La Plateforme Modulaire Socio-Cognitive pour la Création de Connaissance

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The Socio-Cognitive Modular Platform for Knowledge Creation

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Résumé.

La Plateforme Modulaire Socio-Cognitive pour la Création de Connaissance

Le but principal de cette étude est d'explorer les bases théoriques relatives à la création de connaissances dans une perspective socio-cognitive. Ce travail porte sur la création de connaissances, sur les réseaux fondés sur la connaissance, sur les communautés à l'origine de la création de connaissances, et sur les alliances technologiques interdisciplinaires permettant de décrire et d'expliquer les processus de création de connaissances dans les industries de pointe chinoises.

Dans une économie basée sur les ressources et/ou intensive en connaissances, les organisations créent et partagent de la connaissance dans le but de développer des processus innovants. Il est important de noter que le fait de créer des connaissances nouvelles peut être aussi important que de traiter des connaissances déjà existantes. Ces connaissances nouvelles sont créées au travers des différences épistémiques entre les entités étudiées. La création, le partage et l'utilisation de connaissances ne sont ainsi plus limités aux frontières de l'organisation. En effet, la connaissance est également créée par le biais d'alliances technologiques ou réseaux d'organisation. De tels procédés de création de connaissances peuvent ainsi être expliqués en termes de relations inter-organisationnelles. Malgré l'importance de la connaissance et des effets de la connaissance sur l'avantage concurrentiel, la façon de produire de la connaissance reste problématique pour les organisations. C'est pourquoi, il est nécessaire de développer des bases théoriques et des bases empiriques relatives à la création de connaissances.

La question de recherche centrale de cette étude est: comment redéfinir et mieux comprendre le processus de création de connaissance?

Nous nous concentrons sur les trois sous-questions suivantes:
1. *Quels sont les mécanismes génératifs de la création de connaissance nouvelle?*
2. *Comment l'intersubjectivité ou l'interaction intervient-elle, et qu'implique-t-elles?*
3. *Comment le facteur humain modère-t-il les processus de création de connaissance?*

Les questions soulevées dans cette thèse sont inspirées par un débat fondamental sur la nature de la connaissance, l'interaction entre connaissance ("knowledge") et savoir ("knowing"), l'origine des routines, les relations entre niveaux micro et macro, et les construits de l'apprentissage individuel-collectif. Les mécanismes de création de connaissances, et en particulier les micro-fondations de la connaissance occupent une place centrale dans le discours actuel de gestion des connaissances. Nous pensons avoir identifié des conclusions potentiellement importantes concernant la dynamique de la création de connaissances.

Afin de répondre à cette question, nous nous sommes concentrés sur trois objectifs de recherche : (*i*) fournir un modèle en spirale basé sur la pratique et intégrant la création de connaissances dans les organisations et les communautés ; (*ii*) mettre en avant la relation structurale entre création de connaissances et réseau ; et (*iii*) examiner la confiance et les normes à l'origine de l'interaction entre les processus de création de connaissances et les conséquences pour l'organisation de la création de ces connaissances.

Un certain nombre d'ambiguïtés subsistent pour mieux comprendre les processus de création de connaissances organisationnelles. La revue de la littérature récente ne nous permet pas d'expliquer la création de connaissances. Pour combler cette lacune, nous proposons d'étendre la vision de la firme basée sur la connaissance, en considérant celle-ci comme un processus se situant dans la pratique, et en expliquant la façon dont les firmes interagissent les unes avec les autres, et avec les communautés intensives en connaissances. La connaissance organisationnelle nouvelle trouve ses origines dans l'utilisation de la connaissance en tant qu'outil de savoir basé sur la co-construction sociale entre les diverses communautés et les différentes organisations. Nous nous appuierons sur trois corps de littérature (définition de la connaissance, théorie de la création de connaissances organisationnelles, et communautés basées sur la création de connaissances) pour fournir une vision des procédés de création de connaissances dans les organisations et dans les communautés. Parallèlement, nous faisons appel aux implications épistémologiques du néo-confucianisme (concept oriental) et de la théorie socio-cognitive (concept occidental), afin de présenter un modèle conceptuel de création de connaissances, connu sous le nom de plateforme modulaire socio-cognitive.

Après avoir réalisé une série d'entretiens auprès de firmes chinoises, spécialisées dans les véhicules à moteur, nous avons développé un modèle en spirale destiné à la création de

connaissances et basé sur la pratique, dans lequel nous montrons comment une norme sociale reliant les membres des communautés/groupes peut contribuer à promouvoir le savoir dans une plateforme modulaire socio-cognitive. Le modèle repose sur deux mécanismes interconnectés les uns avec les autres pour faciliter les processus de création de connaissances (un mécanisme formateur et un mécanisme modérateur). Dans ce contexte, nous insistons tout particulièrement sur l'importance de coupler action et savoir pour contribuer à l'apparition de connaissances. Ces deux concepts sont déterminés et se soutiennent mutuellement. La connaissance comme outil apparaît ainsi comme un point de départ pour toute pratique et pour l'acquisition d'expérience. Il est donc nécessaire que cette plateforme modulaire socio-cognitive devienne une unité organisationnelle à part entière, de sorte que la création de connaissances ait sa propre dynamique intérieure.

Les observations ci-dessus sont mises en relief par un modèle très simple, mais logiquement contestable. Nous utilisons l'échantillon des alliances multidisciplinaires chinoises de haute technologie afin de trouver un appui empirique sur lequel se basent les différents développements théoriques. La plateforme modulaire socio-cognitive semble jouer un rôle primordial dans l'interaction entre les communautés scolaires et commerciales, d'une part, et les groupes interdisciplinaires dans les industries de pointe chinoises d'autre part, ce qui permet de mettre en avant les facteurs facilitant la création de connaissances.

Le deuxième objectif de ce travail est d'examiner le contexte de formation des connaissances au sein de la plateforme modulaire socio-cognitive. L'étude décrit une infrastructure d'appariement démontrant le rapport structural entre la spirale de création de connaissances et les réseaux de connaissances. Nous utilisons la notion de communauté intensive en connaissances pour décrire les lieux privilégiant la création de connaissances. Ces dernières s'articulent entre les différents membres des communautés ou des groupes interdisciplinaires, réunissant ainsi diverses organisations.

L'infrastructure d'appariement contribue à la façon d'organiser et de gérer les réseaux, tout en favorisant la recherche de processus de création de connaissances. Elle décrit l'interaction répétée entre l'architecture dure et l'architecture douce de la connaissance, dans laquelle les intermédiaires, à l'origine de l'appariement, se situent entre des groupes hiérarchiques de développement de produits nouveaux et des communautés autonomes intensives en connaissances. Le dispositif mettant en avant un tel appariement est un

ensemble de normes sociales ou de règles, incorporées dans les réseaux d'interaction et de collaboration, et reliant les différents modules des activités d'innovation. Les intermédiaires développent une grammaire ou un langage commun de manière à réunir chaque module ou participant, et ainsi mobiliser efficacement le processus d'innovation. Cette architecture de gouvernance comporte trois phases : l'étalonnage, la transformation, et l'adaptation. Il est dès lors possible d'analyser la manière dont s'articule l'interaction entre les différents acteurs dans les processus de création de connaissances. D'après nos résultats, la plateforme modulaire socio-cognitive semble favoriser une dynamique d'apprentissage et d'exploration, tout en consolidant des pratiques normatives, et la coordination des activités d'innovation au-delà des frontières de l'entreprise. Ceci nous donne donc un modèle clair permettant d'expliquer l'interaction entre la création de connaissances et les stratégies des firmes.

Les processus de création de connaissances dans les organisations reposent sur la confiance. Dans ce contexte, les réseaux basés sur la connaissance ne peuvent fonctionner sans confiance. Partager un langage commun semble, de ce fait, être une condition préalable pour que cette confiance émerge. De plus, les processus d'appariement ont besoin de relations de confiance pour augmenter la portée du sens commun. Les intermédiaires doivent donc établir des rapports à long terme, basés sur la confiance, au sein même du réseau. Il apparaît dès lors nécessaire de s'interroger, d'une part, sur la façon de mettre en place cette confiance dans la plateforme modulaire socio-cognitive, et d'autre part, sur la base structurale autour de laquelle repose cette confiance, que ce soit dans les organisations ou dans les communautés.

Le troisième objectif de cette recherche traite du contexte dans lequel s'inscrit la création de connaissances. Dans le cas des normes sociales présentes dans les différentes communautés intensives en connaissances ou dans les groupes interdisciplinaires, le mécanisme modérateur est nécessaire pour transformer des règles normatives en action. La confiance émerge comme facteur de médiation lorsqu'il n'y a pas de contrôles informels sur les processus de création de connaissances, ce qui mène à une coopération accrue. Nous supposons que la construction de la confiance se fait par accumulation, et est fondée sur des mécanismes cognitifs d'interaction, assimilables à des rapports sociaux. Nous distinguons ainsi la confiance d'un point de vue prédictif de la confiance d'un point de vue normatif. Nous examinons ensuite deux facteurs structuraux nécessaires à la formation de deux types de confiance. Nous présentons dans un deuxième temps le concept de "*Hui-bao*" représentant

une norme de réciprocité et qui permet de construire la confiance normative. Ces deux concepts illustrent la dynamique chinoise de formation de confiance dans les réseaux. Ces trouvailles suggèrent qu'en matière de confiance prédictive, les membres des communautés ou des groupes ne se focalisent pas sur leurs liens pour accumuler de la confiance et pour se construire une identité. De plus, les positions d'appariement dans le réseau sont liées à la confiance normative, et tendent à renforcer l'esprit collectif se développant dans les groupes ou communautés. Cette étude offre ainsi une explication à la formation de la confiance dans les groupes et les communautés interdisciplinaires. Elle peut donc aider différentes organisations à établir de bonnes prévisions pour leurs membres, et à faciliter les processus de création de connaissances.

Les principaux secteurs sur lesquels s'appuient ces recherches (industrie des véhicules à moteur, industrie des semi-conducteurs et industrie des télécommunications) sont au premier rang de l'innovation dans une économie chinoise en transition. Etant donné que l'étude traite en détail des constructions dans le contexte d'un marché naissant, une recherche quantitative n'est pas facile à mener. Afin d'augmenter les connaissances et afin de mieux comprendre les processus de création de connaissances organisationnelles dans les industries de pointe chinoises, nous avons adopté une approche inductive en multipliant les études de cas. Ainsi, l'étude empirique met en avant une grande variété de spirales de création de connaissances ; elle illustre également les deux mécanismes nécessaires à la création de connaissances dans une plateforme modulaire socio-cognitive ; elle décrit les mécanismes d' appariement de manière à favoriser un accès plus efficace aux ressources et aux capacités spécifiques des firmes et/ou institutions, dans lesquels les réseaux jouent un rôle significatif ; et enfin, elle illustre comment l'interaction entre la confiance et les normes permet de passer d'un processus de création des connaissances à la formation des alliances technologiques interdisciplinaires.

Nous avons conduit des entretiens à la fois lors de visites sur site et via entretiens téléphoniques. Les interviewés incluent des directeurs généraux, des directeurs de départements, principalement des directeurs de la R&D, et des chercheurs et ingénieurs. La plupart des entretiens sont semi-structurés. Les entretiens ont duré 90 à 120 minutes. Nous avons interviewé vingt-six personnes dans les quatre entreprises et les quatre alliances technologiques sélectionnées. Nous avons par ailleurs interviewé un grand nombre d'experts industriels et académiques connaissant bien ces firmes et ces alliances technologiques.

Ce travail permet de poser un cadre théorique à la création de connaissances. La plateforme modulaire socio-cognitive conduit à explorer de nouvelles pistes de recherche : le modèle proposé de spirale de la connaissance semble pertinent en matière de gestion des réseaux de connaissances, en matière d'intégration des fondements de l'innovation, en matière de résolution des conflits, et en matière de motivation des agents à l'origine de l'émergence des connaissances nouvelles. Ces recherches permettent donc d'identifier et d'examiner la dynamique de la création de connaissances au sein des firmes et des communautés, de manière à accompagner les managers et/ou directeurs dans la mise en place d'une architecture de la connaissance en accord avec les stratégies d'entreprise. Cette étude constitue ainsi un travail préliminaire pour davantage de recherche empirique sur les processus de création de connaissances dans les organisations et dans les communautés.

Aperçu de la thèse

La suite de la thèse est divisée en 6 chapitres.

Dans le chapitre 2, la première étape du processus de recherche a été une revue extensive des littératures qui nous ont semblées les plus pertinentes concernant les processus de création de connaissances. Nous présentons une analyse critique de trois corps de littérature: la littérature sur la connaissance conceptuelle, la littérature sur le théorie de la création de connaissances organisationnelles et la littérature sur les communautés et la création de connaissance. Nous discutons tout d'abord chacun de ses trois courants de littérature séparément, afin de puiser dans leurs idées et d'évaluer leurs limites. Nous les intégrons ensuite pour parvenir à une meilleure compréhension des processus de création de connaissances. Enfin, nous les développons en essayant de dépasser leurs limites.

Dans le chapitre 3, notre objectif est de construire un cadre théorique de la création de connaissances. A cette fin nous passons en revue les littératures pertinentes sur la théorie sociale de l'action/le capital social, la théorie cognitive sociale et la philosophie chinoise de la connaissance et du capital humain. Une deuxième série de revues de la littérature a ensuite été utilisée pour spécifier plus précisément les questions de recherche et l'architecture du modèle conceptuel de la création de connaissances. Ceci nous a mené au cadre conceptuel final, qui consiste en une plateforme modulaire sociocognitive avec interaction entre un mécanisme

formatif et un mécanisme modérateur facilitant les processus de création de connaissances. Nous identifions cinq facteurs affectant le processus de construction de connaissances. cinq facteurs qui interagissent, agissant à la fois comme variables dépendantes et indépendantes, pour influencer les processus de construction de connaissances. Ces cinq facteurs, qui fournissent le cœur de notre recherche sont: *l'identité, l'interface, la norme, la routine et la confiance*. Notre modèle montre que différents processus de création de connaissances dépendent de ces facteurs. De plus, cette revue de la littérature et ce travail conceptuel initial ont formé la base des entretiens et études de cas.

Dans le chapitre 4, nous présentons une étude de cas comparative montrant comment les nouvelles connaissances sont créées pour l'innovation dans l'industrie automobile chinoise. Nous avons réalisé une série d'entretiens dans quatre entreprises: *PATAC Shanghai*, un centre de recherche technique conjoint en *VW* et *SAIC*, *VW Shanghai*, une joint-venture entre *VW* et *SAIC*, *Chery* et *Geely auto Ltd.*, deux producteurs locaux d'automobiles. Nous avons sélectionné et analysé des cas au niveau individuel, au niveau des communautés et au niveau organisationnel. En nous appuyant sur ces études de cas nous avons ensuite développé un modèle en spirale de la création de connaissance, basé sur la pratique, qui décrit la stabilité et le changement dans les processus de création de connaissances.

Le résultat de cette étude est une série de six propositions. Elles sont testées et expliquées dans les chapitres suivants, et reliées entre elles par le modèle en spirale (Figure I.). Ces propositions sont les suivantes:

Proposition 1: Deux mécanismes génératifs corrélés sont nécessaires pour approfondir la génération de connaissances: 1) le contexte formatif accroît la connaissance; 2) le contexte normatif soutien la connaissance.

Proposition 2: Les processus de création de connaissent impliquent trois mouvements: 1) la standardisation: observer, sélectionner et choisir pour vérifier l'interface; 2) la transformation: permettre à la connaissance interne d'émerger et aux expériences d'être transformées; 3) l'adaptation: créer de nouvelles routines et convertir l'expérience en action.

Proposition 3: L'appariement, la modularité et le réseau de processus peuvent créer le locus et maintenir les rythmes et le mouvement de la spirale des connaissances; la distance cognitive fournit une magnitude et un rythme de changement pour la construction générative de connaissances.

Proposition 4: Afin d'accéder à une collectivité plus profonde d'apprentissage et de connaissances, l'individu doit savoir combiner trois instruments: 1) l'identification: ouverture d'esprit, direction, identification du type d'expérience pour soutenir la sélection; 2) la traduction: traduire les règles en action, résoudre les conflits et accélérer l'assimilation; 3) la conciliation: évaluer les procédures et faciliter l'imitation.

Proposition 5: Les normes sociales, la confiance et le réseau relationnel maintiennent la stabilité de l'apprentissage collectif, légitiment la coordination et encouragent la créativité; la proximité relationnelle étaye le jugement en rapprochant les pratiques normatives.

Proposition 6: Gérer la connaissance signifie faciliter les transitions multiples de la spirale des connaissances: du niveau individuel (micro)/du groupe /de la communauté au niveau institutionnel (macro)/global/systémique.

