (Ed.): *The Sage Handbook of Quantitative Methodology for the Social Sciences.* Thousand Oaks, London, New Delhi: Sage Publications, 3-24.

Nonaka, I./ Toyama, R. (2005): The theory of the knowledge-creating firm: subjectivity, objectivity and synthesis. *Industrial and Corporate Change*, 14(3), 419-436.

Nonaka, I./ Toyama, R./ Nagata, A. (2000): A Firm as a Knowledge-creating Entity: A New Perspective on the Theory of the Firm. *Industrial and Corporate Change*, 98(1), 1-20.

Observatoire des Sciences et des Techniques [OST] (Ed.) (2004): *Indicateurs de Sciences et de Technologies.* Rapport de l'Observatoire des Sciences et des Techniques, établi sous la direction de Laurence Esterle et Ghislaine Filliatreau. Édition 2004. Paris: Economica.

Oerlemans, L.A.G./ Meeus, M.T.H. (2005): Do Organizational and Spatial Proximity Impact on Firm Performance? *Regional Studies*, 39(1), 89-104.

Organisation for Economic Co-operation and Development [OECD], European Commission, Eurostat (1996): *The Measurement of Scientific and Technological Activities. Proposed Guidelines for Collecting and Interpreting Technological Innovation Data.* Oslo Manual. Online: http://www.oecd.org/dataoecd/35/61/2367580.pdf (07.10.2006).

Organisation for Economic Co-operation and Development [OECD] (2006): Expenditure on R&D. In: OECD (Ed.): *Factbook 2006 – Economic, Environmental and Social Statistics.* Online: http://lysander.sourceoecd.org/vl=11292791/cl=16/nw=1/rpsv/factbook/06-01-01.htm (21.11.2006).

Organisation for Economic Co-operation and Development [OECD] (2002): Frascati Manual. Proposed standard practice for surveys on research and experimental development. Paris.

Patel, P./ Pavitt, K. (1994): National Innovation Systems: Why they are Important, and How they Might be Measured and Compared. *Economics of Innovation and New Technology*, 3, 77-95. Reprinted in: Edquist, C./ McKelvey, M. (Eds.) (2000): *Systems of Innovation: Growth, Competitiveness and Employment*. Volume I. Cheltenham, UK, Northampton, MA, USA: Elgar Reference Collection, 82-100.

Petty, R. E./ Cacioppo, J. T. (1986): The Elaboration Likelihood Model of Persuasion. In: Berkowitz, L. (Ed.): *Advances in experimental social psychology*, Vol. 19. New York: Academic Press. (Internet version available at http://www.psy.ohio-state.edu/petty/PDF%20Files/1986-ADVANCES-Petty,Cacioppo.pdf) (05.10.2006).

Petty, R.E./ Wegener, D.T./ Fabrigar, L.R. (1997): Attitudes and Attitude Change. *Annual Review of Psychology*, 48, 609-647.

Polanyi, M. (1997): The Tacit Dimension. In: Prusak, L. (Ed.): *Knowledge in Organizations. Resources for the knowledge-based economy.* Boston, Oxford, Johannesburg: Butterworth-Heinemann, 135-146.

Pred, A. (1967): Behavior and Location. Foundations for a Geographic and Dynamic Location Theory. Part 1. Lund Studies in Geography. Series B.27.

Prinz, W. (1990): Wahrnehmung. In: Spada, H. (Ed.): *Allgemeine Psychologie*. Bern, Stuttgart, Toronto: Huber. 25-114.

Quéré, M. (1999): *The French Innovation System: Some Insights into the Analysis of the Institutional Infrastructure Supporting Innovation.* International Conference "Knowledge Spillovers and The Geography of Innovation. A Comparison of National Systems of Innovation" July 1-2, 1999, Château de Goutelas, Université Jean Monnet Saint-Etienne. Online: http://www.univ-st-etienne.fr/creuset/actualite/spillovers.html (02/2001).

Raffelsiefer (2000): *Naturwahrnehmung, Naturbewertung und Naturverständnis im deutschen Naturschutz. Eine wahrnehmungsgeographische Studie unter besonderer Berücksichtigung des Fallbeispiels Naturschutzgebiet Ohligser Heide.* Dissertation, Universität Düsseldorf. Online: http://www.ub.uni-duisburg.de/diss/diss0024/ (14.07.2005).

Rallet, A./ Torre, A. (1998): *On Geography and Technology. The Case of Proximity Relations in Localized Innovation Networks.* Paper presented at the conference "SMEs and districts: hybrid governance forms, knowledge creation & technology transfer", Castellanza, 5-7 November. Online: http://www.druid.dk/conferences/summer2002/ (25.03.2005).

Région Alsace (2006): *Schéma Régional de Développement Economique. Pour une Alsace entreprenante, innovante, ouverte et solidaire.* Edition Mai 2006. Online: http://www.region-alsace.eu/fr/investir/SRDE/SRDEEDITIONMAI2006/2006-05-19_SRDE.pdf (27.06.2006).

Région Alsace (2005): *Développement du potentiel économique et industriel alsacien: 23 actions concrètes pour une Alsace en mouvement.* Communiqué de presse. Online: http://www.region-alsace.fr/js/cadre_rub.htm?rub=06&ss_rub=0 (27.06.2006).

Région Alsace (2004): *Chiffres clés.* Online: http://www.region-alsace.fr/fr/investir/Alsace_chiffres/chiffres_cles.html (27.06.2006).

Région Alsace, Le Président du Conseil Régional d'Alsace (2003): *La politique économique de la Région Alsace Face aux Mutations. Une Stratégie Renouvélée.* Online: http://www.region-alsace.fr/fr/investir/info_eco/politique_eco.pdf (27.06.2006).

Regional Service for Baden Württemberg (2006a): *Research and technology policy. Baden Württemberg, Strategy.* Online: http://cordis.europa.eu/baden-wuerttemberg/strateg.htm (6.8.2006).

Regional Service for Baden Württemberg (2006b): *Strategic development of Baden-Württemberg's research and development landscape. Baden Württemberg, Strategy.* Online: http://cordis.europa.eu/baden-wuerttemberg/strateg2.htm (06.08.2006).

Regional Service for Baden Württemberg (2006c): *Innovation and technology transfer. Baden Württemberg, Strategy.* Online: http://cordis.europa.eu/baden-wuerttemberg/strateg4.htm (06.08.2006).

Rimlinger, A. (2003): *Le règne de la petite entreprise*. *Les services marchands.* INSEE Alsace, 16-19. Online: http://www.insee.fr/fr/insee_regions/Alsace/rfc/docs/sermar_16.pdf (06.06.2006).

Rindskopf, D. (2004): Trends in Categorical Data Analysis. New, Semi-New, and Recycled Ideas. In: Kaplan, D. (Ed.): *The Sage Handbook of Quantitative Methodology for the Social Sciences.* Thousand Oaks, London, New Delhi: Sage Publications, 137-149.

Rock, I. (1983): *The Logic of Perception*. Cambridge, Mass.; London: MIT Press.

Rosenberg, N. (1990): Why do firms do basic research (with their own money)? *Research Policy*, 19, 165-174.

Roth, G. (2000): Radikaler Konstruktivismus, Realität und Wirklichkeit. Gehirn, Realität, Wirklichkeit und Ich. In: Hejl, P./ Stahl, H.K. (Eds.): *Management und Wirklichkeit. Das Konstruieren von Unternehmen, Märkten und Zukünften*. Heidelberg: Carl-Auer-Systeme Verlag, 65-76.

Runco, M.A. (1999): Tension, adaptability, and creativity. In: Russ, S.W. (Ed.): *Affect, Creative Experience and Psychological Adjustment*. Philadelphia, PA: Brunner/ Mazel, 165-194.

Runco, M.A. (1994): Creativity and its discontents. In: Shaw, M.P., Runco, M.A. (Eds.): *Creativity and Affect*. Norwood, NJ: Ablex, 102-126.

Rusch, G. (1994): Kommunikation und Verstehen. In: Merten, K./ Schmidt, S.J./ Weischenberg, S. (Eds.): *Die Wirklichkeit der Medien. Eine Einführung in die Kommunikationswissenschaft*. Opladen: Westdeutscher Verlag, 60-78.

Schätzl, L. (2003): *Wirtschaftsgeographie 1. Theorie.* 9. Auflage. Paderborn: Verlag Ferdinand Schöningh.