Figure I. Le modèle en spirale de la création de connaissance, basé sur la pratique
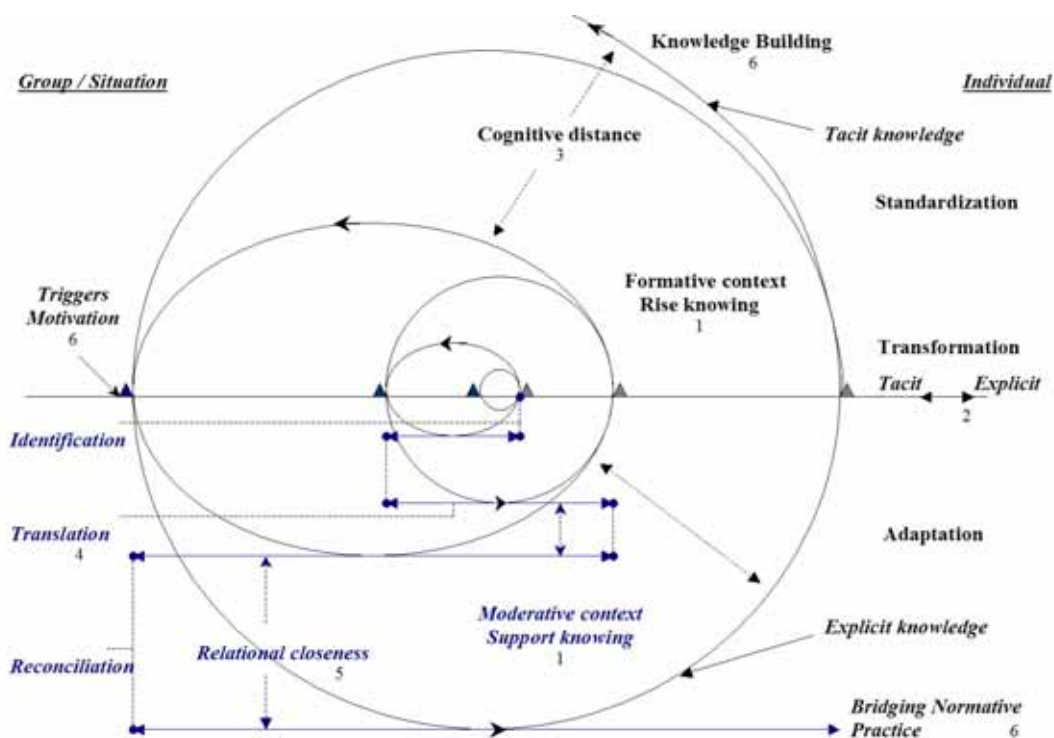
Dans le chapitre 5, nous analysons les déterminants des processus de création de connaissance au sein des alliances technologiques chinoises. Nous nous focalisons donc dans ce chapitre sur la gestion de la connaissance et développons la proposition selon laquelle le courtage et l'échange sont une piste pour comprendre les dynamiques de coordination et de coopération dans les processus de création de connaissances. Nous mettons en lumière les effets de courtage et d'échange propres aux processus de création de connaissances et nous examinons le mécanisme d'appariement et les interactions entre communautés et groupes interdisciplinaires. L'objectif principal de ce chapitre est de mettre au jour les différents aspects du courtage et de l'échange au sein des communautés/groupes et d'insister sur l'importance de considérer le processus de création de connaissance comme un construit multidimensionnel.

A cette fin, nous commençons par fixer la notion d'appariement et de médiation par une description détaillée tirée d'une étude de cas de courtage et d'échange à travers les frontières technologiques au sein des alliances technologiques chinoises. Nous avons collecté des données de quatre alliances technologiques industrielles chinoises: *Shanghai Santana Community, GM Shanghai Joint Development Center*, *Godson Chips Industry Alliance*, et *TD-SCDMA Industrial Alliance*. Ces alliances appartiennent à l'industrie automobile, à

l'industrie des semi-conducteurs ou des télécommunications. Dans cette étude de cas, nous analysons la formation des alliances, le rapprochement des pratiques entre communautés académiques/commerciales et groupes interdisciplinaires, la motivation ainsi que les processus de confiance et la gestion des connaissances au niveau des architecture de connaissances individuelles et collectives. Dans ce chapitre, nous montrons qu'une architecture de gestion cohérente inclut trois phases, de standardisation, de transformation et d'adaptation, puis nous décrivons le déroulement de l'interaction et ce qui est impliqué dans les processus de création de connaissance. Nous montrons de plus dans ce chapitre qu'une plate-forme sociocognitive modulaire soutient une dynamique d'apprentissage et d'exploration. Encore plus crucialement, les courtiers et les "passeurs" de connaissance sont à même de rapprocher les pratiques normatives et de coordonner l'innovation ouverte qui s'étend au-delà des frontières de firmes. Enfin, nous étudions les implications des positions des courtiers et "passeurs" pour la création et la gestion des connaissances dans les alliances technologiques.

Enfin, dans le chapitre 6, nous résumons les résultats et conclusions principaux de cette étude. Nous discutons les contributions clés: nous présentons les contributions théoriques en montrant comment la spirale des connaissances basée sur la pratique se situe dans les processus de création de connaissances et comment le facteur humain modère la création de connaissance aux niveaux individuel, du groupe, de l'organisation ainsi que de l'alliance multidisciplinaire; nous discutons ensuite les implications managériales, en termes des processus clés et des pratiques de création de nouvelle connaissance, à la fois au niveau des communautés et au niveau des organisations. Enfin, nous présentons des directions possibles pour de futures recherches.

The Socio-Cognitive Modular Platform for Knowledge Creation

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Abstract

My dissertation aimed to explore an inductive theory of the knowledge creation dynamics, and specifically examines the knowledge creation processes within and between organizations, communities and technology alliances. The broad focus was on knowledge creation, communities of knowing, and technology alliances in the description and explanation of knowledge creation processes in Chinese high-tech industries. The central question of this study is driven by: How might we re-define and better understand the processes of knowledge creation? In order to answer this question, the study focused on three research objectives: *(i)* to provide an integrated practice-based spiral model of knowledge creation in organizations and communities, *(ii)* to find structural relationships between knowledge generation and process networks and *(iii)* to examine the trust and norms-mediated interaction in the knowledge creation processes and the implications for organizational knowledge governance.

A great deal of ambiguity exists in understanding organizational knowledge creation. To fill this gap, I first expand and integrate three bodies of literature – definitions of knowledge, theory of organizational knowledge creation, and communities of knowing – to provide an integrated view of knowledge creation processes in organizations and communities. Then I appeal to an integrated epistemological implication of Western social capital, socio-cognitive theory and neo-Confucian thought of human behavioral models to build a practice-based conceptual framework of knowledge creation. Furthermore, I use a case study analysis to develop a knowledge spiral in an effort to present the inner dynamics and transformation of knowledge creation processes in organizations and communities.

The second objective of this research shifts the analysis to further examine the formative context of knowledge creation within the socio-cognitive modular platform. The study describes an operative infrastructure – *matchmaking* – that demonstrates the structural relationship between a practice-based knowledge creation spiral and knowledge process networks. The matchmaking infrastructure contributes to organizing and managing the communication and interaction between interdisciplinary groups and knowing communities and seeks to coordinate innovation activities across organizational boundaries. The prominent feature of such matchmaking is a set of social norms or rules that are embedded in the process networks for collaborative interaction amongst loosely coupled modules of innovation activities. The innomediaries develop shared meaning or common understanding to meet at the interfaces connecting each module or specialized participants in order to achieve an effective mobilization in the innovation process. With this coherent governance architecture including three phases of standardization, transformation, and adaptation, we can see how the interaction takes place and what is involved in the knowledge creation processes.

The third research objective is to explain the scope of the study with a particular focus on embedded the moderative context of knowledge creation. The questions of how to build trust within socio-cognitive modular platforms and the relational issues between trust and motivation are high in the moderative context. I argue that trust emerges as a mediating factor when informal controls are lacking in the knowledge creation processes, which leads in turn to higher levels of cooperative behavior. I first distinguish trust with predicative and normative expectations. Then, I examine two structural factors important for the formation of two types of trust. The predictive model is related to the identity transformation, which builds up identity, whereas the normative model is related to the norm of reciprocity, which constructs collectivity to explain the dynamic of trust formation in practice.

As an exploratory study, this dissertation provides a practice-based knowledge spiral model that is useful to explain the nature of knowledge, the interaction of knowledge and knowing, origin of routines, the generative mechanisms for knowledge creation, in particular, a micro-foundation of knowledge creation. I believe that I have identified important potential conclusions concerning the dynamics of knowledge creation. This study may be used as a base for further empirical research on knowledge creation processes in organizations and knowing communities.

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Dedicated To My Parents

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Introduction and Thesis Overview

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1.1. Motivation for the Study

The main purpose of this study is to explore new theoretical ground for knowledge creation in a socio-cognitive learning perspective. The broad focus will be on knowledge creation, communities of knowing, and technology alliances in the description and explanation of knowledge creation processes in Chinese high-tech industries.

Knowledge creation has attracted research scholars from different disciplines and different fields for many years (Grant, 1996, Garud & Karnoe, 2001). In the economic field, scholars have studied the knowledge creation issues from the perspective of technological change (Rosrnberg, 1982). In the sociological studies, people have examined the social forces and environments that lead to knowledge creation (Merton, 1972). In recent research in strategic management and organizational field, scholars examine the organizational conditions that enable the emergence of new knowledge (Leonard-Barton, 1995; Leonard & Sensiper, 1998; von Krogh, Ichijo and Nonaka, 2000). Such a growing interest has lead researchers to examine the antecedents and the consequences of knowledge creation. Empirical research in the area of strategy has examined the effect of strategic alliances, clusters and collaborative inter-organizational projects on knowledge creation (Inkpen, 1996; Maskell, 2001). The community of practice approach has explored the role of boundary objects in facilitating the creation of new knowledge (Cook & Brown, 1999; Carlile, 2002; Lee & Cole, 2003).

These studies have provided valuable evidence as to the importance of knowledge creation, however, little is known about how new knowledge is created, and a general theoretical framework is particularly lacking, with some exceptions on knowledge creation studies based on case study approach (Leonard-Barton, 1995; Nonaka & Takeuchi, 1995; Tsoukas, 2005).

In practice, some scholars argue that Chinese businesses have acquired knowledge from a variety of domestic and foreign sources while also beginning to create knowledge of their own (Hariharan *et al.,* 2005; Burrows *et al.*, 2005). The key innovation players include the Chinese government, top local companies, and multinational corporations. The Chinese government believes the country must control certain core technologies, and promote indigenous innovation in local high-tech companies, for example, the home grown *3G TD-SCDMA*, which have made significant investments in research and development. Such

investments reach top local enterprises and universities and often involve collaboration between various research institutes and companies. Some leading Chinese companies such as *Huawei, ZTE, Datang, Lenovo, TCL* and *Haier*, also developed their own technologies in order to be globally competitive (Hariharan *et al.*, 2005). Consistent with Chinese cultural tradition, Chinese knowledge creation tends to be informal and tacit, particularly the transformation of knowledge lies in the relational contexts. However, the potential question is whether such mechanisms limit knowledge creation and technological innovation. As China plays an increasingly important role in the world economy, the need to understand and explain the knowledge creation processes in the Chinese context becomes more and more urgent.

In the knowledge-based view of the firms, the main drive is technological innovation, and the key source of sustainable competitive advantage and superior profitability within an industry is how a company creates and shares its knowledge (Conner & Prahalad, 1996; Grant, 1996, Kogut & Zander, 1992, 1996; Spender, 1996). Knowledge is taken as the basis for what an organization does, but it is important to know that creating knowledge can be as important as processing knowledge (Tsoukas, 1996). Despite the limitation of understanding how to generate knowledge, there are some arguments about critical features of organizational knowledge creation.

First, the creation of knowledge is a continuous process of dynamic interactions between tacit and explicit knowledge. Knowledge creation has been described as a cyclical process between tacit and explicit knowledge comprised of four conversion steps: socialization, externalization, combination, and internalization (Nokaka, 1994; Nonaka & Takeuchi, 1995). According to Nonaka and Takeuchi knowledge is created and transformed "spirally" from the individual level to the organizational level and finally between organizations. Socialization is the key to knowledge creation and externalization is the central phase in knowledge creation. These conversion modes shift depending on the triggers. However, the model is based on the idea that the sharing of tacit knowledge is accomplished in the mode of socialization and does not take into account the importance of controversies and conflicts in knowledge creation (Engestrom, 1999). Furthermore, in Nonaka and Takeuchi's (1995: 21) view knowledge is perceived as "*justified true belief*". Knowledge resides and is created in an individual's head. In this sense, their model is unable to capture essential features of how knowledge is created and used in collective knowledge building. It is

also not clear how knowledge is connected to action, what is the triggering effect and in what sense knowledge process creation derives from the practice.

Secondly, knowledge creation processes may also be embedded in organizational routines. Nelson and Winter (1982) depict routines as the memory and genes of the organization and the organization's knowledge basis. Routines are the fundamental units of analysis at the organizational level. In addition, routines are also shaped and determined at an intermediate level of knowing communities (Cohendet & Llerena, 2003). However, the process of translation of routines is complex, since routines are social phenomena and implicitly embedded with underlying meaning structures. The process of translation of routines for knowledge creation is a particular type of modification of routines. Such transformation usually implies a mix of linguistic representation, rules, and artifacts (D'Adderio, 2004). Furthermore, the routine is a collective notion that does not have a solid micro-foundation (Felin & Foss, 2005). This shows the lack of clear understanding of the origin of organizational routines. The questions that should be asked are: Where routines come from? How routines are created and emerge from individual action? How do they evolve with the subsequent interaction between individual and collective building (Felin & Foss, 2006)?

Thirdly, the interplay of knowledge and knowing can generate new knowledge and new ways of knowing. Cook and Brown (1999) highlight that new knowledge arises from a *generative dance* between the knowledge that is possessed by the individual and knowing as part of action. They have even assumed that beyond tacit knowledge there is knowledge inherent in practice itself which they call "knowing." According to Cook and Brown (1999: 388), "*Knowledge is seen as a tool at the service of knowing*", something brought into the action to be used during practice. In their view "knowing" is considered to be inseparable from practice and interaction with the world. They see explicit knowledge and tacit knowledge as two distinct forms of knowledge. Moreover, as the new knowledge becomes a way of knowing, it is exhibited outside the individual's head. It is embodied in new practice, becoming new tacit knowledge. According to this view, the generative dance is an important phenomenon to examine the new knowledge creation processes. However, it is not very clear how generative dance or interaction between knowledge and knowing takes place and what kinds of factors are involved in it.

Fourthly, knowledge is created through a combination of deliberate and non-deliberate practices in various knowing communities within and between organizations. In recent research, the role of communities of knowing in facilitating the creation and exchange of knowledge has received much attention. Amin and Cohendet (2004) extended Cook and Brown's notion of *"generative dance"* into an *"autonomous choreography"*. This choreography seeks to grasp the movement and rhythm between knowledge and knowing, which are given by the '*knowing partner*'. The authors go even further to explore the alignment between division of work and division of knowledge, which is how the architecture of knowing can be reconciled to the architecture of possessed knowledge within the firms. It is through the dynamic interactions between structural and epistemic components in such communities that new meanings, routines and knowledge are created. However, the structural and epistemic components of communities of knowing raise questions about the mechanics of their interaction that remain relatively unaddressed to date (Thompson, 2005).

Therefore, as the literature stands, we still do not have a good understanding about how to generate knowledge in individuals, communities or groups, and organizations. A great deal of ambiguity exists in the understanding knowledge creation.

Despite the recent studies focusing on knowledge-based arguments, a number of fundamental constructs and questions have yet to be clarified and explored. As Spender (2005) stated, *"since we do not, even cannot define what knowledge is, ...we must engage the epistemics behind the notion of knowing."* A common theme is the notion that theorizing about knowledge creation processes is constituted by bridging epistemic difference (Tsoukas, 2005). For example, Cook and Brown (1999) define a *"generative dance"* between knowledge and knowing; further, Orlikowski (2002) claims that knowing is an ongoing process and an active accomplishment; Hargadon and Fanelli (2002) argues that new knowledge comes about through cyclic interaction between latent and empirical knowing; also as Tsoukas (2003) suggests, new knowledge is generated when individuals seek to turn an unreflective practice into a reflective one. From this approach, interaction between knowing and knowledge or action is important in order to explain the knowledge dynamics. However, the question of the dynamics of such interaction enables new knowledge to emerge. Spender (2005) has recently noted *"if we think more about knowing as acting in and on the world, we know through language and that is social and inter-subjective ... knowing must be inter-subject-ivied before it can be called knowledge."* In this sense, we need to identify

where our action comes from and what the origins of knowledge are. Therefore, in the research of new knowledge creation, the underlying theoretical mechanisms are still lacking.

Another critical question is when exactly we can precisely move from the individual to the collective level in the analysis of knowledge creation processes (Dansereau *et al.*, 1999; Felin & Foss, 2006). Carlile and Rebentisch (2003) proposed a knowledge transformation cycle to explain the consequences and the nature of knowledge. They argued that knowledge is created in practice, and that the active processes of knowledge transformation determine what knowledge is created. While authors focused on knowledge transfer/diffusion, such as knowledge storage and knowledge retrieval, it is difficult for us to understand the underlying actions, choice/selection, and motivation in the knowledge transformation cycle. Recently, Nonaka and Toyama (2005) argued that knowledge creation is guided through the synthesis of contradictions. Such a synthesis is achieved through dialogues and action. They further claimed that *"what is the matter in dialogues is the meaning it creates, rather than the form of logic it takes"* (Nonaka & Toyama, 2005: 426). In practice lays a foundation to share tacit knowledge through shared experience. However, they failed to present a micro-foundation of knowledge and the concept of synthesis remained fuzzy and has yet to resolve the micro-macro problem. Thus, the questions are: at what level is new knowledge created and what are key processes of knowledge creation both at the individual and collective levels? When building micro-foundations, what behavioral models should we make use of? How to bridge/build meaning or common understanding between data and practice?

My dissertation aims to explore an inductive theory of the knowledge creation dynamics, and specifically examines the knowledge creation processes within and between organizations, knowing communities and technology alliances. I argue that it is possible to build a kind of micro-foundation of knowledge creation from a sociological/physiological and behavioral starting point (e.g. Gavetti, 2005; Felin & Foss, 2006). Additionally, there is an overlap between social theorist and organizational scholars with regard to the micro-macro link or individual-collective relationship (Coleman, 1990). The dissertation uses an integrated epistemological implication of Western social capital, socio-cognitive theory (Bandura, 2001) and neo-Confucian thought of human behavioral models to build a practice-based conceptual framework of knowledge creation. Furthermore, I use a case study analysis to develop a knowledge spiral in an effort to present the inner dynamics of knowledge creation processes

in organizations and communities. I believe this process model can fill a gap in understanding organizational knowledge creation.

1.2. Research Questions

The overarching research question of this study is: *How might we re-define and better understand the processes of knowledge creation?*

There are three sub-research questions in relation with the main focus of this study; Tsoukas (2005) also proposes the similar questions:

1. *What are the generative mechanisms through which new knowledge is created?*
2. *How does inter-subjectivity or interaction take place and what is involved in it?*
3. *How does a human agency moderate knowledge creation processes?*

The first question addresses the basic, but essential "mapping" issue that is the subject of much of the theoretical aspect of knowledge creation. I took the view that knowledge is a process and situates in practice by providing an explanation of how firms interact with its knowing/knowledge communities to create knowledge. Further, knowledge is a process and knowing is an aspect of action and it is about interaction that enables new knowledge creation. More precisely, the source of new organizational knowledge and knowing lies in the use of knowledge as a tool of knowing within situated interaction and social co-construction between knowledge communities and organizations.

Following a series of interview in Chinese automotive companies, I further developed a practice-based spiral model of knowledge creation, and I argue that social norms act as principles of right action binding the members of communities/groups and serving to rise or support knowing within *a socio-cognitive modular platform.* The model shows two kinds of generative mechanisms (*formative and moderative*) to facilitate knowledge creation processes. Both contexts overlap and are intertwined, linking knowledge and knowing in order to generate new knowledge in organizations and communities. In my argument, the socio-cognitive modular platform becomes an organismic unity so that knowledge creation has its inner dynamics for the transformation and exchange between knowledge and knowing.

The second research question shifts the analysis to further examine the formative context of knowledge creation within the socio-cognitive modular platform. The second question explores the possibility of an operative *matchmaking*-infrastructure demonstrates the structural relationship between the practice-based knowledge creation spiral and knowledge process networks. I employ the notion of knowing communities as the basis for knowledge creation and sharing. The matchmaking infrastructure contributes to organizing and managing the communication and interaction between interdisciplinary groups and knowing communities and seeks to coordinate innovation activities across organizational boundaries.

Matchmaking as a kind of interaction/inter-subjectivity outlines repeated interaction between hard architectures of knowledge and the soft architectures of knowledge, in which innomediaries/matchmaker lie between the hierarchical groups of new product development and more socialized autonomous knowledge communities. In my view, the prominent feature of such matchmaking is a set of social norms or rules that are embedded in the process networks for collaborative interaction amongst loosely coupled modules of innovation activities. The innomediaries develop shared meaning or common understanding in order to connect each module or specialized participant and achieve effective mobilization in the innovation process.

In short, the reason for addressing this question in the thesis is to begin to build a more contextualized theory of knowledge creation. I argue that the socio-cognitive modular platform supports dynamics of learning and exploration, bridging normative practices and coordinating open innovation that extends across firm's boundaries. Further, it gives us a clear pattern related to interconnection between knowledge creation and firm strategies.

The third and final question explains the scope of the study from the point of view of the embedded moderative context of knowledge creation. The questions of how to build trust within a socio-cognitive modular platform and the relational issues between trust and motivation are high on the moderative context.

I argue that trust emerges as a mediating factor when informal controls are lacking in the knowledge creation processes, which leads in turn to higher levels of cooperative behavior. I consider that building trust is cumulative and progressive, and based on processes of interaction in which trust appears not only as a cognitive disposition but also as an act and

a social relationship. In my view, moderative mechanisms can translate normative rules into action.

I adopt the concept that trust not only is a cognitive disposition but also is an act/a social relationship. In my view, trust building is accumulative and progressive and based on processes of interaction. I first distinguish trust in a *predicative* and *normative* expectation. I then examine two structural factors important for the formation of two types of trust. I present the predictive model as the identity transformation, which builds up identity, whereas the normative model is the norm of reciprocity, which constructs collectivity to explain the dynamic of trust formation in practice. The finds suggest that in predictive trust, members of communities or groups through the loosen relation ties to accumulate trust and build identity. Further, the matchmaking positions in relation network are related to normative trust towards developing groups or communities collectivity.

In summary, the questions addressed in this thesis are inspired by a core debate about the nature of knowledge, the interaction of knowledge and knowing, the origin of routines, the micro-macro links, and construct the individual-collective learning. The generative mechanisms for knowledge creation, in particular, a micro-foundation of knowledge occupies a central position in the current knowledge management discourse. I believe that I have identified important potential conclusions concerning the dynamics of knowledge creation.

1.3. Data and Methods

The dissertation uses a case study analysis to establish a theory of knowledge creation. The research framework was to be developed inductively with a set of exploratory case studies. The principal sectors in the research are the automotive, semi-conductor and telecommunication industries, and are at the forefront of innovation in Chinese transitional economy. The study deals in details with firm specific paradigm in an emerging market context that quantitative research cannot easily obtain and analyze (Hoskisson *et al.,* 2000). In order to gain an in-depth knowledge and understanding of organizational knowledge creation processes in Chinese high-tech industries, I took an inductive multiple case study approach. Inductive research seemed the most efficient way to develop enough breadth and depth of insight to develop questionnaires. It could capture much of the actual complexity of the

research setting, which should serve to identify for follow-up research, appropriate theoretical lenses and levels of analysis (Freeman 1978; Parkhe, 1993).

Data was collected following the case study data collection protocol (Yin, 1984). Data used in this study was gathered from many different sources, including interviews with R&D managers, and archival sources such as company records, newspaper articles, direct observation, a short questionnaire and various print and electronic sources. Before visiting the companies for the purpose of making observations and conducting interviews, I analyze each company using annual reports, company-supplied archival data, and secondary sources of information such as trade journals.

I conducted interviews through both site visits and follow up telephone interviews. The interviewees include top management executives, middle managers, mainly R&D managers, and researchers and engineers. The majority of the interviews were semi-structured. Interviews typically lasted 90 to 180 minutes. I have interviewed 26 people in the 4 firms and 4 industrial technology alliances I decided to focus on. In addition I have interviewed many industrial and academic experts familiar with the firms and the industrial technology alliances.

All interviewed partners either received in advance written information about the purpose of the study, or, when not feasible, were given a brief description of the project at the beginning of the interview. The interview started with a list of questions that came from the first step of data collection. The interview partners were also assured that all information would be treated anonymously and confidentially. During the interviews, I took intensive notes, because most of the interviewees preferred not to have the interview taped. The interview questions were used as a means for guiding the interviews. However, I allowed the interviewees to discuss at length. I interviewed the presenters until I had believed that I reached a point of saturation or redundancy.

I analyzed the data by first building individual case studies. I then compared cases, both within and across companies, constructing a conceptual framework (Eisenhardt, 1989). In keeping with the principles of a grounded theory case study, I had to step back from the data from time to time, maintain an attitude of skepticism and follow research procedures. I had to minimize my own prejudgment to help inspire me as to what the data showed. In

addition, I brought the theoretical assumption to the cross-level study in Chinese technology alliances and looked for the empirical support of theory development. I found consistent evidence that the socio-cognitive modular platform plays a key role in communication and interaction between academic community/commercial community and multidisciplinary groups of Chinese high-tech industries, which adds to our understanding of factors facilitating knowledge creation in multidisciplinary technology alliances.

1.4. Thesis Overview

The remainder of the thesis is divided into 6 chapters.

In Chapter 2, the first step in the research process is an extensive review of the literature that seems most relevant for knowledge creation processes. I present a critical analysis of three bodies of literature: the literature on conceptual knowledge, the literature on the theory of organizational knowledge creation and the literature on communities of knowledge creation. First, I discuss each body of literature independently in order to draw on its insights and assess its limitations. I then integrate them, thus providing a better understanding of the support knowledge creation processes. Finally, I develop each body of literature by addressing its limitations.

In Chapters 3, I expose the purpose to build a theoretical framework of knowledge creation. I re-review the relevant literatures on social theory of action/social capital, social cognitive theory and Chinese philosophy of knowledge/human capital. A second round of literature reviews is then used to specify more precisely the research questions and the constructs for the conceptual model of knowledge creation. These lead to the final conceptual framework, which is a socio-cognitive modular platform with the interplay between formative mechanisms and moderative mechanisms in order to facilitate knowledge creation processes. I identify five factors that affect the process of knowledge building. Five factors interact together to influence knowledge construction processes, acting both as independent and dependent variables. These five factors, which provide a focus for my investigation, are *identity, interface, norm, routine, and trust*. My model depicts various knowledge processes as dependent on these factors. In addition, this review and initial conceptual work forms the basis for interviews and case studies.

In Chapter 4, I perform a comparative case study analysis of how new knowledge is created for innovation in Chinese automotive industries. I conducted a series of interviews in 4 firms: *PATAC Shanghai*, a joint technical research center between *GM* and *SAIC*; *VW Shanghai*, a joint venture between *VW* and *SAIC*; and *Chery* and *Geely* auto Ltd. both representing local automobile producers. I selected and analyzed cases on the individual level, community level and organizational level. Based on these case studies, I further develop a practice-based spiral model of knowledge creation, which describes the stability and change in knowledge creation processes.

The result of this study is a series of propositions, *six* in total. These are later tested and explained in other chapters and are related to each other in a knowledge spiral model presented in Figure 1.1.

The propositions are:

Proposition 1: To cope with knowledge creation processes, there are two interrelated generative mechanisms that deepen knowledge generation: 1) formative context: raises knowing; 2) moderative context: supports knowing.

Proposition 2: The processes of knowledge creation involve three movements: 1) standardization in order to observe, select and choose to verify the interface; 2) transformation in order to allow the inner knowing to emerge and experiences to be transformed; and 3) adaption in order to create new routines and convert experience into action.

Proposition 3: Matchmaking, modularity, and process network can create the place and keep the rhythms of the movement of the knowledge spiral and the cognitive distance provides the magnitude and rate of change for generative knowledge building.

Proposition 4: In order to access the deeper learning and knowledge collectivity, human agency needs to moderate three instruments: 1) identification: open mind, guidance, identify type of experience to support selection; 2) translation: translate rule

into action, resolving conflicts and accelerate knowing 3) reconciliation: evaluate procedures and facilitate imitation.

Proposition 5: Social norms, trust, and relational network serve to keep stability of collective learning so as to legitimate coordination and encourage creativity, while relational closeness supports judgment in bridging normative practice.

Proposition 6: Knowledge governance means shifting knowledge spiral at multiple levels: from individual (micro)/group/communities to the institutional (macro)/global system level.

Figure 1.1. Practice-Based Knowledge Spiral for Knowledge Creation
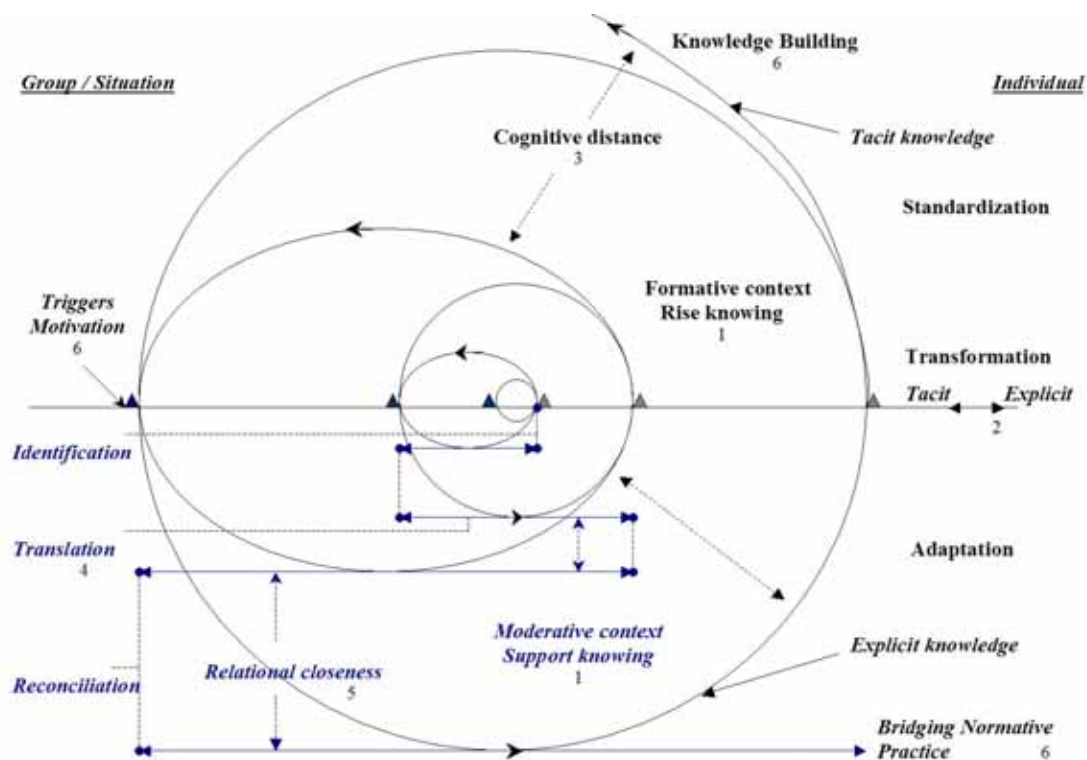
In Chapter 5, I analyze the determinants of the knowledge creation processes in Chinese technology alliances. The focus in this chapter is on knowledge governance and I lay out the argument that brokerage and boundary spanning can provide a path for understanding social dynamics of coordination and cooperation in knowledge creation processes. I highlight

the brokerage and boundary spanning effects of knowledge creation processes and I examine the matchmaking mechanisms and the interactions between communities and interdisciplinary groups. The overarching objective of this chapter is to uncover the different faces of brokerage and boundary spanning in communities/groups and to make the case for the importance of viewing knowledge creation processes as a multi-dimensional construct. In order to accomplish this, I start by anchoring the notion of matchmaking and mediating in descriptive detail from an exploratory field study of brokerage and boundary spanning across technological boundaries in Chinese technology alliances. I collected data from 4 Chinese industrial technology alliances: *Shanghai Santana Community, GM Shanghai Joint Development Center*, *Godson Chips Industry Alliance*, and *TD-SCDMA Industrial Alliance.* These alliances belong to the auto, semiconductor, and telecommunication industries. In this field study, I analyze the formation of alliances, practice bridging between academic/commercial communities and interdisciplinary groups, and motivation, processes of trust and knowledge governance at individual-collective knowledge constructs. In this chapter I show how a coherent governance architecture comprises three phases of standardization, transformation, and adaptation, how the interaction takes place and what is involved in the knowledge creation processes. Moreover, in this chapter I show that the socio-cognitive modular platform supports a dynamic of learning and exploration. More importantly, brokers and boundary spanners can bridge normative practices and coordinate open innovation that extends across firm's boundaries. In addition, I discuss implications of the positions of brokers and boundary spanners for knowledge creation and knowledge governance in technology alliances.

Finally, in Chapter 6, I summarize the main findings and conclusions of this study. I discuss the key contributions: I present the theoretical contributions showing how the practice-based knowledge spiral takes place in knowledge creation processes and how human agency moderate knowledge creation for the individuals, groups and organizations, as well as technology alliances. I then discuss the managerial contributions, in terms of key processes and practices in the new knowledge creation, both at the community level and of the organizational level. Lastly, I outline the directions for future research.

Chapter 2.

Knowledge Creation: A Review of the Literature

- Literature on Conceptual Knowledge
- Literature on Theory of Organizational Knowledge Creation
- Literature on Communities of Knowing
- Integrating the Three Views: Conceptual Knowledge, Knowledge Creation Theory, and Communities of Knowing

Knowledge is recognized as one of the most important resources for company competitiveness and has received considerable attention in the management literature. Much of the research on knowledge examines the organization as the unit of analysis and provides insight into the importance of knowledge transfer and acquisition between and within organizations (Ahuja, 2000; Hansen, 1999). The creation of new knowledge, however, has not received as much attention. To understand the dynamics of knowledge creation processes, we must start with the core epistemological questions of what constitutes knowledge.

In this chapter I present the theoretical discussions within three bodies of literature in which the knowledge creation processes are discussed: the literature on conceptual knowledge, the literature on the theory of organizational knowledge creation and the literature on communities of knowing. First, I discuss each body of literature independently, in order to draw on its insights and assess its limitations. I then integrate them, thus providing a better understanding of what supports knowledge creation processes. Finally, I develop each body of literature by addressing its limitations. These represent probably the most difficult chapter to read, as they are dealing with relatively abstract ideas. However, they provide a useful foundation to the issues addressed in the remainder of the thesis. Therefore, a thorough grasp of these issues should facilitate a deeper understanding of what follows.

2.1. Literature on Conceptual Knowledge

The first major obstacle in the review of literature is interpreting the various definitions of what is knowledge. People have always been interested in what knowledge is and how it can be acquired, and have always asked themselves questions such as: 'How can we be sure about what we think we know?' Such questions have led to many trends in philosophy and more specifically these questions can be situated at the core of epistemology. Epistemology is the theory of knowledge. It is about what knowledge is and how we get it. The term "epistemology" refers properly to the study of knowledge, including questions concerning what counts as knowledge and how bodies of knowledge can be systematically organized (Uschold & Gruninger, 1996).

A philosophical explanation of knowledge is required, since Western philosophy shaped what is considered to be knowledge in the disciplines of, amongst others,

management, learning and organizational theory. Concurrently it is important to also explain knowledge in the context of Eastern philosophy. Taking Eastern philosophy into account provides a holistic understanding of knowledge and brings a different approach altogether to Western philosophy.

There are various ways to conceptualize the process of knowing, or epistemology, and the essential elements of the epistemic literature are often difficult to grasp. Given this situation, the purpose of this section is to clarify the often confusing epistemology literature so that one can understand the various epistemic debates and their implications for knowledge creation and to propose Chinese epistemology that attempts to integrate the Eastern and Western view of knowing. I accomplish this by reviewing Western major epistemological debate: *Positivism vs. Pragmatism, Constructivism vs. Constructionism,* and Eastern philosophical concepts of knowledge: *Chinese epistemology vs. Japanese view of knowledge*.

2.1.1. Historical struggle of conceptual knowledge in Western thought

There are two dominant historical views of epistemology in Western philosophy[1]: rationalism and empiricism. Rationalism essentially says that knowledge can be obtained deductively by reasoning. In this sense, there exists *a priori* knowledge that does not need to be justified by sensory experience. Whereas empiricism holds that knowledge can be attained inductively from sensory experiences. In this sense, everything in the world has an inherently objective existence. Thus, Western philosophy is described as having struggled to understand whether knowledge is based on what we experience or inherent truths (Russell, 1961, 1989).