Schmidt, S.J. (1994a): Die Wirklichkeit des Beobachters. In: Merten, K./ Schmidt, S.J./ Weischenberg, S. (Eds.): *Die Wirklichkeit der Medien. Eine Einführung in die Kommunikationswissenschaft*. Opladen: Westdeutscher Verlag, 3-19.

Schmidt, S.J. (1994b): Konstruktivismus in der Medienforschung: Konzepte, Kritiken, Konsequenzen. In: Merten, K./ Schmidt, S.J./ Weischenberg, S. (Eds.): *Die Wirklichkeit der Medien. Eine Einführung in die Kommunikationswissenschaft*. Opladen: Westdeutscher Verlag, 592-623.

Schmoch, U./ Hinze, S./ Jäckel, G./ Kirsch, N./ Meyer-Krahmer, F./ Münt, G. (1996): The Role of the Scientific Community in the Generation of Technology. In: Reger, G./ Schmoch, U.(Eds.): *Organisation of Science and Technology at the Watershed. The Academic and Industrial Perspective*. Technology, Innovation, and Policy Series of the Fraunhofer Institute for Systems and Innovation Research (ISI). Heidelberg: Physica-Verlag, 1-138.

Schumpeter, J.A. (1979/1976): The Process of Creative Destruction. In: *Capitalism, Socialism and Democracy*, Part II, Chapter VII. London: George Allen & Unwin, 81-86. Reprinted in: Edquist, C./ McKelvey, M. (Eds.) (2000): *Systems of Innovation: Growth, Competitiveness and Employment*. Volume II. Cheltenham, UK, Northampton, MA, USA: Elgar Reference Collection, 75-80. First published 1942.

Senker, J. (1995): Tacit Knowledge and Models of Innovation. *Industrial and Corporate Change*, 4(2), 425-447.

Shalley, C.E./ Zhou, J./ Oldham, G.R. (2004): The Effects of Personal and Contextual Characteristics on Creativity: Where Should We Go from Here? *Journal of Management*, 30(6), 933-958.

Simon, H.A. (1957): Models of Man. New York: Wiley.

Spada, H. (Ed.) (1990): *Allgemeine Psychologie*. Bern, Stuttgart, Toronto: Huber.

Statistisches Bundesamt (no year given): Buttoinlandsprodukt, Bruttonationaleinkommen, Volkseinkommen. Online: http://www.destatis.de/download/d/vgr/biplangreihe.xls (06.12.2006).

Statistisches Bundesamt/ SV-Wissenschaftsstatistik GmbH (2006): Ausgaben für Forschung und Entwicklung nach Sektoren. Online: http://www.destatis.de/basis/d/biwiku/ausgtab5.php (06.12.2006).

Sternberg, R. (2000): Innovation Networks and Regional Development – Evidence from the European Regional Innovation Survey (ERIS): Theoretical Concepts, Methodological Approach, Empirical Basis and Introduction to the Theme Issue. *European Planning Studies*, 8(4), 389-407.

Sternberg, R. (1998): Innovierende Industrieunternehmen und ihre Einbindung in intraregionale versus interregionale Netzwerke. *Raumforschung und Raumordnung,* 4, 288-298.

Sternberg, R./ Arndt. O. (2001): The Firm or the Region: What Determines the Innovation Behavior of European Firms? *Economic Geography*, 77(4), 364-382.

Strambach, S. (2001): Innovation Processes and the Role of Knowledge-Intensive Business Services (KIBS). In: Koschatzky, K./ Kulicke, M./ Zenker, A. (Eds.): *Innovation Networks. Concepts and Challenges in the European Perspective*. Technology, Innovation and Policy Series of the Fraunhofer Institute for Systems and Innovation Research (ISI), Vol. 12. Heidelberg: Physica-Verlag, 53-68.

Tang, J. (2006): Competition and innovation behaviour. *Research Policy*, 35, 68-82.

TechnologieRegion Karlsruhe (2006): Standort. *TechnologieRegion Karlsruhe. Hightech trifft Lebensart.* Online: http://www.*TechnologieRegion*-karlsruhe.de/ueber/standort.de (05.08.2006).

Torre, A./ Rallet, A. (2005): Proximity and Localization. *Regional Studies*, 39(1), February 2005, 47-59.

Vaessen, P. (1993): *Small Business Growth in Contrasting Environments*. Nijmeegse Geografische Cahiers nr. 40. Department of Economic Geography, Faculty of Administrative Sciences, Catholic University of Nijmegen. Amsterdam: Royal Dutch Geographical Society.

Vandervert, L.R. (2003): The Neurophysiological Basis of Innovation. In: Shavinina, L.V. (Ed.): *The International Handbook on Innovation*. Amsterdam et al.: Elsevier Science, 17-30.

Vavakova, B. (2006): Reconceptualizing innovation policy. The case of France. *Technovation*, 26, 444-462.

Vernon, R. (1966): International Investment and International Trade in the Product Cycle. *The Quarterly Journal of Economics*, 80, 190-207.

von Keitz, B. (1986): Wahrnehmung von Informationen. In: Unger, F. (Ed.): *Konsumentenpsychologie & Markenartikel.* Heidelberg: Physica, 97-121.

Wackermann, G. (2000): Das Elsass. Wandel und Perspektiven einer europäischen Grenzregion, *Geographica Helvetica*, 55(1), 45-60.

Walmsley, D.J./ Lewis, G.J. (1993): *People and environment: behavioural approaches in human geography.* 2nd edition. Harlow: Longman.

Walmsley, D.J./ Lewis, G.J. (1985): *Human Geography. Behavioural approaches.* London, New York: Longman. 2nd printing 1985, first published 1984.

West, M.A./ Farr, J.L. (1990): Innovation at Work. In: West, M.A./ Farr, J.L. (Eds.): *Innovation and creativity at work: Psychological and organizational strategies*. Chichester: Wiley.

Willke, H. (1996): *Systemtheorie I: Grundlagen.* 5th edition. Stuttgart: Lucius & Lucius Verlagsgesellschaft mbh Stuttgart.

Willke, H. (1989): *Systemtheorie entwickelter Gesellschaften. Dynamik und Riskanz moderner gesellschaftlicher Selbstorganisation.* Grundlagentexte Soziologie. Weinheim, München: Juventa-Verlag.

Wilson, T.D./ Lindsey, S./ Schooler, T.Y. (2000): A model of dual attitudes. *Psychological Review*, 107: 101-126.

Young, F.W./ Takane, Y./ de Leeuw, J. (1978): The Principal Components of Mixed Measurement Level Multivariate Data: An Alternating Least Squares Method with Optimal Scaling Features. *Psychometrika*, 43(2), 279-281.

Zeijl, E./ du Bois-Reymond, M./ te Poel, Y. (2001): Young Adolescents' Leisure Patterns. *Loisir et société/ Society and Leisure*, 24(2), 379-402. Online: http://www.erudit.org/revue/ls/2001/v24/n2/000188ar.pdf (15.04.2006).

Annex

Annex 1: The guideline for the 2004 telephone interviews

In a short introduction, the objectives of the interview as well as the reference to the 1995 survey and the regional reference context have been explained to the interviewees.

Unternehmensmerkmale:
Name des Betriebs:
Tel.-Nr.:
Ansprechpartner 1995:
Ansprechpartner 2004:
Interviewer:
Datum Interview:

1. Wie schätzen Sie den Einfluss der Arbeitskräfte in der Region (Angebot/ Verfügbarkeit) auf die Durchführung von Innovationen in **Ihrem Betrieb** ein?

☐ eher günstig ☐ eher ungünstig ☐ ohne Einfluss

2. Wie schätzen Sie den Einfluss von Forschung und Technologie (Universitäten, Forschungsinstitute, Fachhochschulen) auf die Durchführung von Innovationen in **Ihrem Betrieb** ein?

☐ eher günstig ☐ eher ungünstig ☐ ohne Einfluss

3. Wie würden Sie aus der Sicht **Ihres Betriebs** das gegenwärtige Innovationsklima in Baden charakterisieren?

☐ eher günstig ☐ eher ungünstig ☐ ohne Einfluss

4. Wie hoch waren im Mittel der letzten drei Jahre schätzungsweise die gesamten FuE-Aufwendungen Ihres Betriebs?

Im Jahr 1995 hatte Ihr Betrieb ca. .... % des Umsatzes angegeben.

5. Wie viele Mitarbeiter sind derzeit in Ihrem Betrieb in Forschung und Entwicklung beschäftigt? (Vollzeitäquivalent?)

Im Jahr 1995 hatte Ihr Betrieb .... Personen angegeben.

6. Wie werden sich die FuE-Aktivitäten in Ihrem Betrieb in den kommenden drei Jahren voraussichtlich entwickeln?

☐ steigen ☐ sinken ☐ unverändert bleiben

7. Liefern Ihre Kunden Ihnen entscheidende Anregungen für Innovationsaktivitäten in Ihrem Betrieb?

☐ ja ☐ nein

8. Liefern Ihre Wettbewerber Ihnen entscheidende Anregungen für Innovationsaktivitäten in Ihrem Betrieb?

☐ ja ☐ nein

9. Sind Forschungs- und Technologietransfereinrichtungen eine entscheidende Informationsquelle für Innovationen in Ihrem Betrieb?

☐ ja ☐ nein

10. Welche anderen bedeutenden Informationsquellen für Innovationen in Ihrem Betrieb nutzen Sie?

____

11. Spielt die räumliche Nähe eine wichtige Rolle für einen derartigen Informationsaustausch, d.h. sind die von Ihnen als bedeutsam eingestuften Informationsquellen für Innovationen im Wesentlichen in Baden ansässig?

☐ ja ☐ nein

12. Haben Sie eine Verlagerung Ihres Betriebs oder Teile der Aktivitäten geplant? Falls ja, aus welchem Grund und an welchen Standort?

____

13. Wie viele Beschäftigte hat Ihr Betrieb zurzeit? ______________

Im Jahr 1995 hatte Ihr Betrieb .... Beschäftigte angegeben.

14. Die Zahl der Beschäftigten in Ihrem Betrieb wird während der nächsten drei Jahre voraussichtlich…

☐ steigen ☐ sinken ☐ unverändert bleiben

15. Wie hoch war im letzten Geschäftsjahr der Umsatz Ihres Betriebs (ohne MWSt)?
    ____

Im Jahr 1995 hatte Ihr Betrieb einen Umsatz in Höhe von rund .... Mio. € angegeben.

16. Der Umsatz Ihres Betriebs wird während der nächsten drei Jahre voraussichtlich…

☐ steigen ☐ sinken ☐ unverändert bleiben

Caractéristiques de l'entreprise:
Nom de l'entreprise:
No. tél.:
Interlocuteur 1996:
Interlocuteur 2004:
Enquêteur:
Date interview:

17. Comment caractériseriez-vous l'influence de la main d'œuvre locale (bassin d'emploi) sur la capacité d'innovation de **votre entreprise**?

☐ plutôt favorable ☐ plutôt défavorable ☐ neutre

18. Comment caractériseriez-vous l'influence du potentiel technologique et scientifique de l'Alsace (universités, centres de recherche, écoles d'ingénieurs) sur la capacité d'innovation de **votre entreprise**?

☐ plutôt favorable ☐ plutôt défavorable ☐ neutre

19. Comment caractériseriez-vous, du point de vue de **<u>votre entreprise</u>** le climat d'innovation en Alsace à l'heure actuelle?

☐ plutôt favorable ☐ plutôt défavorable ☐ neutre

20. Quel est le niveau de dépense actuel (moyenne des 3 dernières années) en R&D de votre entreprise? env. _____ % CA

En 1996 votre entreprise avait indiqué env. % CA.

21. Combien de salariés employez-vous **actuellement** en R&D? env. _____ personnes (ETP)

22. Comment estimez-vous le développement des activités en R&D pendant les 3 années à venir?

☐ augmenter ☐ diminuer ☐ rester stable

23. Vos clients constituent-ils une source d'information déterminante pour les innovations réalisées au sein de votre entreprise?

☐ oui ☐ non

24. Vos concurrents constituent-ils une source d'information déterminante pour les innovations réalisées au sein de votre entreprise?

☐ oui ☐ non

25. Les organismes de recherche et de transfert de technologie constituent-ils une source d'information déterminante pour les innovations réalisées au sein de votre entreprise?

☐ oui ☐ non

26. Voyez-vous d'autres sources d'information déterminantes pour les innovations réalisées au sein de votre entreprise?

____

27. La proximité géographique joue t'elle un rôle pour ces échanges? En d'autres termes, ces sources sont-elles essentiellement situées en Alsace?

☐ oui ☐ non

28. Votre entreprise envisage t'elle de délocaliser tout ou partie de son activité ? Si oui, dans quel pays et pour quelle raison?

____

29. Nombre actuel de salariés de l'entreprise? _____________

En 1996 votre entreprise avait indiqué env. salariés

30. Dans les 3 années à venir, le nombre de salariés de votre entreprise va probablement:

☐ augmenter ☐ diminuer ☐ rester stable

31. Le chiffre d'affaires actuel de l'entreprise? ______________________________

En 1996 votre entreprise avait indiqué un CA d'env. M. €

32. Dans les 3 années à venir, le chiffre d'affaires de votre entreprise va probablement:

☐ augmenter ☐ diminuer ☐ rester stable

Annex 2: Sectoral structure of the 1995 sample

The following section points at some findings for the whole 1995 sample of manufacturing and knowledge-intensive business service firms in Alsace and in Baden.

Muller/ Traxel (1997: 5) show that the Alsatian manufacturing sample is largely representing the regional firm population; the sectoral deviation of the sample with respect to the regional firm population is below 5 %. The Alsatian manufacturing sample is composed of 21.8 % of the firms in the food sector, 19.3 % in metal processing, 14.6 % in wood, paper, printing, 13.9 % in electrical engineering, 13.6 % in chemical products and plastics, 10.0 % in mechanical engineering and vehicle construction and 6.8 % in textiles. Similarly, the Baden sample did not show significant deviations between the population and the sample firms (cf. Koschatzky/ Traxel 1997: 7). The sectoral structure of the Baden sample is characterised by metal processing (21.5 %), electrical engineering (20.5 %), mechanical engineering and vehicle construction (19.4 %), wood, paper, printing (16.7 %), chemical products and plastics (12.5 %), textiles (5.9 %) and food (3.5 %).[349] 58.5 % of the sample firms had less than 50 employees and 14.6 % had more than 200 person employed, the average size of all Baden firms is 132 employees. 48.9 % of innovating firms, i.e. firms that introduced innovations during the preceding three years, had less than 50 employees whereas 21.2 % belonged to the size class with 200 and more persons. The sample firms sold 27.1 % of their turnover within Baden-Württemberg and 32.2 % abroad whereas innovating sample firms had a slightly higher export share (35.1 %). The share of employees with higher education degree was 6.8 % (mean value) and 4.6 % (median value). Smaller and younger firms reported comparatively higher investments in research and development. A high share of sample firms (80 %) conducted R&D in Baden (77 % in Alsace, cf. Koschatzky 1998a: 280). Between 1993 and 1995, 70 % of Baden and nearly 62 % of Alsatian firms reported innovation activities (product or process innovations), i.e. manufacture of new or highly improved products or processes. On average, 6.4 % of the Baden sample workforce was involved in R&D activities, 4.6 % in Alsace. Baden sample firms invested 7.9 % of their turnover in R&D activities whereas their Alsatian counterparts spent 3.7 % of their turnover for R&D purposes. 83 % of the Baden manufacturing sample firms conducted permanently or occasionally development activities and 45 % of the firms permanently or occasionally were involved in research activities (cf. Koschatzky/ Traxel 1997: 15-30).

Among manufacturing sample firms, the high majority (Alsace: 84 %, Baden: 94 %) are enterprises with one establishment or have their headquarters in the region. The 1995 Alsatian sample has a higher share of branch plants or subsidiaries of French or foreign companies. The respective values for the service sample firms are 93 % for Baden and 90.5 % for Alsace. Thus, the regional decision competence among the sample service firms is supposed to be high. 70 % of Baden and about 62 % of Alsatian manufacturing sample firms (see above), as well as 76 % of Baden and 68 % of Alsatian business service firms claimed to be innovative, i.e. to have been performed innovation projects during the preceding three years.[350] Alsatian manufacturing sample firms employed comparatively lower shares of R&D personnel than Baden firms (mean value of 6.3 persons, median: 1 person), with Karlsruhe at first rank and Haut-Rhin reporting the smallest share of R&D employees (cf. Muller/ Traxel 1997: 8, Koschatzky 1998a: 280).