Plato laid the foundation of rationalism by claiming the existence of a perfect world of ideas that cannot be known through sensory experience. He therefore believed in absolute truth that cannot be known by man and that man attempts to know the absolute truth through his senses and that senses simply lead to an imperfect world. In Plato's view knowledge is merely an awareness of absolute, universal *Ideas* or *Forms*, existing independently of any subject trying to understand to them.

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[1] For history of Western epistemology, see Russell (1961, 1989), Moser and Nat (1987), and Jordan (1987).

Aristotle puts more emphasis on logical and empirical methods for gathering knowledge. He stressed the importance of observation and the verification of individual sensory perception. But, he still accepted the view that such knowledge is an expectation of necessary and universal principles. It should be noted that perceiving and observing by a sentient being produce an output related to the state of the world outside the observer. The characteristics of the output of the process serve as input to memory structures that store beliefs. A belief is an idea, or statement. In this sense, knowledge has been frequently described as *"justified true belief,"* a belief held by an individual that is both true and for which they have some justification. However, the notion of knowledge as *"justified true belief"* stemming from Plato's Meno has been very much debated. Gettier (1963) pointed out that a justified true belief might not be knowledge. He suggested examples of justified true beliefs that were not knowledge, and each example has a problem involving justification. A justification requires an assumption, the assumptions in Gettier's counter examples are false, but through chance or invalid reasoning support a true belief. In contrast, Lehrer and Paxson (1969) proposed that the justification must not be false in order to support a true belief that is knowledge.

A well-known Continental rationalist, Descartes, coined the famous phrase *Cogito, ergo sum* (I think, therefore I am) and presented that humans possess a priori mental structures that contain innate ideas and concepts. For Descartes' rationalism, knowledge was described as a pattern or habit managing the way we formulate the relationships that who/what we are. Knowledge is not a re-presentation of the world. Knowledge is never certain and it can be achieved deductively by appealing to mental constructs such as concepts, laws, or theories. The empiricists, on the other hand, during the same period in Europe, whose spokesmen were Locke, Berkeley, and Hume, viewed reason as no more than the inherent powers for sensible perception and considered knowledge to be derived not from reason but from sensory experience alone. For Hume, not only are the basic forms of knowledge of the external world based on individual impressions, but also the concepts of causation and self-identity are to be regarded as subjective constructions with no objective validity (Heylighen, 1997).

Towards the eighteenth-century Kant and Hegel attempted to synthesize the two streams of rationalism and empiricism. According to the German philosopher Immanuel Kant, knowledge results from the organization of perceptual data on the basis of inborn cognitive

structures, which he called "categories". Categories include space, time, objects and causality. He agreed that the basis of knowledge is experience, but did not accept the empiricist argument that experience is the sole source of all knowledge. He argued that knowledge arises from the both logical thinking of rationalism and sensory experience of empiricism (Russell, 1961).

According to the above debate, we can see clearly the two dominant approaches to Western epistemology, rationalism and empiricism, with their different tendencies to form the actual source of knowledge.

Philosophers such as Husserl, Heidegger, Sartre, Merleau- Ponty, Wittgenstein, James and Dewey continued the debate in the twentieth-century. During this period knowledge became associated with action and the separation between theory and practice gradually disappeared (Russell, 1991: 651-783).

2.1.2. Contemporary challenge: Positivism vs. Pragmatism, Constructivism vs. Constructionism

The contemporary challenge of Western epistemology in the twentieth-century is the Cartesian dualism: subject vs. object (Ayer, 1984; Dancy, 1985). The Cartesian dualism of subject and object supposed that the essence of a human being lies in the rational thinking self. This assumption looks for knowledge by separating itself from the world and other human beings. The relationship between self and the world was emphasized by Edmund Husserl, a German philosopher, he argued that certain knowledge is kind of interaction between "pure consciousness" and its objects (Nonaka & Takeuchi, 1995).

The emphasis on the relationship between subject and object or knowledge and action can also be found in positivism and pragmatism. The foundational assumption of positivism is that an objective reality exists that can be precisely known by observers. Knowledge is created through objective, scientifically based observation. In other word, science is the only basis for generating knowledge and knowledge exists in the minds. As Astley (1985: 497, Astley & Zammuto, 1992) suggested that positivism is characterized by *"a conventional model of scientific progress as a cumulative discovery of objective truth"*. Knowledge grows linearly as new data are added to the existing stock of research of research findings (Astley,

1985). In this sense, people stand as neutral observers, using scientific techniques that allow them to get beyond human biases so that they can make contact with reality and document facts. According to the positivists, the scientifically grounded study is the only way to gain true knowledge (Wick & Freeman, 1998).

In contrast, pragmatism offers a very different interpretation. From a pragmatism view, science is simply a language game with a set of ground rules that one accepts before playing the game. In this sense, data that we document can *"cause us to hold beliefs, but it cannot suggest beliefs for us to hold. It can only do things which our practices will react to with preprogrammed changes in beliefs"* (Rorty, 1985: 7). According to pragmatic epistemology, knowledge consists of models that attempt to represent the environment in such a way as to maximally simplify problem solving. As Dewey (1988: 14) argued that *"the notion, which has ruled philosophy since the time of the Greeks, that the office of knowledge is to uncover the antecedently real, rather than, as is the case with our practical judgments, to gain the kind of understanding which is necessary to deal with problems as they arise"*.

In Pragmatism, William James (1970) argued that if an idea works, it is true. Furthermore, John Dewey maintained that *"ideas are worthless except as they pass into actions which rearrange and reconstruct in some way, be it little or large, the world in which we live"* (Dewey, 1929: 138). James and Dewey opposed the spectator theory of knowledge that separates *"theory and practice, knowledge and action."* They argued that people should use philosophy as a *"forum in which people can talk about how to fulfill their needs, which beliefs work to get them what they want, without running into platonic and Cartesian impasses"* (Rorty, 1985: 5). They attempted to develop an interactive relationship between human beings and the world by means of human action, experiment, and experience. In this sense, pragmatism emphasizes the importance of experimenting with new ways of living, searching for alternative and opens up an array of possibilities for human action (Rorty, 1989).

From the above discussions, we can see that there is a distinct difference between positivism, which presumes reality, and pragmatism, which says 'forget it' (Spender, 2005).

The differences between positivism and pragmatism can be summarized in Table 2.1.

Table 2.1. Differences Between Positivism and Pragmatism

	Positivism	**Pragmatism**
Nature of knowledge	Sharp and categorical divisions across three distinctions (making v. finding; descriptive v. prescriptive; science v. non-science)	Rejects the categorical distinctions of positivism (no privileged status, as such, to science)
Origin of knowledge	Science as the only basis for generating knowledge Knowledge is created through objective, scientifically based observation	Can draw useful (pragmatic) distinctions among methods and forms of evidence in terms of what is useful (e.g. between "descriptive" and "prescriptive", "science" and "non-science"; better and worse metaphors
Reliability of knowledge	Reality as unequivocal	Reality as Equivocal, but grounded in terms of language, history, and culture

© Sources from A.C. Wicks and R.E. Freeman, "Organization Studies and the New Pragmatism", *Organization Science*/Vol.9, No.2, 1998

Recent epistemological theories have moved focus away from the individual. A more radical starting point is offered by *constructivism vs. constructionism.* The foundational assumption of constructivism and constructionism is that people actively contribute to the construction of their knowledge, and knowledge and world are both constructed and constantly reconstructed through personal experience. Each gains existence and form through the construction of the other. In this sense, knowledge is not merely a commodity to be transmitted, and reused, but an experience to be actively constructed, both individually and collectively (Ackermann, 2004). Both epistemologies share an incremental view of knowledge construction, but the approaches however differ.

Constructivism is the epistemic position that individuals create realities. Constructivism centers the reality creation process within individuals, in which each individual has particular mental templates for making sense of things and events. Constructivism has its roots in Kant's synthesis of rationalism and empiricism, where it is noted that the subject has no direct access to external reality, and can only develop knowledge by using fundamental in-built cognitive principles/categories to organize experience (Heylighen, 1997).

One of the first psychologists to develop constructivism was Jean Piaget, who developed a theory of the different cognitive stages through which a child passes while building up a model of the world. To Piaget, knowledge grows according to complex laws of self-organization, which are acquired through interaction with the world, people and things according to some 'logic' of their own. Piaget's theory tends to overlook the role of context, uses, and media, as well as the importance of individual preferences or styles, in human learning and development (Ackermann, 2004). The latter position leads to social constructvism (Vygotsky, 1978) which sees knowledge merely as the product of social processes of communication and negotiation. Most constructivist view of knowledge construction remains essentially science-centered and logic-oriented and grounded in action or mediated thought language.

In contrast to constructivism, constructionism posits that realities are constructed by groups of people (Rosen, 1996). In constructionism views, things, events, and behaviors have no inherent meanings, but groups assign meanings. Social constructionists would even argue that the practice of science does not uncover objective truths (Gergen, 2001). Scientific communities, as all social groups, operate within particular systems of meaning, language, and values that shape and determine their perceptions.

Seymour Papert developed a theory of learning based upon Piaget's constructivism. He focuses more on the art of learning, and on the significance of making things in learning. Papert is interested in how learners engage in a conversation with artifacts, and how these conversations boost self-directed learning, and ultimately facilitate the construction of new knowledge. To Papert, knowledge remains essentially grounded in contexts, and shaped by uses, and the use of external supports and mediation remains essential to expand the potentials of the human mind. Papert's constructionism, in other words, is both more situated, more pragmatic than Piaget's constructivism or Vygotsky's socio-constructivism (Papert, 1980; Ackermann, 2004). Unlike Piaget, Papert thinks of "diving into" situations rather than looking at them from a distance. To Papert, different individuals may develop their own ways of thinking in given situations and remain excellent at what they do (Papert & Turkle, 1991). This notion of situated knowledge, or knowledge as it lives and grows in context, has led many researchers to look closely at individual people's ways of knowing.

In summary, Papert's research focuses on how knowledge is formed and transformed within specific contexts, shaped and expressed through different media, and processed in different people's minds (Ackermann, 2004). While Piaget liked to describe the construction of internal mental stability, Papert is interested in the dynamics of change.

Table 2.2. summarizes the differences between constructivism and constructionism.

Table 2.2. Differences Between Constructivism and Constructionism

	Constructivism	**Constructionism**
Nature of knowledge	Individual has mental templates for making sense using inner cognitive categories to organize experience (Heylighen, 1997) context, media, and negotiation (Vygotsky, 1978)	Rejects things, events and behaviors have inherent meaning Groups assign meaning (Rosen, 1996) meaning, language and values shape and determine perceptions (Papert, 1980)
Origin of knowledge	Knowledge is constructed and reconstructed through experience Self-organization interaction with world individual mental logic (Ackermann, 2004) Internal stability	Making things in learning Dialogues facilitate the construction of new knowledge (Gergen, 2001) situated, pragmatic knowledge grows in context (Papert & Turkle, 1991) Dynamics of change (Ackermann, 2004)
Reliability of knowledge	Individuals create realities	Groups create realities

To conclude, in Western thought, knowledge is generated by the ways in which people categorize, code, process and attribute meaning to their experiences. Knowledge emerges out of a complex process involving social, situational, cultural and institutional factors. According to the above debate, we can see that each epistemic position is defined by the critiques of the others. In this regard, Western epistemology is described as having struggled about three major problems: the nature of knowledge, the origin of knowledge and the reliability of knowledge (Nonaka & Takeuchi, 1995). In my view, the various epistemologies can be considered constitutive elements of human cognition and introducing alternative epistemologies is indeed possible. The relevant question is what Western and Eastern epistemology hold for knowledge in various theoretical fields.

2.1.3. Discovering alternative concepts of knowledge in Eastern philosophy

Recently, in contract with "Western thinking", Nonaka and Takeuchi explain how Japanese intellectual tradition focuses on the *"oneness"* of humanity and nature, body and mind, and self and other. Nonaka and Takeuchi (1995: 27) make it clear that no distinct Japanese philosophy exists, but that the Japanese have a very definite approach to knowledge. Nonaka and Takeuchi stated, *"Japanese intellectual tradition suggests that ultimate reality for the Japanese lies in the delicate, transitional focuses process of permanent flux, and in visible and concrete matter, rather than in eternal, unchanging, invisible and abstract entity"* (1995: 31-2). According to Nonaka and Takeuchi, the main characteristic of Japanese epistemology is *"oneness",* where the oneness of humanity and nature and the oneness of body and mind lead the Japanese to value the interaction between self and other. They list these distinctions of intellectual tradition as follows:

- Oneness of humanity and nature.
- Oneness of mind and body.
- Oneness of self and other.

For the Japanese, knowledge means wisdom that is acquired from the perspective of the entire personality. True knowledge cannot be obtained by theoretical thinking but only through one's total mind and body. Western epistemology tends to attach the highest values to abstract theories and hypotheses, which have contributed to the development of science. In contrast, Japanese epistemology tends to value the embodiment of direct, personal experience. A Japanese approach to knowledge is holistic and has always been that way. On the other hand the Western approach was initially dualistic and grew to become more holistic.

The Japanese live are very close to their environment, which is evident in their language. Their language is not arbitrary symbols as in the case of Western languages, but consists of concrete images of objects that are contextualized when used. It is echoed through their art in that they do not have a fixed perspective of time and space, but rather see them as being in constant flux and transition – hence more circular. As a result Japanese drawings do not fix the artist's viewpoint and therefore there is no need to draw shadows (Nonaka & Takeuchi, 1995: 28). They also have a holistic view of the human, i.e. the concept of the oneness of mind and body found in Zen Buddhism. In Zen Buddhism, *"true knowledge*

cannot be obtained by theoretical thinking but only through one's total mind and body" (Nonaka & Takeuchi, 1995: 30). Finally, oneness of self and other is expressed by the collective, intuitive and organic worldview of the Japanese. Everything and everyone is interrelated. The implication is that for the Japanese, to work for others means to work for oneself (Nonaka & Takeuchi, 1995: 31).

The implication for epistemology is that Japanese philosophy integrates what is referred to in Western philosophy as *rationalism* and *empiricism.* Hence knowledge is acquired from experience and generated from the mind. Mind and body are one. Furthermore, the oneness of self and other implies a social element of knowledge.

In addition, since the Japanese approach to knowledge integrates the teaching of Buddhism, Confucianism, and major Western philosophical thoughts, it cannot be described in any systematic way (Nonaka & Takeuchi, 1995: 27). The Japanese intellectual tradition, as far as Chinese influence is concerned, has been formed by the deliberate projection of China's Confucius forms (essentially typified experiences) on external reality. Contrary to China, Japan's philosophical pattern easily succumbed to ideological interpretations. Japanese epistemology tends to value the embodiment of direct, personal experience and neglects rational thinking. Yujiro Nakamura (1967), a contemporary Japanese philosopher, says that the Japanese failed to build up a rational thought of clear universality, because they did not succeed in the separation and objectification of self and nature. At this point it would be interesting to compare the Japanese intellectual tradition with that of China- a country that was Eastern Asia's dominant civilization in ancient times.

In Western philosophy since Plato, there has been a tendency to separate reason and experience, while, in the view of Chinese epistemology, reason and experience cannot be separated. In Chinese epistemology, knowledge is created from interaction and interrelation between individual mind and world. Genuine knowledge is the result of discovering reason in experience and inducing experience in reason. It is perfect fit the two (reason and experience) that is to be established by interactive learning (Cheng, 2002). In this sense, knowledge is a sort of experience, and both knowledge and experience are first and foremost modes of interaction.

In Chinese epistemology, knowledge is to be observed inter-subjectively, historically, and holistically. For Confucius knowledge is not simply rational and logical cognition but a

matter of correctly describing reality as feelingly experienced by a person in the community. Knowledge would be a matter of this congruence of mutual feelings reached from this reciprocating process of feeling projection and feeling response. Furthermore, knowledge in a sense does reflect self and reality, because the self grows and reality is in constant change, knowledge has to change as well and this requires the individual knower to live up to growth of self and changes in the world. In this sense, knowledge has to become organismic so that it will have its inner dynamism for change and transformation (Cheng, 2002). Knowledge is a fulfillment unity between individuals and world.

In Chinese epistemology, thinking and action have such a relationship: they interact; each is the foundation for the other; each nourishes the other; and they constitute an endless, unbroken process of initiation and return. This explains why in the history of Chinese philosophy there is the absence of the fundamental Descartes dualism of mind and body, or the fundamental dualism of reality and appearance by Plato, or the fundamental dualism of knowledge or understanding of objects and rational intuition of things-in-themselves by Kant (Grange, 2003; Ames, 2003, Cheng, 2002). The difference between Japanese and Chinese epistemology is presented in Table 2.3.

Table 2.3. Differences Between Japanese and Chinese View of Knowledge

	Japanese Epistemology	Chinese Epistemology
Nature of knowledge	Knowledge means wisdom Knowledge acquired from experience, generated from mind (Nonaka & Takeuchi, 1995) In directly through discussion, nature, image, context-sensitive	Reason and experience cannot be separated, discover reason in experience and inducing experience in reason Knowledge is sort of experience observation, reciprocal feeling, practice, and self-cultivation, (Cheng, 2002)
Origin of knowledge	Knowledge resides in mind, body, and Social system Oneness, body and mind (Nonaka & Takeuchi, 1995) Knowledge is holistic	Knowledge is created from interaction and interrelation between individual and world (Cheng, 2002; Ames, 2003; Grange; 2003) Knowledge building as inter-subjectivity Knowledge is fulfillment unity
Reliability of knowledge	Oneness of self and other Collective Everything and everyone is interrelated (Nonaka & takeuchi, 1995)	Knowledge does not reflect self and reality Both are in constant change Correctly describing reality in community Knowledge becomes organismic (Cheng, 2002)
Integrates with Western view	Refers to rationalism and empiricism	Close to pragmatism and constructionism

To conclude, in Chinese epistemology, knowledge is not to be seen as an isolated phenomenon independent of individual and the world, nor is it a construction related only to the basic functioning of the mind. Knowledge construction happens through comprehensive observation, reciprocal feelings, practice and self-cultivation between individuals and the world (Cheng, 2002). In contrast, the Japanese approach of knowledge is focused on oneness of humanity and nature, oneness of body and mind, and oneness of self and other, as Nonaka and Takeuchi (1995: 28) emphasized that *"Japanese epistemology has nurtured a delicate and sophisticated sensitivity to nature, it has prevented the objectification of nature and the development of 'sound skepticism.'"*

2.1.4. Debate of the conceptual knowledge literature

The above section provides the context for understanding the Eastern and Western view of concepts of knowledge. The comparative study approach to understand these epistemological assumptions is important given that the concepts and theories addressed on which they are based, are essential for developing a new concept and thinking of the knowledge creation theory. As noted by Rosenberg (1995: 4), *"Being clear about a discipline's philosophy is essential because at the frontiers of the disciplines, it is the philosophy of science that guides inquiry"*.