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349 Thus, comparing the two regional manufacturing firm samples, the deviation in the food sector becomes obvious with 21.8 % of the sample firms in Alsace and 3.5 % of Baden sample firms being active in this field. On the other hand, the Baden sample has higher firm shares in mechanical engineering and vehicle construction (19.4 % versus 10.0 % in Alsace) and in electrical engineering (20.5 % versus 13.9 % in Alsace).

350 Innovations in service firms are understood as inventions and modifications of services or of the process of producing those services (cf. Muller/ Schneider 1997: 4).

The KIBS sample consists of firms of the following service fields of activity: Computer and related activities, architectural and engineering activities; technical consultancy and technical testing and analysis (technical services), legal activities, accounting, tax consultancy, market research, business and management consultancy, and advertising (business services) (cf. Koschatzky 1997: 7, Koschatzky 1999: 740). The sample largely represents the population. Computer-related activities are slightly higher represented in the sample, whereas market research and consulting firms are slightly less represented than in the population. However, the deviations are assumed to be small. The Baden service sample is characterised by 31.9 % architectural, surveying and engineering firms, 27.2 % of computer-related firms, 24.7 % of firms in market research, consulting and advertising fields, and 16.2 % legal and tax advise firms (cf. Koschatzky 1997: 8-10). The Alsatian sample has a higher focus on technical services: It is composed with 42.2 % of architectural, surveying and engineering firms, 25.2 % of market research, consulting and advertising firms, and 16.3 % in both computer-related and legal and tax advise firms (cf. Koschatzky 1998a: 279). The Baden service firms have 21 employees on average, but the median (5 employees) indicates that the majority of firms is smaller. Alsatian service sample firms are on average smaller (mean value of 11 employees). Innovative firms employ more persons than non-innovative ones (cf. Koschatzky 1997: 10/11). Manufacturing firms are the most important clients for Baden business service firms (59.4 % of turnover), followed by other service firms (23.2 %), private households (9.4 %) and the public sector (8.0 %). 46.0 % of the service firms significantly (more than 10 %) increased in size between 1992 and the beginning of 1996. On the other hand, 29.2 % of the firms reported a reduction of their employee number higher than 10 %. 21.3 % of the sample firms kept their size constant during this period. Referring to the fields of activity, the architectural, surveying and engineering firms had the highest growth shares in the sample (cf. Koschatzky 1997: 13-18).

For Baden manufacturing sample firms, clients are a very important information source for product innovations; 93 % of the 1995 sample firms approved this question. Further information sources relevant for product innovations are fairs and exhibitions (77 %), professional literature (64 %) and competitors (65 %). Research institutions are mentioned as important or very important information source by 29 % of the sample firms. Important information sources for process innovations are the professional literature (65 %), fairs and exhibitions (61 %), suppliers (54 %) and clients (44 %) (cf. Koschatzky/ Traxel 1997: 35/36).[351] 31.9 % of the manufacturing sample firms in the

[351] Compared with the results for the Alsatian manufacturing firm sample, fairs and exhibitions, the professional literature, suppliers and research institutes seem to be of higher importance for Baden firms' product innovations (cf. Muller/ Traxel 1997: 13).

Baden region have applied for at least one patent (cf. Koschatzky/ Traxel 1997: 40). Koschatzky/ Traxel (1997: 41ff.) analyse that innovative firms were to a higher extent engaged in co-operations than non-innovative firms: Nearly 70 % of the manufacturing sample firms had innovation co-operations with clients, 50 % with suppliers, nearly 40 % with research institutions and 33 % with further firms. 87 % of the sample firms reported co-operations (in this case not restricted to innovation-oriented co-operations) with business service firms. Co-operations with business services also have a highly local character; 66.8 % of all co-operations are with partners located in the same district as defined by the chamber of commerce.

Finally, the sample firms have been asked to assess their regional framework conditions for innovation. The Baden manufacturing sample firms rank the transport infrastructure on first position. More positive than negative assessments were further given to the supply of workforce, availability of suppliers, consulting supply and the research supply. On the other hand, rather negative assessments have been given for the availability of clients, technology and economic support, and the supply of venture capital. Generally, and also including obstacles to innovation mentioned by the manufacturing sample firms, Baden firms' assessments are more critical than among the Alsatian manufacturing firm sample. An exception are consulting services which are rated predominantly negatively (cf. Koschatzky/ Traxel 1997: 50ff., Koschatzky 2000b: 438/439).

Concerning business service firms' assessments of the regional framework conditions for innovations, the general view in Baden is rather unfavourable. Exceptions are the availability of a qualified workforce and the availability of clients; here, positive assessments outbalance negative ones. 21.1 % of the sample firms have a positive view of the general innovation climate in the region, but 27.4 % think the opposite. Particularly the supply of venture capital is negatively assessed. On the contrary, Alsatian business sample firms have a more positive view of their region; they give more positive than negative ratings for all characteristics except the availability of venture capital (cf. Koschatzky 1997: 40-43).

Focusing on innovative firms in both regions, Koschatzky (2001: 251, Koschatzky 2000b: 436-438) gives some characteristics in an interregional perspective:

While there were no significant differences in firm age between the regional subsamples, innovative manufacturing firms have been larger in Alsace than in Baden (mean size in number of employees in Alsace: 195.7, and in Baden: 175.8). Accordingly, the turnover and turnover/ employee have been higher in the French sub-sample. Innovative firms of the Alsatian sample had a higher share of employees with tertiary education: on average 12.0 % versus 8.1 % of their Baden counterparts. Concerning the number and share of R&D employees, Baden innovative manufacturing sample firms had higher figures than their Alsatian counterparts with an average of 11.0 persons and 7.1 % of all employees in Baden and 9.9 persons and 4.7 % in Alsace. Innovations had a slightly higher contribution to turnover in Baden innovative sample firms than in the sub-sample of Alsatian innovative manufacturing SMEs: On average 33.3 % of Baden firms' turnover was attributed to new products whereas 27.8 % of Alsatian firms' turnover was due to new products. Contrary to the innovative manufacturing sample firms, Baden business services were larger than the French ones with an average number of 19.6 versus 14.5 employees in the Alsatian sample. Equally, Baden innovative business service firms' had higher average turnovers and turnover values/ employee than Alsatian business services of the sample. Concerning their sales areas, a higher share of Alsatian innovative business service firms sold their services in their home region.

The analyses showed that there were only very limited innovation co-operations between firms of the surveyed regions despite their geographical proximity. With the exception of the transport infrastructure, suppliers and consulting supply, Alsatian manufacturing sample firms had a more positive image of their regional framework conditions than Baden firms (cf. Koschatzky 2001: 250-252).

Annex 3: Further information concerning the categorical principal components analysis for the 2004 sample

Variance accounted for and goodness-of-fit

The main goal of the categorical components analysis is the analysis of interdependencies of the variables treated through nonlinear transformations and the maximisation of their average interdependencies. The overall goodness-of-fit is determined by the sum of the eigenvalues which, in turn, corresponds to the total variance accounted for of the transformed variables. The component loadings, which express the correlation between the transformed variables and the principal components, are the base for the variance accounted for in each dimension since the sum of the squared component loadings for each variable on each dimension results in the variance accounted for in each dimension. Table 16 and table 19 show this relationship: The squared component loadings for each variable on each dimension (cf. table 16) equals the variance accounted for each variable and dimension (vector coordinates, cf. table 19). So the squared component loading of the variable "Share of R&D employees 04" on the first dimension (0.796^2, cf. table 16) equals the variance accounted for of this variable on the first dimension (0.633, cf. table 19). The sum of the variance accounted for on each dimension represents the eigenvalue of this dimension.

Table 19: Variance accounted for: Variables and dimensions 2004

	Zentroidkoordinaten				Gesamt (Vektorkoordinaten)			
	Dimension			Mittelwert	Dimension			Gesamt
	1	2	3		1	2	3	
Share of R&D employees 04 (% of employees, classes)	,638	,056	,077	,257	,633	,044	,016	,693
R&D/Innovation expenses 04 (% of turnover, classes)	,660	,095	,083	,279	,654	,063	,007	,724
Perception of regional human capital 2004	,124	,574	,016	,238	,096	,568	,002	,666
Perception of regional innovation climate 2004	,040	,632	,055	,242	,035	,631	,054	,720
Perception of research and technology 2004	,016	,036	,825	,292	,014	,032	,824	,871
Mainly regional information sources for innovation 2004	,435	,000	,257	,231	,435	,000	,257	,692
Structural characteristics 04: size, region, activity(a)	,250	,149	,274	,225				
Innovation related information from clients 2004(a)	,006	,025	,012	,014				
Innovation related information from competitors 2004(a)	,000	,034	,033	,022				
Innovation related information from research and technology 2004(a)	,075	,000	,095	,057				
Aktiver Gesamtwert	1,913	1,392	1,313	1,539	1,867	1,338	1,160	4,365
a Zusätzliche Variable								

Source: Selected from CATPCA output, SPSS 11.0

The relation between Cronbach's α and the total variance accounted for is as follows (cf. Meulman et al. 2004: 55/56):

$$\alpha = \frac{M(\lambda - 1)}{(M-1)\lambda}$$ with M being the number of variables and λ the eigenvalue.

In the analysis at hand, this results in:

- Dimension 1: $\alpha = \frac{6(1.867-1)}{(6-1)1.867} = \frac{5.202}{9.335} = 0.55726$
- Dimension 2: $\alpha = \frac{6(1.338-1)}{(6-1)1.338} = \frac{2.028}{6.690} = 0.30314$

- Dimension 3: $\alpha = \frac{6(1.160 - 1)}{(6-1)1.160} = \frac{0.960}{5.800} = 0.16552$ (cf. table 15).

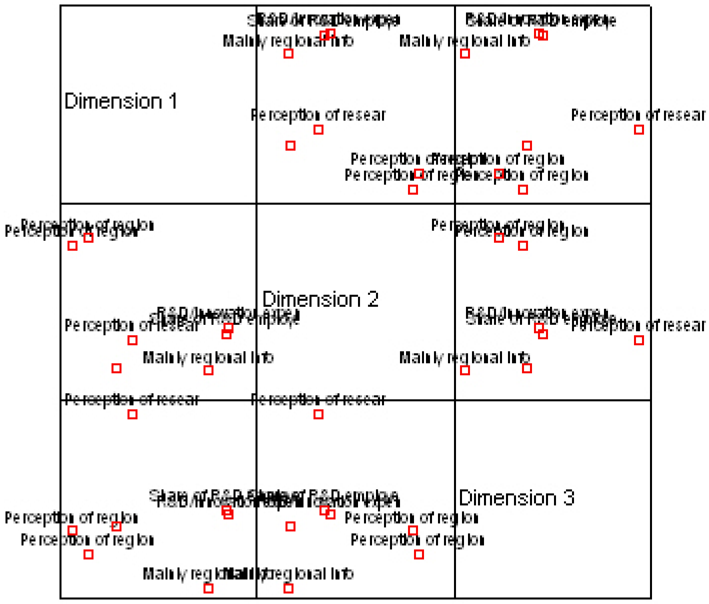
The total variance accounted for (4.365, cf. table 15) leads to an α of 0.92509, indicating a fairly good fit (the maximum is 1). The maximum for the total eigenvalue equals the number of variables in the model (6).

Component loadings

Supplementary to the component loadings table (cf. table 16), SPSS produces a graphical output. A three-dimensional solution results in a component loading diagram in the scatterplot matrix which plots every dimension against every other dimension (cf. figure 39). The first row, for instance, plots the first dimension (y-axis) against the second dimension and the third dimension (x-axes) with the transformed category points in the same position on the y-axis (always with the zero point indicated as origin of the vectors). The first row shows that the innovation input and the regional variables score highly on the first dimension whereas two perception variables – perception of workforce and innovation climate – score highly on the second dimension. The third dimension is highly influenced by the perception of the research and technology infrastructure. The left-side plot of the second row mirrors the middle plot of the first row since it plots dimension 2 (y-axis) against dimension 1 (x-axis) while the right-side plot shows dimension 2 (y-axis) against dimension 3. The latter plot indicates that the vector of the regional variable and the perception of the research infrastructure point in opposite directions (cf. Meulman et al. 2004: 57/58). The transformation plots (cf. figure 44 and figure 45) show that the directions of these vectors indicate a rather favourable perception of the research and technology infrastructure on the one hand and mainly extra-regional information sources for innovation.[352] However, the vectors have their starting points (i.e. neutral perceptions of the research infrastructure and positive answers concerning the regional variable, i.e. mainly regional information sources, cf. the transformation plots in figure 44 and figure 45) at the opposite side of the origin. So the starting point of the regional vector is close to the 'research and technology perception' category point of 'favourable' evaluations, bringing a positive perception in relationship to a high importance of the region concerning innovation-related information. This relationship is also pointed at in the middle plot of the third row which is the 'mirror' of the right plot in the second row, showing the dimension on opposite axes.

[352] This related to the codings of the variables with the highest codes for "rather favourable" concerning the perception variables and "no" for the question "Are your information sources for innovation mainly located in the region?"

Figure 39: Component loadings plot of the 2004 analysis



Normalisierung mit Variablen-Prinzipal.

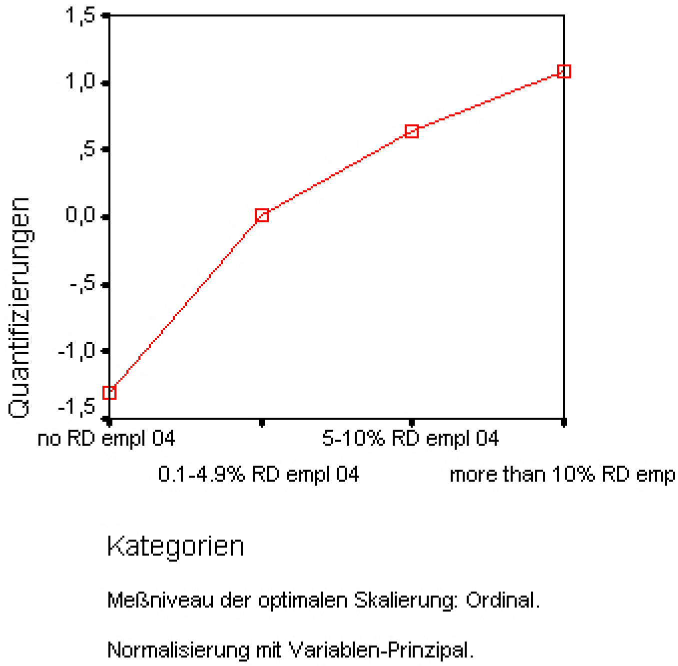
Source: Selected from CATPCA output, SPSS 11.0

Transformations

The process of optimal quantification transfers qualitative variables into quantitative ones and produces nonlinearly transformed variables. These can be displayed as vectors whose coordinates are based on the component loadings or the correlations with the dimensions of the object space (cf. Meulman et al. 2004: 56/57). The following figures display the nonlinear transformations for the variables of the "core model" with the original categories on the vertical and the quantifications on the horizontal axes and the average quantification of 0. This means that the category level nearest the zero line is nearest to the average response given (cf. Blasius/ Gower 2005: 377) displaying the mode category near the origin of the principal components space.

The transformation plot of the 'share of R&D employees' variable approximates a concave function, i.e. decreasing distances between adjacent categories, contrasting the categories indicating R&D employees (above the mean of 0) to the 'no R&D employees' category (below 0) (cf. figure 40). The category '0.1 – 4.9 % R&D employees' is plotted near the origin in the resulting space.

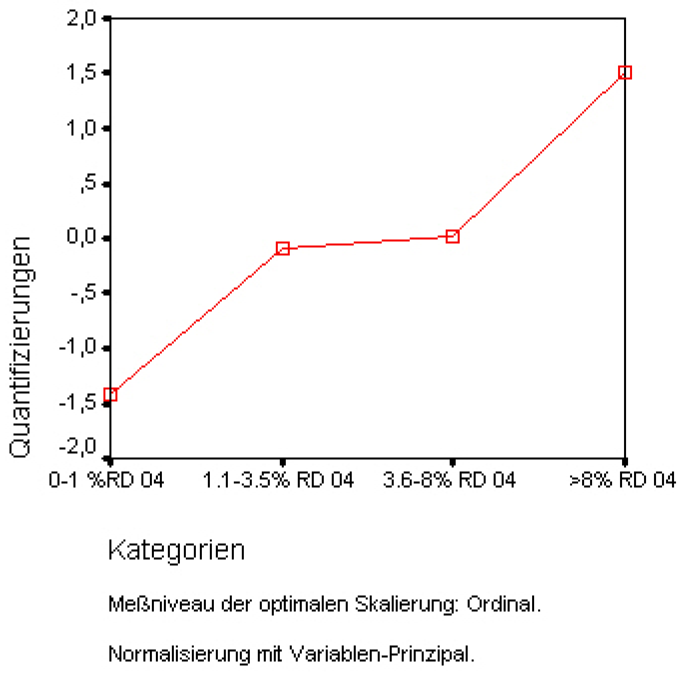
Figure 40: Nonlinear transformation of the variable 'Share of R&D employees 2004'



Source: Selected from CATPCA output, SPSS 11.0

The transformation plot of the share of R&D expenses opposes the lowest with the highest category and indicates less distinction between the categories '1.1 – 3.5 % R&D expenses' and '3.6 – 8 % R&D expenses' which receive similar transformations and are located near the mean. Thus, these two categories are supposed to be plotted in close neighbourhood and near the origin of the geometric space (cf. figure 41).