In Western conceptual knowledge, we can see that each epistemic position is defined by the critiques of the others. Important debates of Western epistemology can include two points:

(1) In Constructivism, the construction of an epistemology is an attempt to find common ground, predicated by the assumption that such ground exists. Because constructivistic approaches put much more emphasis on the changing and relative character of knowledge, they give to either social consensus or internal coherence and their description of construction processes is incomplete (Heylighen, 1997). Knowledge cannot be directly conveyed from one individual to another, because data have to be interpreted.

(2) Pragmatism treats knowledge root truth and meaning in the 'conversation' which unites speakers. The root of knowledge relates to action within the social world. For the pragmatists the individual and the environment are mutually constitutive. Pragmatism is thus

a philosophy which locates knowledge in action, that is, knowledge relates to successful manipulation of the real world. This knowledge is located in language which is internally coherent. However, the pragmatic epistemology does not give a clear answer to the question of where knowledge or models come from. There is an implicit assumption that models are built from parts of other models and empirical data on the basis of trial-and-error complemented with some heuristics or intuition (Heylighen, 1993).

To compensate for these debates, for example, the unanswered question remains, how could people learn from their experience, there comes a time when one needs to translate the experience into a description or a model. I think the discussion of Chinese philosophy of knowledge laid the groundwork for further model development to fill the academic gap and improve knowledge creation theory.

2.2. Literature on Theory of Organizational Knowledge Creation

In the knowledge-based view of the firms, the main drive is technological innovation, and the key source of sustainable competitive advantage and superior profitability within an industry is how a company creates and shares its knowledge (Conner & Prahalad, 1996; Grant, 1996, Kogut & Zander, 1992, 1996; Spender, 1996). Knowledge is taken as the basis for what an organization does, but it is important to know that creating knowledge can be as important as processing knowledge (Tsoukas, 1996).

Traditionally, organizations are considered to be open systems, and knowledge is seen as a representation of these worlds, data accumulation and dissemination are the major knowledge development activities in organizations. In this sense, organizational knowledge is developed by processing incoming data and information and stored in computers, databases, archives and manuals (von Krogh *et al.,* 1998). Some scholars claim that organizations are seen as self-organized networks composed of relationships, and driven by communication. They look at relationships and local rules, and do not focus on the individual or the entire system. For example, Kogut and Zander (1992) argue that knowledge is socially constructed, and this embeddedness of knowledge in social relationships is what makes knowledge sometimes not easily transferable. They note that *'firms exist because they provide a social community of voluntaristic action structured by organizing principles that are not reducible*

to individuals' (1992: 384). The authors define the firm further as *"a social community specializing in the speed and transfer of knowledge"* (Kogut & Zander, 1996: 503). They believe that generative rules may vary throughout the company: *'it is the persistence in the organizing of social relationships in which knowledge is embedded'* (1992: 385). Organizational knowledge is a state in a system of interconnected individuals. The rules of these connections therefore form an essential part of knowledge.

In the past several years, knowledge researchers have gone back to the caves to explore a knowledge creation theory (Grant, 1996; Nahapiet & Ghoshal, 1998; Nonaka, 1994). Then as now, tacit knowledge was not transferred from one brain to another; it was re-created through experience (Leonard-Barton, 2004). Studies on knowledge creation in organization have focused on the organizational conditions that enable the emergence of new knowledge (Leonard-Barton, 1995; Leonard & Sensiper, 1998; Nonaka & Takeuchi, 1995; von Krogh & Nonaka, 2000); the social networks that facilitate knowledge creation and innovation (Hansen, 2002; Fischer, 2001); the effect of strategic alliances, clusters and collaborative inter-organizational projects on knowledge creation (Inkpen, 1996; Maskell, 2001); "generative dance" between knowledge and knowing and the role of boundary objects in facilitating the creation of new knowledge (Cook & Brown, 1999; Carlile, 2002) and how new knowledge is created in loosely coordinated, distributed systems such as the open-source software community (Lee & Cole, 2003).

In this section, I review the literature on organizational knowledge creation. Given the vast literature on organizational knowledge theory, I do not attempt to include all the knowledge creation literature in my analysis, but rather focus on key, foundational articles. For the purposes of this chapter, I took the appearance of knowledge creation as tacit and explicit interaction (Nonaka & Takeuchi, 1995); social embedded in organizational routines (Nelson & Winter, 1982); generative dance between knowledge and knowing (Cook & Brown, 1999) to accomplish my analysis.

2.2.1. Knowledge ecology: how tacit becomes explicit

New knowledge comes about not when the tacit becomes explicit, but knowledge creation is more dependent on the combination and sharing of tacit knowledge. Tacit knowledge cannot be "captured", "translated", or "converted" but only displayed and

manifested, in what we do. We cannot operationalize tacit knowledge but we can find new ways of talking, fresh forms of interacting through social interaction (Ambrosini & Bowman, 2001; Tsoukas, 2001).

A primary distinction with respect to knowledge is between its explicitness and its tacitness. Tacit knowledge is hard to articulate, is acquired through experience (Polanyi, 1966), whereas explicit knowledge is transmittable in formal, systematic language. As first stated by Polanyi (1966), individuals know more than they can explain. This is because individuals have knowledge that is non-verbalized, intuitive, and unarticulated. Polanyi (1962) defined such knowledge as *'tacit.'* Tacit knowledge is hard to communicate and is deeply rooted in action, involvement and commitment within a specific context; it is *"a continuous activity of knowing,"* (Nonaka, 1994: 16); it is *"the way things are done around here,"* (Spender, 1996). According to Polanyi (1962: 17), *"The act of knowing includes an appraisal; and this personal coefficient, which shapes all factual knowledge, bridges in doing so the disjunction between subjectivity and objectivity"*. For him, all knowing involves *skillful action* and that the knower necessarily participates in all acts of understanding. It is in this sense that Polanyi talks about all knowledge being *personal* and all knowing being *action* (Tsoukas, 2005).

Nonaka and his colleagues (Nonaka 1994; Nonaka & Takeuchi, 1995; Nonaka *et al.* 2000) view knowledge as dynamic rather than static, with new knowledge being continually created through a cyclical process between tacit and explicit knowledge comprised of four conversion steps: socialization, externalization, combination, and internalization, ultimately they conceptualize knowledge as an entity that individuals possess. Nonaka points out, that knowledge creation is a continuous and dynamic interaction between tacit and explicit knowledge, and that conversion modes shift depending on the triggers. *Socialization* is key to knowledge creation. The socialization creates common understanding and trust within a group. *Externalization* is the central phase in knowledge creation. It means that tacit knowledge is explicated and conceptualized by using metaphors, analogies and concepts. *Combination* means that already existing explicit knowledge is combined and exchanged. Finally, *internalization* means that explicit knowledge at the group or organizational level must be internalized into individuals' tacit knowledge and into action in order to have real effects in organization. The contents of knowledge creation created by the four modes, is presented in Figure 2.1.

Figure 2.1. Contents of Knowledge Created by the Four Modes: SECI

	Tacit knowledge to Explicit knowledge	
Tacit Knowledge From	*Socialization* Sympathized knowledge	*Externalization* Conceptual knowledge
Explicit Knowledge	*Internalization* Operational knowledge	*Combination* Systematic knowledge

© Sources from Nonaka and Takeuchi, *The Knowledge-Creating Company*, 1995

Nonaka and Takeuchi's (1995) theory of knowledge creation cannot easily be characterized as embedded in either the objectivist or practice-based perspectives on knowledge, as it embodies elements of both. In Nonaka and Takeuchi's (1995: 21) view of knowledge is perceived as "*justified true belief*". Knowledge resides and is created in an individual's head. Nonaka and Takeuchi (1995) emphasize "beliefs" and "justification" rather than "truth" to differentiate themselves from the cognitivist tradition in which a belief is considered more or less true based on its correspondence to some external reality. A constructionist perspective, by contrast, views cognition not as an act of representation but as an act of construction or creation (von Krogh, Ichijo and Nonaka, 2000). According to Nonaka (1994), justification is the key process for generating common knowledge. In Nonaka's theory of knowledge creation, interaction is required both between and within three separate, but interrelated layers:

    i.   *SECI*, represents the four modes of knowledge conversion, with knowledge being created through the interaction between tacit and explicit knowledge.

    ii.   *'ba'*, refers to the shared context in which knowledge creation occurs, with there being four types of *ba*, each one related to a specific mode of knowledge creation.

    iii.   Knowledge assets, which are tacit knowledge shared through experience, explicit knowledge in the form of symbols and language, tacit knowledge embedded in organizational routines and practices, and systematized explicit knowledge.

Knowledge is created through individuals collectively bringing together their specific knowledge assets, within particular contexts (*ba*), with this contributing to the creation of knowledge through the interaction and combination of these different knowledge assets through the four articulated modes of knowledge creation.

Organizational knowledge creation proceeds in a knowledge spiral/cycle, with each cycle consisting of five phases:

1. Sharing of tacit knowledge among the members of a group.
2. Creation of concepts through a team articulates its shared mental model.
3. Justification of concepts in terms of the overall organizational goals.
4. Building of an archetype which is a tangible manifestation of the justified concept.
5. Cross leveling of knowledge, whereby a new cycle of knowledge creation may be created elsewhere the organization.

Nonaka and Takeuchi's (1995) theory of organizational knowledge creation both explains why certain Japanese companies have been successful innovators, and attempts to blend together the best aspects of Japanese and Western business practices. While their theory is centrally concerned with the dynamics of knowledge creation, they also consider important contextual factors such as the most appropriate organizational forms and management strategies.

2.2.2. Tacit knowledge is socially embedded in organizational routines

Routines are the fundamental units of analysis at the organizational level. Routines have traditionally been seen as the *"memory of an organization"* (Cyert & March, 1963: 101), representing an accretion of rules and practices, and reflecting experimental wisdom in that routines are the outcome of trial and error learning and the selection and retention of past behaviors (Gavetti & Levinthal, 2000). This view of routine is linked to an emphasis of tacit knowledge, since tacitness arises when learning is experiential (Zollo & Winter, 2002). Following Polanyi (1996), Nelson and Winter (1982) argue that much operational knowledge in organization exists at a tacit level and that routines are the carriers of such knowledge. As Nelson and Winter (1982: 128) emphasized, *"The behavior of firms can be explained by the routines that they employ. Knowledge of routines is the heart of understanding behavior.*

Modeling the firm means modeling the routines and how they change over time". Furthermore, Nelson and Winter (1982) emphasized that routines are the memory and genes of the organization and encompass the organization's knowledge basis.

Sidney Winter (1964: 263) defined a routine as *"pattern of behavior that is followed repeatedly, but is subject to change if conditions change".* Routines can be distributed across the organization, in which the multiple actors carrying out the routines belong to different organizational units, and are located in different places. It is important to consider also the knowledge socially embedded in routine (Becker, 2005). In other words, routines can be seen as a stock of knowledge. As Winter (1995) noted, routines are a key repository of knowledge in the firm, in this sense, routines are also capable to store tacit knowledge. Another similar notion of tacit knowledge embedded in routines is "procedural knowledge". Cohen and Bacdayan (1994: 554) defined the term *"procedural knowledge"* as knowledge of how things are done, which is relatively inarticulate and encompasses both cognitive and motor activities. Their notion of "procedural knowledge" is very close to Polanyi's (1969) definition of tacit knowledge, but adds some precision, namely that cognitive and motor activities make up an important part of procedural knowledge. The concept of routines is helpful for understanding the processes of transformation of knowledge in firms. In addition, routines also capture collectively held organizational knowledge rather than held by individuals (Becker, 2005). Such collective knowledge can be held through databases, artifacts and documents within organizations.

Furthermore, routines are also seen as collective phenomena (Nelson & Winter, 1982: 73; Cohendet & Llerna, 2003; Becker, 2005). Cohen and Bacdayan (1994: 555) suggest that routines are *"patterned sequences of learned behavior involving multiple actors who are linked by relations of communication and/or authority".* Cohendet and Llerena (2003) have recently developed a second aspect of the collective nature of routines. They argue that routines are also shaped and determined at an intermediate level, the level of knowledge communities. The multiple actors that are involved in the routine can make up different kinds of communities. Knowledge communities provide a different location in which routines emerge and learning takes place, leading to routines that strongly differ in terms of power of replication, of degree of inertia, of search potential (Cohendet & Llerena 2003). In an empirical study of collective nature of routines, Weick (1990: 579) found that routines could be disrupted when participants in a routine start *"acting in a manner that is more individual*

than collective". This finding has deep implications for understanding the relationship between individual actors and the collective routines they participate in, routines are not simply followed or modified, rather individual actors have a choice to follow the routine or to modify it (Feldman, 2000; Feldman & Pentland, 2003).

The process of translation of routines for knowledge creation is a particular type of modification of routine. However, the process of translation of routines is complex, since routines are social phenomena and implicitly embedded in underlying meaning structures. Such a transformation usually implies a mix of linguistic representation, rules, and artifacts (D'Adderio, 2004). Similarly, Egidi (1996) found that routines emerge as the outcome of distributed process as generated by personal production rules. Although rule-enforcement mechanisms play a crucial role in making routine operation possible (Nelson & Winter 1982: 109), their role is limited. Thus, there is a need to explain: How do routines change? How do rules bring about recurrent interaction patterns? How do recurrent interaction patterns bring about rules (Becker, 2005)?

Routines represent stable sequences of actions that are triggered by certain stimuli contexts and which serve as knowledge repository for organization. Because routines are social phenomena, they go beyond individual skills and must raise issues of motivation and coordination (Felin & Foss, 2005). Nelson and Winter (1982) emphasized that the coordinative power of routines derives from establishing a *"truce"*. That smoothly running routines can be observed is due to an implicit truce established between those giving and those executing the orders. The notion of "truce" serves to make the account of organizational change more realistic. Furthermore, Lazaric (2000) argue that understanding a routine as comprising a "truce" helps recognize and appreciate the governance, in particular the motivational arrangements underlying the stability of a recurrent activity.

In summary, organizational routines contribute to both stability and change, and play an important role for organizational flexibility. Tacit knowledge socially embedded in routines. Routines are kinds of knowledge stock. Routines enable coordination, in which cognitive triggers play an important role in bringing about coordination. Moreover, routines shape a critical aspect of knowledge right at its joints, namely, its application (Becker, 2005). In this sense, routines are also seen as the building blocks of organizational capabilities (Dosi, Nelson and Winter 2000; Winter 2003).

2.2.3. Generative dance: the practice-based perspective of knowledge creation

As outlined in the previous section, the tradition conceptualizes knowledge as being primarily derived from cognitive processes, something involving the brain but not the body. The practice-based perspective conceptualizes knowledge not as an object, but instead of emphasizes the extent to which it is embedded within and inseparable from practice. Knowledge from this perspective is socially constructed through collaborative efforts with common objectives or by dialectically opposing different perspectives in dialogic interaction (Bakhtin, 1981; Pea, 1993). Knowledge can be seen as less of a purely cognitive process, and more of a holistic process involving the whole body (Gherardi, 2000). From a practice-based perspective, knowledge/knowing is inseparable from human activity. Blackler (1995: 1023) summed this up as follows, *'rather than regarding knowledge as something that people have, it is suggested that knowing is better regarded as something they do'*.

Knowledge is both tacit and organizationally embedded in social group. This insight is used as the basis for a further dichotomy of knowledge types: into individual and group or collective knowledge. Spender (1996) combined the tacit-explicit dichotomy with the individual-group dichotomy to produce a *two by two* matrix with four generic types of knowledge. See Figure 2.2.

Figure 2.2. Generic Knowledge Types

	Individual	**Social**
Explicit	Conscious	Objectified
Tacit	Automatic	Collective

© Sources from J-C Spender, Making Knowledge the Basis of a Dynamic Theory of the Firm, *Strategic Management Journal*, Vol. 17, 1996

Collective knowledge represents tacit group knowledge, and is more complicated to understand than codified knowledge, individual-embodied tacit knowledge, i.e. knowledge possessed by a group that is not codified. Collective knowledge was shown to be culturally embedded in a number of different contexts, for instance within communities of practice, or

within the context of a national or regional culture. However, is the distinction between tacit and explicit knowledge a dichotomy? Inkpen & Dinur (1998) argued that the distinction between tacit and explicit knowledge is not a dichotomy, but a spectrum or continuum with extremes of the two types at either end. At the explicit end of the continuum, knowledge is codified in specific products and processes; at the tacit end, knowledge resides in individual cognition and organizational routines all developed through experience and use. Also, Tsoukas (1996) suggested that dichotomies such as tacit-explicit and individual-group are unhelpful as they disguise the extent to which these elements are inseparable, and mutually defined.

The practice-based nature of knowing /knowledge assumes that knowledge develops as people conduct activities and gain experience through practice. Bolisani and Scarso (2000) suggest that the practice-based perspective on knowledge-sharing represents a 'language game', due to the importance of dialogue and language for such processes; further, tacit and explicit knowledge are inseparable and mutually constituted. Knowledge is embodied in people and socially constructed.