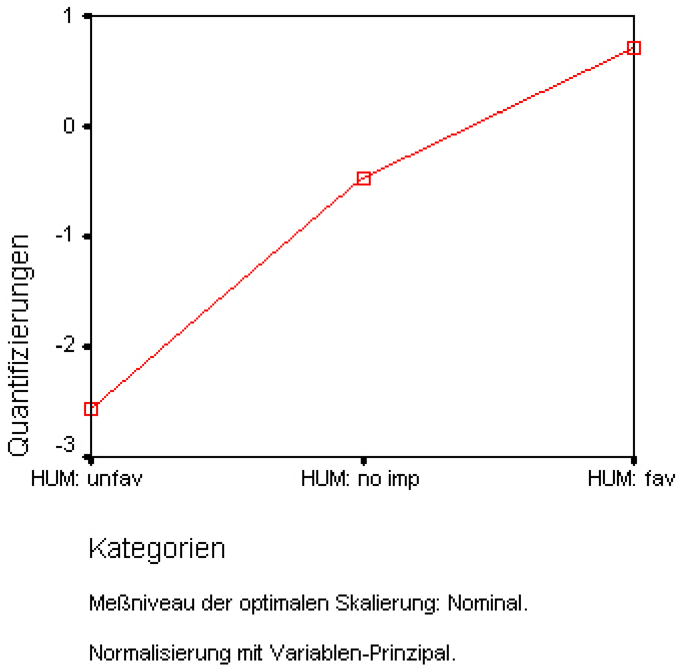
Figure 41: Nonlinear transformation of the variable 'Share of R&D expenses 2004'



Source: Selected from CATPCA output, SPSS 11.0

The perception variables show different results of their transformations (cf. figure 42, figure 43, figure 44). The transformation of the workforce variable can be described as slightly approximating a concave function, with the 'favourable' and 'unfavourable' categories being opposed to each other. Since the nominal level has been chosen for the transformations, the order of the categories ('rather unfavourable' – 'no impact' – 'rather favourable') must not necessarily be kept after the transformation. The steeper part between 'unfavourable' and 'no impact' indicates a larger distance between those categories in the geometric space than between 'no impact' and 'favourable'.

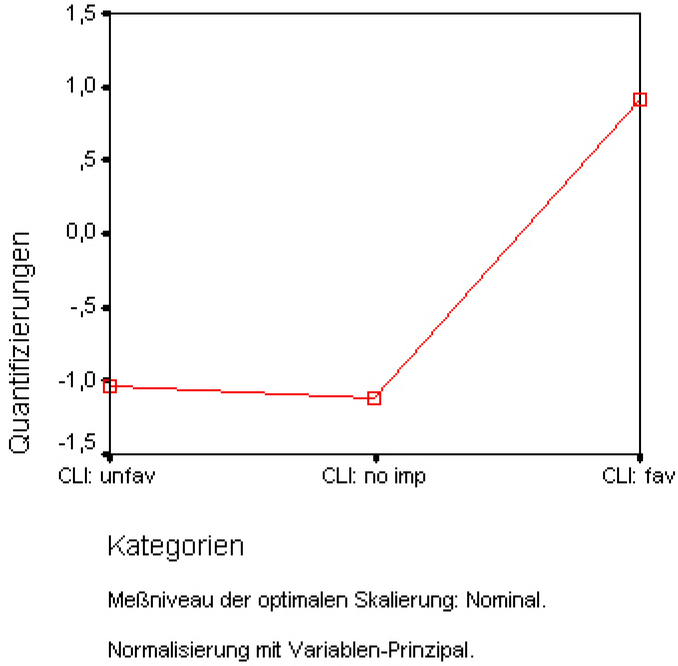
Figure 42: Nonlinear transformation of the variable 'Perception of regional workforce 2004'



Source: Selected from CATPCA output, SPSS 11.0

The transformation of the variable 'perception of the regional innovation climate' displays the 'unfavourable' and 'no impact' categories in the rather even part of the curve to the 'favourable' category with the neutral category as minimum (cf. figure 43). This result indicates comparatively similar quantifications for the former two categories whereby the neutral category has lower scores than the negative one, indicating that the vector has an apex at the neutral category and will be plotted as a line between the neutral and the favourable categories as minimum and maximum endpoints. The apex is indicated through plotting the negative category on the line.

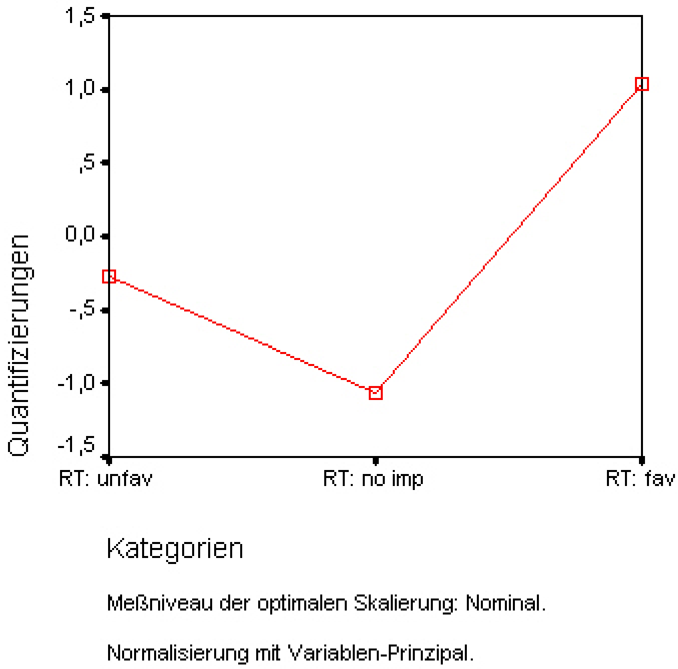
Figure 43: Nonlinear transformation of the variable 'Perception of regional innovation climate' 2004



Source: Selected from CATPCA output, SPSS 11.0

The variable 'perception of research and technology in the region' shows a V-shaped transformation plot (cf. figure 44). The neutral category 'no impact' at the minimum receives below zero quantifications and is opposed to the 'favourable' and 'unfavourable' answer categories. This indicates that the categories are not plotted on a line respecting the order 'unfavourable' – 'no impact' – 'favourable', but rather figuring 'favourable' as being opposed to 'no impact' with the 'unfavourable' category point on this line.

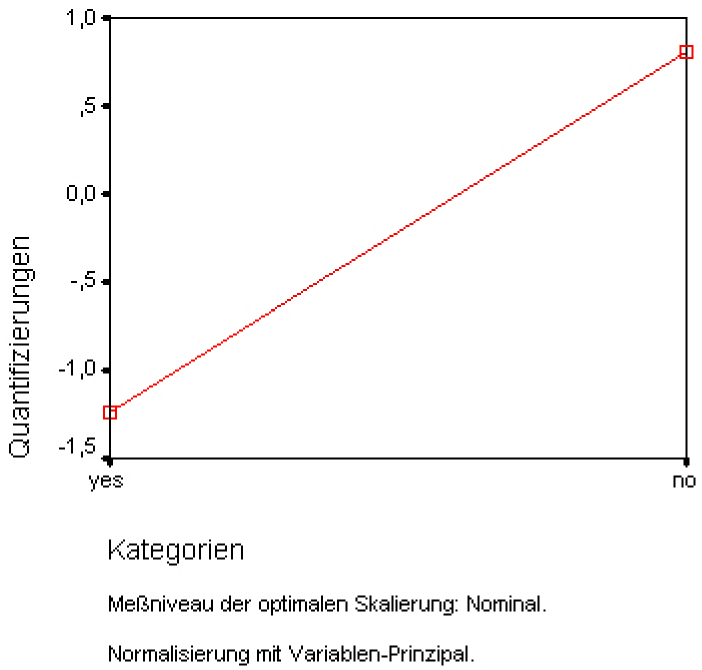
Figure 44: Nonlinear transformation of the variable 'Perception of research and technology in the region 2004'



Source: Selected from CATPCA output, SPSS 11.0

Figure 45 finally represents the transformation plot for the variable 'Mainly regional information sources for innovation' with the yes/no answer categories. Scores for the positive answer are found below 0 whereas the opposite category receives above zero scores.

Figure 45: Nonlinear transformation of the variable 'Regional availability of main innovation-related information sources'' 2004



Source: Selected from CATPCA output, SPSS 11.0

Annex 4: Further information concerning the categorical principal components analysis for the 1995 sample

The following tables and figures illustrate the results of the 1995 categorical principal components analysis. Table 20 gives an overview of the variance accounted for attributed to variables and dimensions, giving the base for the eigenvalues of the solution.

Variance accounted for and component loadings

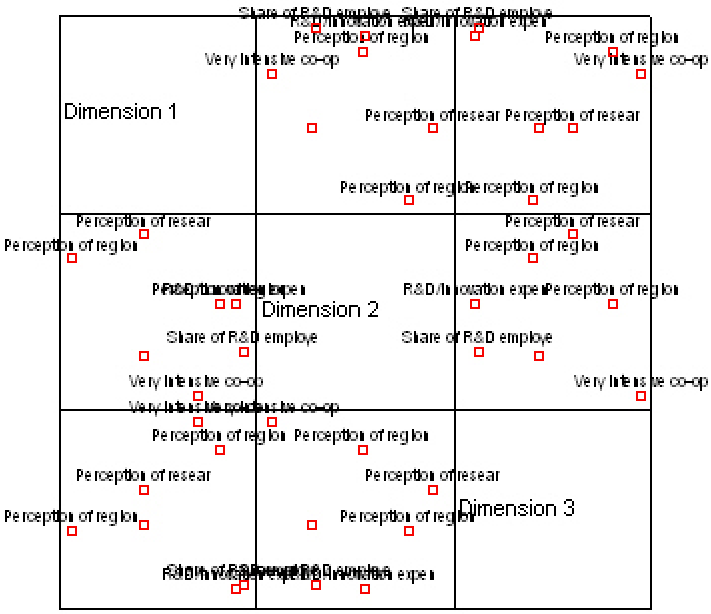
Table 20: Variance accounted for: Variables and dimensions 1995

	Zentroidkoordinaten				Gesamt (Vektorkoordinaten)			
	Dimension			Mittelwert	Dimension			Gesamt
	1	2	3		1	2	3	
Share of R&D employees 95 (% of employees, classes)	,531	,020	,192	,247	,527	,001	,181	,708
R&D/Innovation expenses 95 (% of turnover, classes)	,463	,145	,228	,278	,437	,136	,199	,772
Perception of regional human capital 1995	,317	,135	,296	,249	,307	,132	,291	,730
Perception of regional innovation climate 1995	,282	,481	,013	,259	,263	,472	,001	,736
Perception of research and technology 1995	,002	,738	,065	,268	,000	,737	,063	,800
Very intensive co-operation with clients or research inst. in Kammerbez./ Département or Land/ Région (manuf.) or location of clients, competitors or research institutes in the Land/ Région (KIBS)	,153	,084	,543	,260	,153	,084	,543	,780
Structural characteristics 95: region, activity(a)	,130	,053	,177	,120				
Innovation related information from clients 1995, (Manuf.: Product + process innov., KIBS: industrial clients)(a)	,001	,001	,007	,003				
Innovation related information from competitors 1995, (Manuf.: Product+process innov.)(a)	,037	,032	,005	,024				
Innovation related information from research institutes 1995, (Manuf.: Product+process innov.)(a)	,005	,001	,001	,003				
Aktiver Gesamtwert	1,748	1,602	1,338	1,563	1,687	1,561	1,278	4,527
a Zusätzliche Variable								

Source: Selected from CATPCA output, SPSS 11.0

The component loadings plot (cf. figure 46) shows the high scores of the innovation input and the HUMCAP variables as well as the regional one. Furthermore, the INNOCLI variables scores highly on the first dimension, but in opposite direction. This indicates that high categories of the innovation input variables are rather related to the negative category of the INNOCLI vector. Dimension two relates the RESTECH and INNOCLI perception variables; these variables have the highest component loadings on the second dimension. The regional and the HUMCAP variables are the variables with the highest scores on the third dimension that opposes them to the innovation input variables.

Figure 46: Component loadings plot of the 1995 analysis



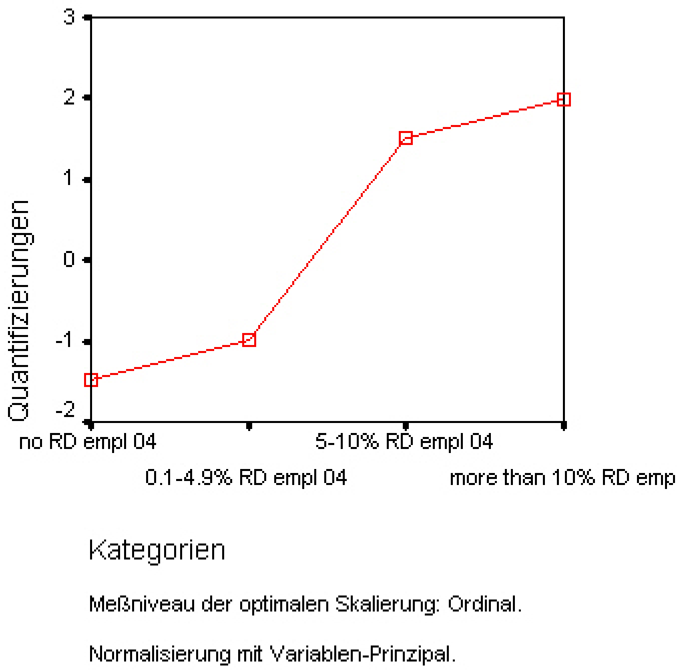
Normalisierung mit Variablen-Prinzipal.

Source: Selected from CATPCA output, SPSS 11.0

Transformations

Figure 47 to figure 52 show the transformation plots of the 1995 categorical principal components analysis. The transformation of the R&D employee variable indicates that the lower categories (less than 5 % of the total employees engaged in R&D activities; below the zero point) are opposed to the higher categories (above zero point; cf. figure 47).

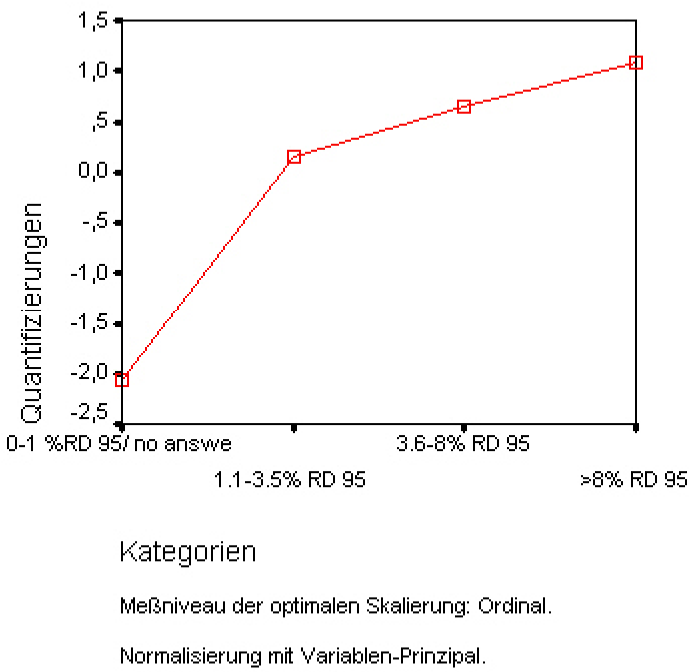
Figure 47: Nonlinear transformation of the variable 'Share of R&D employees 1995'



Source: Selected from CATPCA output, SPSS 11.0

The transformation plot of the R&D expenses variable approximates a rather concave function with a steep part between 0 and 3.5 % R&D expenses with the category 1 – 3.5 % plotted not too far from the zero point. This steep part – indicating a comparatively large distance between the categories '0-1 % R&D expenses' and '1-3.5 % R&D expenses' on the resulting vector – is opposed to a more flat part with the categories 3.5 % R&D expenses and higher. This flat part of the plot indicates less distances between the higher category points on the vector (cf. figure 48).