Cook and Brown (1999) argued that beyond tacit knowledge there is a knowledge inherent in practice itself which is called "knowing." The authors argue that technology transfer, creation of routines, and repeatable performance do not explain the creation of new knowledge. They highlight that new knowledge arises from a *generative dance* between what knowledge is possessed by the individual and knowing as part of action. The key to Cook and Brown's view is identification of the difference between knowledge that is possessed by its owner and knowing as part of action. According to Cook and Brown (1999: 388), "*Knowledge is seen as a tool at the service of knowing*", something brought into the action to be used during practice. In their view "knowing" is considered inseparable from practice and interaction with the world. They see explicit knowledge and tacit knowledge as two distinct forms of knowledge: while we may try to articulate what we do in practice, this does not separate our knowing from our practice, and *"each form of knowledge can often be used as an aid in acquiring the other,"* and explicit knowledge can be used as an aid to acquire tacit knowledge (Cook & Brown, 1999: 385).

The generative dance between knowledge and knowing is shown in Figure 2.3.

Figure 2.3. The Generative Dance between Knowledge and Knowing

Individual   *Group*

Knowing
(As Action)

Explicit

Tacit

Bridging Epistemologies
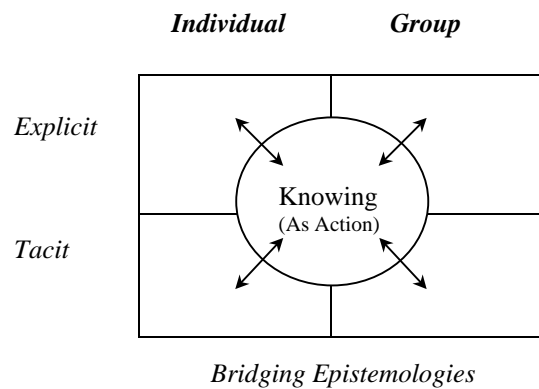
© Source from Cook and Brown, Bridging Epistemologies, *Organization Science*, Vol. 10, No.4, 1999

Moreover, as the new knowledge becomes a way of knowing, it is exhibited outside the individual's head. It is embodied in new practice, becoming new tacit knowledge. As Cook and Brown (1999: 386) noted, "*knowing does not belong to an epistemology of possession, but rather that it calls for an epistemology of practice*". Possessed means that this knowledge will be to some extent embodied, and cannot be fully articulated and made explicit. In their view, the term of practice can be defined as the coordinated activities, action informed by meaning drawn from a particular group context.

Cook and Brown's (1999: 383) view of knowing is important for understanding the generation of new knowledge, and particularly knowledge in groups: "*for human groups, the source of new knowledge and knowing lies in use of knowledge as a tool of knowing with situated interaction with the social and physical world"*, we must bring the knowledge in our heads into play in actual situations in order to go forward in what we know. Through the dialogue with others, interacting with objects and other devices, the knowledge we possess is used in practice and "*dynamically affords a generative dance within which the creation of new knowledge and new ways of knowing is possible*" (Cook & Brown, 1999: 393). Individuals and collective knowing associated with this generative dance is directed, and interactions associated with the exploration. Furthermore, the generative dance is also interpreted because its form and outcomes differ according to the local knowledge and practices. When new knowledge becomes a way of knowing, it is embodied in new practice, and becomes new tacit knowledge which is expressed through new procedures, routines, skills or technologies.

To conclude, the generative dance is an important phenomenon to examine the new knowledge creation processes, particularly where the interest is in the alignment of knowledge and knowing. Knowing and doing are inseparable, as undertaking specific tasks requires the use and development of embodied knowledge. It will be a good approach to explore knowledge creation processes in knowledge communities, interdisciplinary groups, as well as technology alliances.

2.2.4. Limitations of the organizational knowledge creation theory

The literature of organizational knowledge creation presents three limitations.

First, by focusing on knowledge creation we do not fully understand the processes of new knowledge creation in organization. Nonaka and Takeuchi's knowledge creation theory has several limitations in dealing with:

1) The essential misunderstanding of tacit knowledge in the second cycle of the dynamic knowledge spiral. Nonaka and Takeuchi assume tacit knowledge is a set of rules incorporated in the activity an actor is involved in, which is a matter of time for him/her to first learn and then formulate. According to Tsoukas' (2003) argument, in Nonaka and Takeuchi's term tacit knowledge is compared to the notion of *"practical knowledge"* (Oakeshott, 1991: 12-15) or *"Knowing how"* (Ryle, 1963: 28-32), which is the sort of knowledge that exists only in use and cannot be formulated in rules, it is equivalent to technical knowledge. In this sense, the second cycle of the dynamic knowledge spiral is merely an alternative mechanism for transferring knowledge (Tsouskas, 2003).

In contrast to Polanyi's notion of tacit knowledge, he highlights the skilled performance that all acts of knowing require: the actor does not know all the rules he/she follows in the activity he/she is involved. As Polanyi (1962: 50) notes, *"rules of art can be useful, but they do not determine the practice of an art; they are maxims, which can serve as a guide to an art only if they can be integrated into the practical knowledge of the art. They cannot replace that knowledge"*. Nonaka and Takeuchi's interpretation of tacit knowledge ignores the essential ineffability of tacit knowledge, thus reducing it to what can be articulated. Additionally, the tacit dimension of knowledge in Nonaka's model actually includes considerable 'implicitness' idiosyncratic in Japanese context (Li & Gao, 2003). In

the Japanese language, the dialogue among people in favor of indirect and ambiguous signaling, people try to feel out others' mood and ideas. In this sense, communication is replaced by some degree of *haragei* (visceral communication) to reach implicit common understanding in groups.

2) Nonaka and Takeuchi's model does not take into account the importance of controversies and conflicts in knowledge creation. Engeström (1999) has analyzed Nonaka and Takeuchi's model and argued that the central problem of their model is that it does not take into account the first two phases in the knowledge creation cycle, *i.e.*, questioning and analyzing the situation. Their model is based too much on the idea of sharing tacit knowledge in the socialization phase and does not take into account the importance of controversies and conflicts in knowledge creation.

3) Nonaka and Takeuchi's model is based on the externalization of tacit knowledge and appears to rely on a mentalistic assumption that knowledge resides and is created in an individual's head. What is missing from this model is the dynamics of interactional processes. Nonaka and Takeuchi's model is unable to capture essential features in knowledge creation processes, *i.e.,* how knowledge is created, understood, and used in collaborative knowledge building? How did conversations among the members of the development team enable them to make new distinctions leading to improving the prototype (Tsoukas, 2005)?

Second, we do not resolve the problem of the origins of organizational routines. There exists an extensive body of literature that focuses on organizational routines. Routines can be seen as collective constructs that are the central analysis in organizational studies. However, as Becker (2005) and Felin and Foss (2006) claimed there are many ambiguities and inconsistencies in the literature on routines until today. Routine has been defined in many ways in evolutionary economics and strategic management, such as capabilities (Teece *et al.,* 1997), competencies (Henderson & Cockburn, 1994), dynamic capabilities (Eisenhart & Martin, 2000), etc. Becker (2004) argued that routines are usually defined as "patterns", but it is unclear to what exactly the relevant patterns refer. He further noted that it is still not clear whether routines denote non-observable -individual level- 'habits of thought' or observable, individual 'habits'; at the collective level whether routine as non-observable through patterns or observable recurrent interaction patterns (Felin & Foss, 2006).

The most critical limitation is the question about the origins and foundations of routines. Although Nelson and Winter define routines as partly unobservable, emergent, collective level constructs, they fail to provide a micro-foundation for routines (Becker, 2005; Felin & Foss, 2006). Winter also recently noted, *"the question of where routines and capabilities come…deserves vastly more attention"* (Winter in Murmann *et al.,* 2003: 29). In this case, we do not know how routines are developed. The more precise question is how should we consider routines in the term of practice.

Third, it is not clear how the generative dance is enacted between knowledge and knowing. Cook and Brown (1999) argued that the new knowledge is embodied in practice, and it becomes a new way of knowing, such new tacit knowledge is associated with and expressed through local procedures, and routines. In this sense, routine is generated through interaction between knowledge and knowing in which the generative dance is performed. However, it is not very clear how this is processed, how the generative dance is enacted, and what is involved in this dance. In my view, it is necessary to establish tests of factors that facilitate the generative dance in knowledge creation processes.

As I argued in the previous section, pragmatism is a philosophy, which locates knowledge in action. Knowledge is the result of social negotiation, which draws on the learning and experience of individuals in manipulating the real world. As a result knowledge creation is focused on experience, learning and communication in practice. Thus the knowledge-based organization focuses on the collective, allowing individuals to learn, experiment and communicate with each other in an atmosphere that is open to change.

When knowledge-based researchers focus on the collective, they are implicitly assuming some collective dynamics, for example, as routines, generative dance, and community (Felin & Foss, 2006). They specify a collective construct as the key level of analysis- a shift in focus from the individual context to the community context, which promotes the development of "self" through participation in a community. As Lave and Wenger (1993: 65) stated *"developing an identity as a member of a community and becoming knowledgeably skillful are part of the same process, with the former motivating, shaping, and giving meaning to the latter, which it subsumes"*. It is being argued that being a participant in a community is an essential component of the knowledge creation process, essentially, that the community is the locus of knowledge creation and sharing. But, which communities are

we talking about? Just what is a community and what characterizes the community? It is with these questions in mind that I turn to a more in-depth discussion on the literature of communities of knowing in the next section.

2.3. Literature on Communities of Knowing

Communities as the core of the human social system have been studied for decades in anthropology, sociology, and psychology. Tonnies (2001), the 19th century sociologist, distinguishes between *Gemeinschaft* (the personal community as living organism) and *Gesellschaft* (society as a mechanical aggregate). The difference between community and society is that "community" conventionally is used to refer to forms of collective life in which people are tied together through tradition, interpersonal contacts, informal relationships, and interests or similarities, while "society" generally refers to collectivities held together through anonymous, rule-bound, more transparent, formal, and universalistic principles (Storper, 2004). Dewey (1916) treats the community's relationship to the public education system. Giddens (1990) and other sociologists refer to communities as means to improve the functioning of labor markets, generate entrepreneurship, and organize the provision of public goods. Thus, "Community" is to be used as the ways of grouping together with people who share similar identity, expectations, interests and values (Storper, 2004).

In this section, I review the literature on communities of knowing. First, I assess the literature on traditional views of communities of practice then I provide an analysis on the recent notion of knowing communities. Finally, I identify the difference between knowing communities and interdisciplinary groups.

2.3.1. Communities of practice as the main base for knowledge creation

Communities of practice have recently become key components in an organizational learning toolkit (Plaskoff, 2001). A growing number of scholars suggest that developing communities of practice can be the key to the success of knowledge management initiatives (Ward, 2000; Wenger, 1998; Wenger *et al.* 2002). Communities can span organizational boundaries (Brown and Duguid, 2001), for example, Gittelman and Kogut (2003) analyze the

researchers involved in the US biotechnology industry as constituting a community of practice.

Lave and Wenger (1990) defined *communities of practice* as groups of people, who, focusing on the practices of individuals, engage in the same practice, communicate regularly with one another about their activities. The key characteristics of communities of practice are self-organization and built identity, which allow the members to behave collective acquisition and processes of stimuli from the environment (Cohendet & Llerena, 2003; Wenger, 2000; Brown & Duguid, 1991). The knowledge base of communities of practice is overlapping and interdependent, with an existing element of common knowledge (Kogut & Zander, 1992). Members of a community not only have a stock of common knowledge, but also provide individuals with a sense of collective identity and some overlapping, common values. In this sense, the common knowledge possessed by members of communities, combined with the collective sense of identity and system of shared value can create a bond that may facilitate group learning, and knowledge sharing.

Communities of practice are highly dynamic, evolving as new members become absorbed, as existing members leave, and as the knowledge and practices of the community evolve with changing circumstances. As Lave and Wenger (1990: 57) argue, *"There is a fundamental contradiction in the meaning to newcomers and old-timers of increasing participation by the former; for the centripetal development of full participants...implies the replacement of old timers."* Members of the group engage in more durable relations, and they form new kinds of overlapping communities, which present a dominant model of learning and collective behavior. Learning and knowledge evolution are therefore inherent and fundamental aspects of the dynamics of communities of practice.

As Brown and Duguid (1991) argued, a great deal of learning and innovation occur in communities of practice focused on simply getting work done, thus such communities exist in a variety of settings and may develop improvements or innovations in products, services and work practices. For organizations, communities of practice can provide a crucial source of innovation. Communities of practice can strengthen a basis of organizational innovativeness through supporting and encouraging the creation, development, and use of knowledge. For example, photocopiers repair technicians (Orr, 1996), clerical workers (Wenger, 1998), and radiology technicians (Barley, 1996).

The difference between intra- and intercommunity knowledge processes relates to the sense of shared identity and high level of common knowledge which exists within communities, but which is relatively absent from intercommunity contexts. This is due both to the differences in identity, which may cause intercommunity conflict and the lack of common knowledge (Hislop, 2005). People from different communities who work together may have less shared common knowledge, and a weak sense of shared identity, or may have distinctive and separate identities. In this sense, the social relations between people from different communities are much less conducive to effective knowledge processes. As Hansen (1999) found when weak ties exist between people this is likely to impede the transfer of complex knowledge. Also Newell and Swan (2000) suggested that the greater the epistemological difference between collaborating members, the lower the chance that such collaborations will be successful, and the more likely that they will not be able to effectively integrate their different perspectives and knowledge bases (Hislop, 2005). Thus, one of the challenges is to coordinate these diverse communities, integrating, diffusing, and combining fragmental knowledge as necessary (Blackler *et al.*, 2000; Brown & Duguid, 2001; Grant, 1996; Tsoukas, 1996).

Knowledge processes across communities require two closely interrelated elements: social interaction and communication. Brown and Duguid (1998) identified two roles that key individuals could play in order to facilitate interaction and communication between different communities: brokers and translators. When there exists an overlapping common knowledge between two different communities, a broker is someone who belongs to both communities, and uses his/her knowledge and understanding of both to facilitate the building of a mutual understanding between other members of the communities. As Gherardi and Nicolini (2002) argued, a broker is someone who has the ability to translate certain elements of one practice to another. When there is no overlapping common knowledge between communities, this requires the translator to have a detailed knowledge of both communities, and further, the translator requires to be trusted by the members of both communities as his/she plays a key role in interacting between them. Such roles are acknowledged to be extremely complex and difficult to successfully manage (Hislop, 2005).

Also, Brown and Duguid (1998) discussed the development and utilization of boundary objects for knowledge processes at intercommunity level. According to Brown and Duguid, boundary objects exist that are common to a number of communities and can be

either physical or linguistic/symbolic in character. Boundary objects provide a focus for negotiation, discussion, or even shared activity between people from different communities. Boundary objects can be utilized to help develop and improve effective communication and interaction between people, and mutual understanding (Hislop, 2005).

2.3.2. Knowing communities as the main drive enables knowledge creation

In recent research, the role of communities of knowing in facilitating the creation and exchange of knowledge has received much attention. The distinction between communities of practice and communities of knowing is that communities of knowing are truly oriented toward new knowledge creation, whereas communities of practice are oriented toward the achievement of an activity (Cohendet & Llerena, 2003).

Knowing Communities represent a new and seemingly fruitful direction. Cohendet (2005) defined a knowing community as *"a gathering within the organization of individuals who accept to exchange voluntarily and on a regular basis about a common interest or objective in a given field of knowledge"*. In this sense, communities of knowing are open systems or platforms. The concept of knowing communities broadly includes *"communities of practice"* (Lave & Wenger, 1990; Brown & Duguid, 1991; Orr, 1990), and *"epistemic communities"* (Cowan *et al.*, 2000). These scholars highlighted the notion of communities of knowing as communities that develop unique social and cognitive repertoires which guide their interpretations of the world.

Epistemic communities can be defined as *'small working groups, comprising knowledge-creating agents who are engaged in a mutually recognized subset of questions, and who (at the very least) accept some commonly understood procedural authority as essential to the success of their collective activities'* (Cowan *et al*. 2000: 234). Epistemic communities can thus be seen as groups of agents sharing a common goal of knowledge creation and a common framework allowing the shared understanding among members of communities. Within an epistemic community, agents are bound together by their commitment to enhance a particular set of knowledge. Here, notions of autonomy and identity are weaker than in the case of communities of practice, which favor the group creativity (Leonard-Barton, 1995).

Knorr-Cetina (1999) presents some grounded examples of how local communities of knowing develop their unique paradigmatic worlds and are resistant to changing them. She found that knowing communities developed local interpretations of methodical rules, or a local know-how with regard to how to make things work best in actual research practice. Also, the role of communities of knowing has been studied in the context of physicists and molecular biologists; researchers engaged in the design of a new technological artefact (Garud & Rappa, 1994). These scholars proposed that the "stickiness" of knowledge is not so much a function of its underlying degree of tacitness, but reflects its embeddedness in knowing communities who share common cognitive frames, social norms, communication rules and respect the procedural authority (Gittelman & Kogut, 2003). These communities are responsible for generating both routine and strategic learning, through practices of socialization, interaction, interest alignment, and knowledge translation (Amin & Cohendet, 2004). It is through the dynamic interaction between such communities that new configurations of the knowledge processes emerge by creating new meanings, new linguistic routines, and new knowledge. In this sense, new knowledge creation in an organization is often the result of an open system/platform of transformation, in which a group of specialized knowing workers create norms, routines, new processes and relationships among themselves within communities of knowing (Argyris & Schon, 1978; Cohendet, 2005).

As I discussed in the previous section, knowledge creation involves communication and interaction within and between communities of knowing. Communities of knowing are normally the result of the spontaneous development of relationships between members over time and are not necessarily aligned with the strategic goals of their members' formal organization. However, as the potential value of knowing communities has become clear, organizations try to build or support them. But, the question is, how organizations can provide helpful support to such communities, without constraining the delicate dynamics by which they are sustained? Amin and Cohendet (2004) claimed that the way organizations can benefit from the useful knowledge held by its different knowing communities without compromising the hierarchy of the division of labor geared towards efficiency will become a key question in the future.