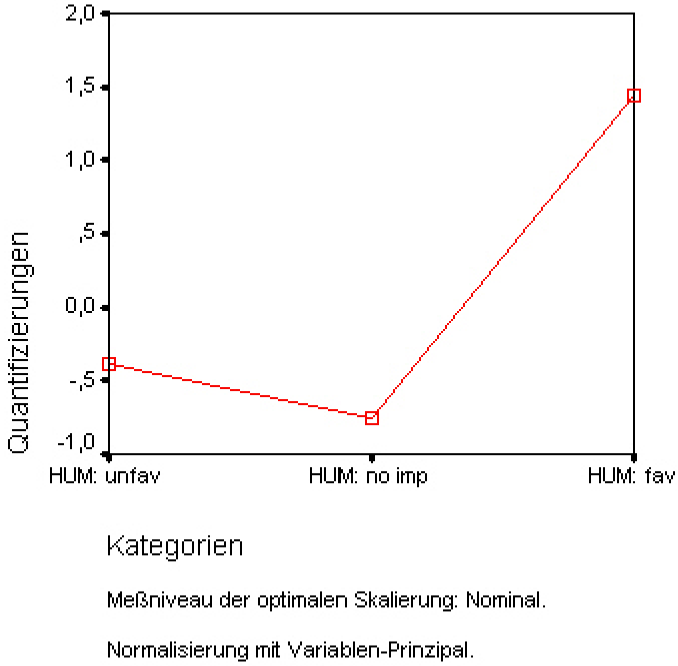
Figure 48: Nonlinear transformation of the variable 'Share of R&D expenses 1995'



Source: Selected from CATPCA output, SPSS 11.0

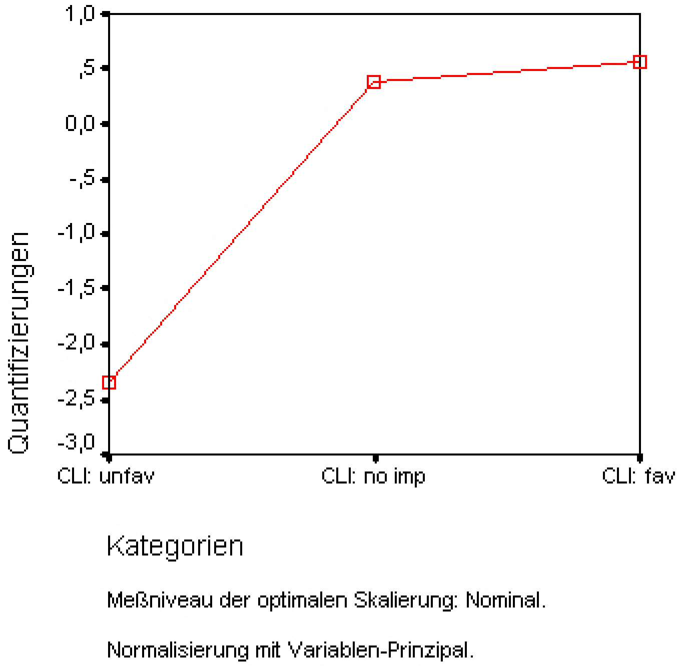
Figure 49 is the transformation plot of the HUMCAP variable, i.e. firm representatives' perceptions of the regional workforce with respect to innovation activities in their firms. The transformation plot shows that the neutral category is attributed the minimum value. However, the negative and neutral categories receive below zero quantifications and are opposed to the positive category point above zero.

Figure 49: Nonlinear transformation of the variable 'Perception of the regional workforce' 1995



Source: Selected from CATPCA output, SPSS 11.0

Figure 50: Nonlinear transformation of the variable 'Perception of the regional innovation climate'

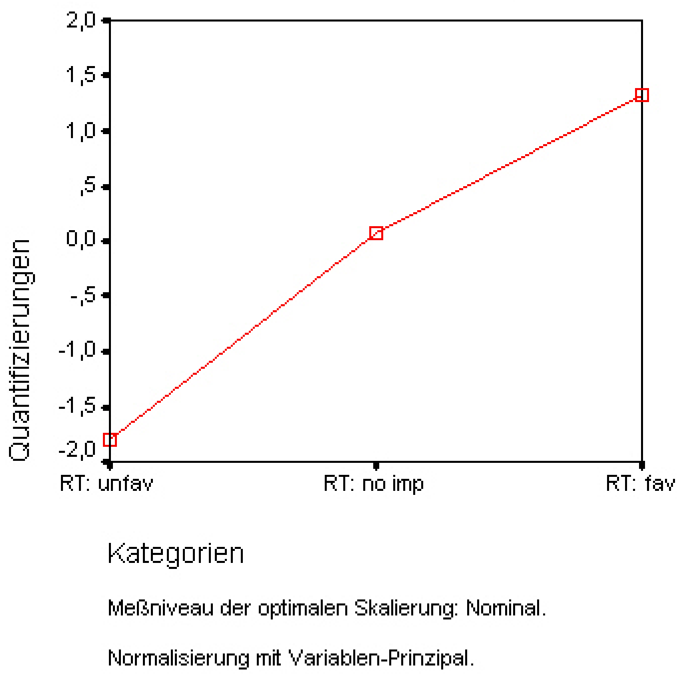


Source: Selected from CATPCA output, SPSS 11.0

Figure 50 shows a different picture for the regional innovation climate. Here, the negative category receives below zero quantifications and is opposed to the neutral and positive categories which receive similar quantifications, indicating quite close representations on the resulting vector.

The transformation of the variable 'Perception of the regional research supply' results in a nearly linear plot with the neutral category near the zero point, opposing the negative and positive ends. The part connecting the 'unfavourable' and 'no impact' categories is steeper than the 'no impact'-'favourable' part, indicating a longer 'unfavourable'-'no impact' distance on the resulting vector (cf. figure 51).

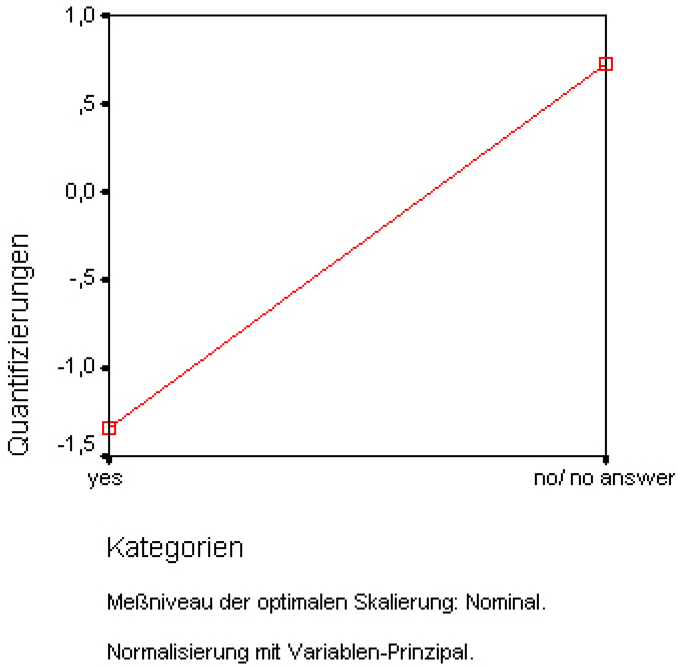
Figure 51: Nonlinear transformation of the variable 'Perception of the regional research supply' 1995



Source: Selected from CATPCA output, SPSS 11.0

The transformation plot of the regional variable 1995 shows a larger part with negative than with positive quantifications. This indicates that the part of the vector between the "yes" endpoint and the zero point is larger than between the zero point and the "no" endpoint (cf. figure 52).

Figure 52: Nonlinear transformation of the variable 'Importance of regional partners' 1995



Source: Selected from CATPCA output, SPSS 11.0

This variable is defined as: Very intensive co-operation with clients or research institutes in the *Land* / *région* (manufacturing sample firms), or the location of clients, competitors or research institutes in the *Land/ région* (KIBS), cf. section 5.3.8.1.