Plaskoff (2001) suggested that community building involves a strong sense of intersubjectivity around practice. A key to developing community is building expanding circles of intersubjectivity or common understanding, about the concept of community.

According to Crossley (1996), intersubjectivity can take two forms: radical and ecological. In the radical form, relationships involve an unconditional communicative openness between parties and a lack of self-awareness of each individual. The self and other become one. In the ecological form, the individual empathizes with the other by transposing him/herself into the other's position. Both forms emerge in communities. Plaskoff (2001) further argues that metaphors and analogies serve as good intersubjectivity-building tools.

Managers should take into account that community building differs from community creation. Where there is practice, there is community. We should have a new infrastructure and new view of the concept of community in order to support communities. As Thompson (2005) suggested, organizations should sponsor the creation of certain loose organizational structures, around which it is hoped that communities may then interact. In Thompson's view, there are two kinds of components in knowing communities: one is structural components, such as symbols, infrastructure, and point of focus etc. another is epistemic components, such as learning, social constitution, practice, identity, and situatedness. Knowing communities should consist in practice of these two components around which communities can organize their interaction and communication. More important, is introducing a newcomer into the community to see how the community model can enhance their work and practice. As newcomers increasingly participate in knowing community, they are likely to raise their own profile/identity by challenging social relations and norms previous established within the community. In this case, managers should deal with power dynamics. As Contu and Willmott (2003) reminded us if knowing is a social activity, then it is not immune from the power relations with which social activity is saturated. In addition, in order to encourage the growth of knowing communities, organizations should manage manipulating identity transformation and motivations as a tool to increasing productivity (Fiol, 2002; Alvesson & Willmott, 2002).

2.3.3. Distributed knowledge: interdisciplinary groups vs. knowing communities

Recent studies have also suggested that the notion of communities of knowing does not fit squarely with temporary organization or interdisciplinary group's dynamics (Lindkvist, 2005). Typically, the temporary organization or interdisciplinary group within or between organizations consists of specialized workers, most of them having not met before and with different background, who have to carry out a pre-specified task within set limits as to time and cost (Lindkvist, 2005).

However, the literature on communities is still proposing different and ambiguous views of the notion of communities. For example, such interdisciplinary groups were also defined as communities of knowing, as Boland and Tenkasi (1995) argued that firms are characterized by a process of distributed cognition in which knowing communities of specialized knowledge workers, each dealing with a part of an overall organizational problem, interact to create the patterns of sense making and behavior. In contrast, Cohendet *et al.*, (2004) argued that knowing communities differ from functional groups: functional groups are under the responsibility of a hierarchy at the top of them, with clear boundaries. There is informal hierarchy in knowing communities. Function groups are characterized by learning by doing, while knowing communities are the locus of knowledge creation and sharing.

In addition, Lindkvist (2005) proposed a notion of knowledge collectivity, which an organization that is able to operate on "distributed knowledge"[2]. The knowledge base is highly dispersed and individualized among collectivity members. In his view, project groups must be able to operate such distributed knowledge. They operate on 'distributed' knowledge and achieving collective action here relies on the 'well-connectedness' of knowledge bases. The knowledge collectivity is thus presented as a notion of group level epistemology, individuals try to reach goals relying on *"articulation"* they are involved in high-order-learning processes (Paoli & Prencipe, 2003: 152). With the greater reliance of such groups on individual knowledge, agency and goal-directed interaction, interdisciplinary/temporary group may be designated as 'collectivities of practice' (Lindkvist, 2005).

In contrast to communities of knowing, knowledge is decentred, residing in the activities, narratives and practices of the community. Knowledge is generated through collective learning among members of the community. Lindkvist (2005) further suggested that it is possible to focus on the different roles played by knowing communities and interdisciplinary groups in organizational setting, recognizing these as two separate forms that enable a better alignment between the particular circumstances in organizational design. As Lindkvist (2005: 1206) suggested,

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[2] "Distributed knowledge" is knowledge that is not possessed by any single mind, but "belongs to" a group of interacting agents, somehow emerges from the aggregation of the (possibly tacit) knowledge elements of the individual agents, and can be mobilized for productive purposes. In K. Foss and N. Foss, "Authority in the context of the distributed knowledge", DRUID working papers 2002

"We may imagine that a paradigm driven knowledge community, downplaying individuality and critical inquiry, would have a good chance of creating a powerful consensus and momentum in many contexts, but we may also conjecture that the sustained differences among members' knowledge bases in the knowledge collectivity may promote creativity and flexibility, counteracting both groupthink (Janis and Mann, 1977) and the emergence of core rigidities (Leonard-Barton, 1992)."

However, the question is how coordination and cooperation are brought about in such settings where traditional structures are lacking, therefore, there is a need to do empirical test of the interplay within two-fold typology. In short, questions to be addressed are: What is the structure of interaction between interdisciplinary groups and knowing communities? How to facilitate the circulation and exchange knowledge between these two "knowledge unities"?

2.3.4. Limitations of the communities for knowledge creation literature

The community of knowing literature presents four limitations:

First, it implies that power and conflict can shape the internal dynamics of communities, but it does not test this implication. Second, it acknowledges that the management of community should be done with a 'light touch', but it does not specify what the 'light touch' management approach looks like, or consists of.

Second, one of the main limitations of this literature is that, the community creates blindness to the range of potential ways in which they inhibit organizational knowledge processes. Communities may develop 'blinkers' which can inhibit innovations and intercommunity interaction. More precisely, power and conflict can shape the internal dynamics of communities when communities are faced with change (Hislop, 2005). Change that requires a community's practice/knowledge to adapt, threatens the reproduction of existing knowledge/practice, and can have contradictory implications for different members of a community of practice (Fox, 2000). Thus, old timers may see such a change as a threat to their status, power, and knowledge, whereas other members of a community may see it as an opportunity to develop and increase their own power, knowledge, and status. These insights have two implications with regard to how communities of practice respond to charge, which

are both neglected by the mainstream literature. They do not provide empirical tests of implications.

Third, another limitation is that most of these studies suggest that there is an invisible hierarchy in communities of knowing, and that their management should be done with a 'light touch'. McDermott (1999: 110) suggests that organizations should *develop natural knowledge communities without formalizing them',* Ward (2000: 4) argues that communities require to be, *'tended and nurtured rather than commanded and controlled'.* The limitation of this managerial advice is that it is somewhat ambiguous and lacking in detail. It fails to provide specific details on what the 'light touch' management approach looks like, or consists of (Hislop, 2005).

The last limitation is that we do not know which infrastructure or concept of community can help us to hold/support different communities in the organizational setting. As Thompson (2005) emphasized, we should consider the role of structural and epistemic components in communities in order to organize the efficient communication and interaction between hierarchical organization and knowing communities. But it is still not clear what are the mechanics of such interaction.

2.4. Integrating the Three Views: Conceptual Knowledge, Knowledge Creation Theory, and Communities of Knowing

Based on the analysis of epistemology literature, we can see that there is a strong debate on knowledge creation: one side argues that knowledge is generated by individuals and knowledge resides in individual's mind; the opposite view of knowledge is created through collective learning processes and knowledge resides in practice. Each epistemic position is defined by the critiques of the others. More important, epistemology literature does not give a clear answer to the question where knowledge comes from and how people could learn from their experience. It is still not clear how we can define the knowledge or maybe we cannot define knowledge. In short, we do not know the origins of knowledge.

After analyzing the organizational knowledge creation literature and communities of knowledge creation literature, we still cannot grasp how to generate new knowledge in organizations and communities.

On the one hand, the organizational knowledge creation literature suggests that the generative dance between knowledge and knowing is an important phenomenon to examine the new knowledge creation processes, however, we do not know how this interaction takes place and what is involved in it. We probably know that routine is created through interaction between knowledge and knowing, but it is not clear how routines are developed. As Felin and Foss (2006) emphasized, researchers devote much attention to the analysis of collective constructs, and it has led to a corresponding neglect of the levels of individual action and interaction. They further proposed that it is necessary to know how individual actions, abilities and choices aggregate up to the collective level. We need to explore the underlying social mechanisms to explain such dynamics of human interactions.

On the other hand, the community literature suggests that communities of knowing are the locus of knowledge creation and sharing. These communities enable the creation both of routine and strategic learning through practices of socialization, interaction, interest alignment, and knowledge transformation (Amin & Cohendet, 2004). We also realized that building intersubjectivity is the key to supporting knowing communities for organizational innovation, we need to design the new loose infrastructure in order to enhance the commutation and interaction with knowing communities. It is through the dynamic interactions between structural and epistemic components in such communities that new meanings, routines and knowledge are created. However, the structural and epistemic components of communities of knowing raise question about the mechanics of their interaction that remain relatively unaddressed to date (Thompson, 2005).

In order to develop a complete model of how knowledge is created, a number of fundamental constructs and questions have yet to be clarified and explored. A common theme is the notion of theorizing about knowledge creation processes as constituted by bridging epistemic difference. Furthermore, interaction between knowledge and knowing or action is important to explain knowledge dynamics. However, here is a question about the dynamics of such interactions that enables new knowledge to emerge. As Spender (2005) has recently noted, " *if we think more about knowing as acting in and on the world, we know through*

language and that is social and inter-subjective ... knowing must be inter-subject-ivied before it can be called knowledge." In this sense, we need to identify where our action comes from and what the origins of knowledge are. In the research of new knowledge creation, the underlying theoretical mechanisms are still lacking. Another critical question is when exactly we can precisely move from the individual to the collective level or micro-macro level in the level of analysis of knowledge creation processes (Dansereau *et al.*, 1999; Felin & Foss, 2006). Felin and Foss (2006) suggested it is possible to build a kind of micro-foundation of knowledge creation from a sociological/physiological and behavioral starting point (Gavetti, 2005). I agree that in choosing a level of analysis, human nature is a critical assumption. But what specifically are the underlying assumptions regarding human nature? When building micro-foundations, what behavioral models should we make use of?

In the next chapter, I re-review the relevant literatures on micro-macro linkages, social capital, social cognitive theory and neo-Confucian thought of human behavioral models with a view to building a theoretical framework of a micro-foundation for knowledge creation.

Chapter 3.

Theoretical Framework: A Micro-Foundation of Knowledge Creation

- Micro-Macro Linkages, Social Capital, and Social Cognitive Theory
- Confucian View of Human Nature and Chinese Co-Creativity
- The Conceptual Model of Knowledge Creation: Alignment of Knowledge and Knowing
- Linking levels and Units of Analysis: Individuals, Communities/Groups, and Organizations

In the preceding chapter I have established the primary purpose of this dissertation, which is to investigate what is knowledge and how knowledge is created in organizations and communities. By analyzing an extensive literature of knowledge creation, I have sought to support alternative ways to explore the micro-foundation of knowledge creation. Theory building requires a careful investigation of fundamental assumptions. To understand the basic concepts and theories is essential for new concept generation (von Krogh *et al.*, 1998). In this chapter I re-review the literature of micro-macro linkages, social capital, social cognitive theory, the Confucian's view of human nature and the Chinese notion of co-creativity and try to identify or establish links between them. My aim here is to provide support to the conceptual framework of a micro-foundation of knowledge creation.

3.1. Micro-Macro Linkages, Social Capital and Social Cognitive Theory

In the organizational knowledge literature, knowledge-based research largely focuses on collectives as the locus of knowledge (Kogut & Zander, 1992; Nelson & Winter, 1982; Teece *et al.,* 1997). Nelson and Winter (1982: 63) emphasized, *"...the possession of technical 'knowledge' is an attribute of the firm as a whole, as an organized entity, and is not reducible to what any single individual knows, or even to any simple aggregation of competencies and capabilities of all the various individuals, equipments and installations of the firm"*. Also Kogut and Zander (1992: 384) highlighted that *"firms exist because they provide a social community of voluntaristic action structured by organizing principles that are not reducible to individuals"*. The focus in this perspective has been put on various collective structures, such as routines (Nelson & Winter, 1982; Winter, 2003), interactions (Argote & Ingram, 2000), capabilities (Teeces, *et al.,* 1997) and community (Kogut & Zander, 1992; Brown & Duguid, 2001). Indeed, collective structures are important to explain the knowledge creation processes and collectivist assumptions have guided most of knowledge-based work. However, the emphasis on collective constructs has led to a corresponding neglect of the levels of individual action and interaction, practically, the underlying micro-foundation of collective structures (Felin & Foss, 2006; Gavetti, 2005).

3.1.1. Micro-Macro linkages and the emergence of norms

Bridging link between micro and macro levels has been problematic in the social sciences, but also in the organizational knowledge creation theory.

In the social sciences, a classic distinction is made between the collective and the individual level. Giddens (1979, 1984, 1985) most famously treats the individual-collective dilemma (or action-structure) as an inseparable dualism. Giddens' theory of *structuration* notes that social life is more than random individual acts, but is not merely determined by social forces. To put it another way, it is not merely a mass of 'micro'-level activity - but on the other hand, you cannot study it by only looking for 'macro'-level explanations. Instead, Giddens suggests that human agency and social structure are in a relationship with each other, and it is the repetition of the acts of individual agents which reproduces the structure. As Giddens puts it, *"Society only has form, and that form only has effects on people, in so far as structure is produced and reproduced in what people do"* (Giddens & Pierson, 1998: 77). In addition, he states that the individual and collective level both have value, and since the 'micro' and 'macro' levels of social life naturally feed into each other, we should not have to choose between them. This means that the individual and collective cannot be separated in any meaningful way as each simultaneously supports the other. This structuration approach has led to a growing 'knowledge practice' literature, which builds on the arguments of both Giddens and Bourdieu (e.g., Carlile, 2002; Orlikowski, 2002). The *'knowledge practice'* approach focuses more on collectivist approaches (e.g., Brown & Duguid, 2001: 112) given its underlying assumption of individual homogeneity. But such an approach neglects individual differences, accounts for knowledge heterogeneity. The critical question is: How exactly do individual actions move to the collective level?

In the organizational knowledge creation theory, Carlile and Rebentisch (2003) proposed a knowledge transformation cycle to explain the consequences and the nature of knowledge. They argued that knowledge is created in practice, and the active processes of knowledge transformation determine what knowledge is created. While authors focused on knowledge transfer/diffusion, such as knowledge storage and knowledge retrieval, it is difficult for us to understand the underlying actions, choice/selection, and motivation in the knowledge transformation cycle. Recently, Nonaka and Toyama (2005) argued that knowledge creation is guided through the synthesis of contradictions. Such a synthesis is achieved through dialogues and action. They further claimed that *"what is matter in dialogues is the meaning it creates, rather than the form of logic it takes"* (Nonaka & Toyama, 2005:

426) and practice lays a foundation to share tacit knowledge through shared experience. However, they failed to present a micro-foundation of knowledge and the concept of synthesis has remained fuzzy and has yet to resolve the micro-macro problem. Thus, the questions are: at what level is new knowledge created? What are the key processes of knowledge creation both at the individual and collective levels?

Felin and Foss (2006) suggested that it is possible to use Coleman's (1990) model to explain the individual level origins or micro-foundations of collective structures. They argued that Coleman's conceptual model is the best and most concise effort to capture meta-theoretical matters and problems relating to micro-macro transitions (Felin & Foss, 2006; Abell, 2003). Coleman's model is based on the individual level theory of action. He considers a mechanism-oriented approach to discover how human action and interaction causally produce collective level phenomena. It is argued that individuals are heterogeneous and observations, interventions are more naturally made at individual level. In this sense, individual level factors may precede collective facts and build explicit links between the individual and the collective levels. Coleman's model could improve our understanding of micro-foundations of knowledge creation.

Coleman's (1990: 19) conceptual model consists of two transitions: *"macro to micro and micro to macro"*. He argued that the character of macro to micro and micro to macro transitions can be understood by imagining a social simulation game of the sort that is sometimes used in education. Such a game is composed of a set of roles that players take on, each role defining the interests or goals of the player, and rules about the kinds of actions that are allowed to players in each role, rules which transmit consequences of an individual's action to other individuals and rules which derive macro-level outcomes from combinations of individuals' actions. The two transitions are briefly described as follows:

- macro to micro: the play interests, given by the goal established by the rules; the constraints on action, which are imposed by other rules; the initial conditions, which provide the context within which action is taken; and after the game is in play, the new context imposed by other's actions.
- micro to macro: how it combines interferes or in any other way interacts with actions of others. Thus, creating a new context within which the next action takes place.

Furthermore, Coleman (1990: 244) argued, *"the emergence of norms is in some respects a prototypical micro-to-macro transition, because the process must arise from individual actions yet a norm itself is a system-level property which affects the further actions of individuals, both the sanctions applied by individuals who hold the norm and the actions in conformity with the norm."* The concept of a norm provides a means for making micro to macro transitions. Coleman (1990: 241) argued, *"A norm is a property of a social system, not of an actor within it."* The concept of a norm exists at a macrosocial level and governs the behavior of individuals at a microsocial level, and provides a convenient device for explaining individual behavior. He further noted that *"a norm maybe embedded in a social system in a more fundamental way: the norm may be internal to the individual carrying out the action, with sanctions applied by that individual to his own actions"* (1990: 243). A diagram is described in Figure 3.1. It shows that the emergence of a norm begins at the micro level and ends there as well, with individual sanctions and conformity to the norm. A norm exists only when others assume the right to affect the direction an actor's action.

Figure 3.1. Relations of Micro-Macro levels in the Emergence of a Norm
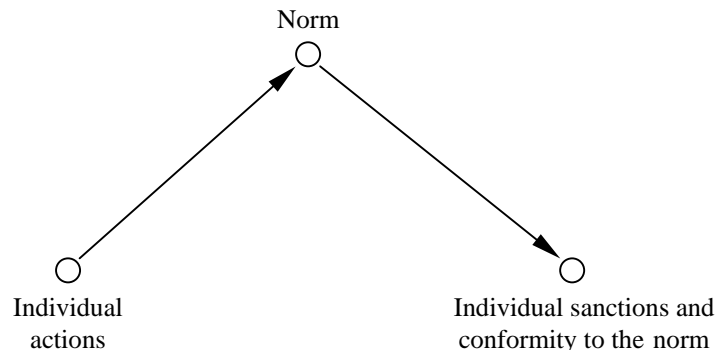
© Source from James S. Coleman, *Foundation of Social Theory,* 1990, pp 245

When a norm exists and is effective, it is a powerful, though sometimes fragile, form of social capital. As Durkheim (1933) argued, *"without norms it is hard to imagine how interaction and exchange between strangers could take place at all"*. For a norm to exist there must be an agreement among group members regarding the validity of the rule and the right of group members to enforce it. It should be noted that norms are not simply rules. Without some means of enforcement, rules serve merely as assertions of ideals. In a broad perspective, March *et al.* (2001) argue that rules consist of explicit or implicit norms, regulations, and expectations that regulate the behavior of individuals and interactions among them. The

difference between rules and norms is that rules are often explicit, precisely specified in written texts. Norms, by contrast, are often spontaneous, unwritten and enforced informally. Rules are created by an authority and based on agreement making, while norms are based on mere mutual belief (Tuomela & Bonnevier-Tuomela, 1995). Recently, Reynaud (2005) claimed that rules are explicit and public statements that trigger an action with a certain degree of predictability, but do not determine individual choices and guide behavior. In a deeper sense, rules form a system. Similarly, Gary Alan Fine (2001: 145) argued that normative behaviors do not just occur, they are taught. *"Norms are not treated as objects that are given by society. Instead, they are understandings that are recognized in situation, tied to meaning systems."* In this sense, norms are based on doing, negotiated and performed. In the rational choice theorist's world, norms provide common knowledge about the individual payoff to particular courses of action.

To explore how norms come into existence, we should analyze the contextualization of meaning and the coordinating lines of action (Fine, 2001). In my view, exploring the concept of social capital may be helpful in understanding how a normative system develops and how organizational and individual elements must be combined in order to create knowledge.

3.1.2. Social capital, intellectual capital, and human capital

Knowledge researchers have recently positioned social capital as a key factor in understanding knowledge creation (Nahapiet & Ghoshal, 1998). Drawing upon previous research, I look at social capital as the interpersonal relationships of a person, as well as the resources embedded in those relationships (Bourdieu, 1986; Coleman, 1986; Lin, 2001; Nahapiet & Ghoshal, 1998). According to theory, social capital and knowledge creation will have a positive relationship because social capital directly affects the combine-and-exchange process and provides relatively easy access to network resources (Nahapiet & Ghoshal, 1998). I consider that the concept of social capital is important for my study for the following reasons: First, the very of existence of social capital depends on the building of links between individuals; second, such links are the product of individual choices; and third, links hold either because the individuals feel subjective obligations or because there is a normative system, such as norms, rules, incentives, sanctions, guaranteeing their continuation.

James Coleman (1988) in "Social Capital in the Creation of Human Capital" proposes that the level of trust, the information, the norms that regulate interactions and the "closure" of social relations are *"aspects of the social structure that facilitate actions within that structure."* The most important effect of social capital is on the creation of human capital[3]. He also argued that social capital in the community plays a role in the creation of human capital in the rising generation. In addition, Robert Putnam, in his book *"Making Democracy Work"* (1993), extends the concept of social capital to include different features of social organization, such as trust, norms, and networks.

Two elements are common in the definitions of social capital. First, social capital refers to a specific type of social arrangement that creates links and bridges between individuals that enable them to use resources unavailable to them on an individual basis. Second, the emergence of such an arrangement depends on specific values and beliefs common to the agents involved such as trust, reciprocity, norms and regulations. Apparently, social trust rests in the assurance that there is a whole system of sanctions in place created to enforce specific types of behavior and prevent others.

In the analysis of the links between social and intellectual capital, Janine Nahapiet and Sumantra Ghoshal (1998) produce a more comprehensive definition of social capital that influences the combination and exchange of intellectual capital, which includes three main dimensions:

- The structural dimension, which refers to "the properties of the social system and of the network of relations as a whole", includes the existence of links between individuals and the hierarchy and the appropriable organization of those links; the structural dimension refers overall to the pattern of connections between actors.
- The relational dimension, which focuses on the nature of the links and relations that people have developed over time, includes aspects such as closure to other members of the network, and friendship or respect, which may affect individual agency within the network. *"Among the key facets in this cluster are trust and*

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[3] Human capital is created by changes in persons that form skills and capabilities that enable them to act in new ways. J. Coleman, Social Capital in the Creation of Human Capital, *The American Journal of Sociology, Vol.94.* 1988, pp 95-120

trustworthiness, norms and sanctions, obligations and expectations…and identity and identification" (Naphapiet *et al.*, 1998).

- The cognitive dimension, which refers to *"those resources providing shared representations, interpretations and systems of meaning among parties"* (Nahapiet *et al.,* 1998). This dimension is very similar to what Lave & Wagner (1991) describe as an attribute of a "community of practice" as requisite for knowledge creation, in the sense that it provides the "interpretive support" that makes its understanding in content and heritage possible.

However, in my opinion the three dimensions, as defined, are still insufficient in their failure to deeply address the psychosocial domain of the individual. Based on my research, I would argue that a fourth dimension of social capital formation is necessary, the *rational* dimension. This dimension would cover other subjective elements involved in the process of individual choice, judgment, decision-making that induce the individual to engage in interactive actions with others.

Felin and Foss (2006) suggested that we should consider human nature as an important assumption of building micro and macro linkages. As Simon (1985: 303) noted, *"nothing is more fundamental in setting our research agenda and informing our research methods than our view of the nature of the human beings whose behavior we are studying"*. Following this suggestion, I also attempt to identify possible correlations between human nature and collective properties, including the motivation, rational choice, self-efficacy and other individual psychosocial factors the importance of which in the knowledge creation processes is discussed in the following sections.

3.1.3. Human nature, self-efficacy and motivation

Action, even in groups, starts as an individual process. Human agency is characterized by a number of core features that operate through phenomenal and functional consciousness. The core features of human agency address the issue of what it means to be human (Bandura, 2001).

The first element for human agency is *intentionality*. An intention is a representation of a future course of action to be formed. It is not simply an expectation or prediction of

future actions but a proactive commitment to bring them about. Therefore, intentions and actions are two different aspects and it is meaningful to speak of intentions grounded in self-motivators affecting the likelihood of actions at a future point in time (Bandura, 2001).

The second core feature of human agency is *forethought*. Through the exercise of forethought, people motivate themselves and guide their actions anticipatorily. People construct outcome expectations from observed conditional relations between environmental events in the world around them, while forethought provides direction, coherence, and meaning to one's life. In this regard, people display considerable self-direction in the face of competing influences. After they adopt *personal standards,* people regulate their behavior by self-evaluative outcomes, which may augment or override the influence of external outcomes.

The third feature of human being is *self-reactiveness*. An agent has to be not only a planner and forethinker, but a motivator and self-regulator as well. After people adopt an intention and action plan, they need to make choices and give shape to appropriate courses of action and motivate and regulate their execution. This multifaceted self-directedness operates through self-regulatory processes that link thought to action. It is governed by a set of self-monitoring, performance self-guidance via personal standards, and corrective self-reaction (Bandura, 1986). In short, by making self-evaluation conditional on matching personal standards, people give direction to their pursuits and create self-incentives to sustain their efforts for goal attainment (Bandura, 2001).

The fourth human feature is *self-reflectiveness.* People are not only agents of action but also self-examiners of their own functioning. Through reflective self-consciousness people evaluate their motivation, values, and the meaning of their life. People judge the correctness of their predictive and operative thinking against the outcome of their actions, the effects that other people's action produce, what others believe, deductions from established knowledge and what necessarily follows from it. This efficacy belief is the foundation of human agency.

Human agency is the engine that brings about social changes, and for human agency to develop, two ingredients are necessary: motivation and self-efficacy. "*Self-efficacy*" is what Bandura (1997) calls that sense of confidence in one's ability to successfully carry out tasks.

Self-efficacy beliefs provide the foundation for human motivation, well-being, and personal accomplishment.

Bandura (1997) presented a social cognitive vision of the origins of human thought and action and the influential role of self-referential processes to motivation, affect, and action. He depicted people as self-organizing, proactive, self-reflective, and self-regulative in thought and action rather than as merely reactive to social environmental or inner cognitive-affective forces. In addition, he brings together the socio-structural and psychological theories of human behavior, arguing that human beings are mere contributors to what they experience, not the sole determinants of it: *"social influences operate through self processes and produce behavior"* (1997: 6). This argument is the basis of his triadic model of the determinants of personal causation, shown in Figure 3.2.

Figure 3.2. Determinants of Personal Causation
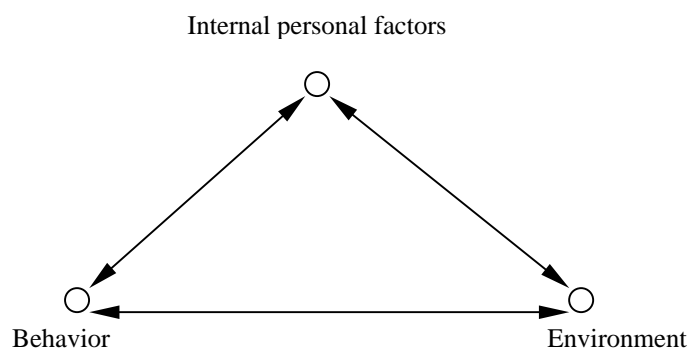
© Source from Albert Bandura, *Self-Efficacy, the exercise of control*, 1997

There are two important points that follow from this model: First, Bandura's (1997: 7) key contention as regards the role of self-efficacy beliefs in human functioning is that *"people's level of motivation, affective states, and actions are based more on what they believe than on what is objectively true"*. Second, perceptions have a definite impact on the potential outcomes of any activity. In the words of Bandura (1997: 2-3), *"people make causal contributions to their own psychosocial functioning through mechanisms of personal agency. Among the mechanisms of agency, none is more central or pervasive than beliefs of personal efficacy... people guide their lives by their beliefs of personal efficacy. Perceived efficacy refers to beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments."* Therefore, perceived self-efficacy is crucial for human agency.

Bandura (1997, 2001) argues that perceived self-efficacy influences our choices of activities and our motivation to do them, and also contributes to the acquisition of the knowledge structures on which skills are founded. Reciprocally, motivated achievement reinforces efficacy.

The concept of "motivation" plays a central role in research concerned with understanding the determinants of individual behavior in communities/groups and its impact on knowledge creation (Deci, 1971, 1975; Deci & Ryan, 1985). The basic argument is that motivation can be linked to a set of underlying goal: from where accomplishment individuals derive a certain level of utility (Deci, 1976). Also as Ford (1996) argued that individual motivation levels respond mainly to goal setting, emotional reinforcement, and personal agency beliefs. In this sense, the motivation to behave in a certain way is determined by the degree to which the behavior helps individuals to meet their goals and the relevance of each goal to the individual.

Lindenberg (2001) refined Deci's (1975) initial dichotomy of extrinsic and intrinsic motivation and separated intrinsic motivation into a task-related component, the enjoyment-based "hedonic intrinsic motivation" and a social component, the obligation based "normative intrinsic motivation". Lindenberg's three-category taxonomy is as follows:

- *Extrinsic motivation* is most directly influenced by the reward system that specifies rewards (or sanctions) for a given behavior (Brief *et al.,* 1977). The impact of extrinsic motivation also depends on the importance of these rewards for the individual.
- *Hedonic intrinsic motivation* is driven by the goal of being engaged in enjoyable (Lindenberg, 2001), self-determined and competence-enhancing (Deci *et al.,* 1985) behavior. The impact of hedonic intrinsic motivation depends on the importance the individual attributes to being engaged in enjoyable, self-determined and competence-enhancing behavior (King, Hautaluoma and Shikiar, 1983).
- *Normative intrinsic motivation* is driven by the goal of engaging in a behavior that is compliant with norms and values. As members of the community or group, individuals are thus normatively intrinsically motivated to engage in, or refrain from, a given behavior, depending on whether this behavior is congruent with the community's/group's norms and values (Allen & Meyer, 1990; Kreps, 1997).

Furthermore, the intensity of the normative intrinsic motivation depends on the degree to which individuals identify with the quasi-stable community's/group's norms and values.

This three-category taxonomy captures the fundamental differences between the mechanisms through which institutions or groups can influence motivation. Osterloh and Frey (2000) argue that intrinsic motivation is crucial if the sharing of tacit knowledge is an important concern (Foss, 2005). However, individuals in fact are quite "smart" and rational in how they approach and learn in unpredictable environments (Gigerenzer *et al.*, 1999). Thus, there is a need to include a rational program in the analysis of social capital. It is relevant to assess how capable the participants in any process perceive themselves in regard to carrying different activities. In other words, individuals with the same skills and competences may perform differently depending on how they perceive specific challenges. In order to be effective, people must have, besides the skills, the motivation and the efficacy beliefs necessary to apply them wisely.

In Bandura's socio-cognitive theory, individuals are viewed both as products and as producers of their own environments and of their social systems. As Bandura (2001) argued, *"People do not live their lives isolatedly. Many of the things they seek are achievable only through socially interdependent effort. Hence, they have to work coordinatively with others to secure what they cannot accomplish on their own."* In this sense, social cognitive theory extends the conception of *human agency* to *collective agency* (Bandura, 1997). This notion is important to explain the link of individual and collective learning. In Bandura's view, people's shared belief in their collective power to produce desired results is a key ingredient of collective agency. Group attainments are the product not only of shared intentions, knowledge and skills of its members, but also of the interactive, coordinative, and synergistic dynamics of their transactions. Beliefs of collective efficacy serve functions similar to those of personal efficacy beliefs and operate through similar processes (Bandura, 1997). However, the question of something becoming a collective-level property, still remains a mystery, Bandura's notion of collective efficacy neglects the dynamic interplay of different features of human agency and fails to provide a detailed description of how and why such collective efficacy might emerge from personal efficacy or some lower levels.

Based on the above discussion, previous research has shown the importance of social relationships in knowledge creation processes. The above discussion is located in the Western tradition of socio-physiological scholarship. We also should be aware that there are other cultures that place a far greater emphasis on collectivist perspectives and processes of knowledge creation, particularly, the Confucian view of human nature and Chinese notion of co-creativity can help us in understanding how to generate knowledge and make collaboration work.

3.2. Confucian View of Human Nature and Chinese Co-Creativity

As I discussed in the previous chapter, Chinese knowing roots in comprehensive observation, reciprocal feelings, practice and self-cultivation among people and between a human person and nature, can make many contributions to the contemporary knowledge creation theory. For Confucius knowledge is a matter of correctly describing reality as feelingly experienced by a person in the community. For presentation's sake, I shall divide the discussion of Chinese knowledge processes into three principles: *Ti-Yong distinction, Wu-Xing succession,* and *Co-creativity interaction.* The principle of *Ti-Yong* distinction emphasizes the unity of reason and experience, or body and mind. The principle of *Wu-Xing* succession emphasizes the mutual dependency of the individual and the network in generating knowledge and understanding through a continuum logic of knowing process. The principle of *co-creativity interaction* emphasizes the intimate relationship between knowledge and action in practice. Although the details need further elaboration, I can begin here with the general, yet essential characteristics of Chinese knowing.

3.2.1. Ti-Yong distinction, inter-subjectivity, and foundation of Chinese knowing

The principle of *Ti-Yong* distinction has a fundamental position in Chinese philosophy of knowledge. From the Chinese point of view of the "*Ti-Yong He Yi*" mind and body are both functions of the human person. For Chinese, this is the level of application of *Yin-Yang balance* and *Wu Xing succession*. In the Greek and European traditions, this is the level of questions about the homogenous or heterogeneous nature of reality, the methodologies for knowing it, the nature of value dichotomies, and the meaning of terms and nature of reason.

Ti is seen as the fundamental source of metaphysical and epistemological insights in Chinese Philosophy. *Ti* is one of the most basic, earliest, and most essential concepts in Chinese philosophy, which derives its meaning from the intimate understanding of reality, self, and practice. *Ti* is not simply a matter of organization of physical elements. Instead, it is a structure and system of organic functions and vital spirit in the vehicle of the physical body. In common use, *Ti* extends its meaning of organic system to refer to groups of people or community organized for special purposes (Cheng, 2002). In contrast to the Chinese paradigm of *Ti*, early Greek and medieval European philosophers looked upon the human body as a question, a problem, a source of trouble and non-values (Cheng, 2002).

The idea of *Yong*, means function, activity, use, application. It is well presented in both the text and commentaries of the *Yijing* or the *Book of Changes*. The *Ti-Yong* distinction is a relative, context-dependent distinction (Cheng, 2002). As Zhu Xi, an ancient Chinese thinker and educator, insightfully points out, *"Just as the distinction between what is prior and posterior is indeterminate, Ti-Yong distinction is indeterminate. Thus Yin can be the Ti of Yang, and Yang can be the Ti of Yin... the Ti-Yong distinction is relative discourse."*

To experience something and be aware of this experience is referred to as *Ti-Yan*, coming to know by *personal experience*, where "*Yan*" means "confirmed" or "confirmation." Hence, *Ti-Yan* is to confirm by direct experience of one's own person. As Mencius says, "*one has to fulfill one's mind on order to know one's nature, and on the basis of knowing one's nature; one could come to know heaven*". Hence, *Ti* is not unknowable, but it is to be known through a process of internal self-cultivation of the human mind and comprehensive external observation and close experience of things. The important thing about this notion of *Ti-Yan* is that there is no restriction as to what we could get from experience. People have the ability to experience closely reality, both internal and external, on many levels, in the meantime, they have to cultivate themselves to enable this ability to experience to become active and productive (Cheng, 2002). Hence, *Ti-Yan*, is a potential way of reading reality and understanding meaning, which is a source of visions, faith, and values.

As we discussed, to experience something is *Ti-Yan*, but to embody it is to actually participate in and share a situation. To embody something is to form an organic system with the thing, so that the thing can be said to be part of the whole reality resulting from the embodiment, or a person's self becomes part of the resulting system. In this sense, *Ti-Yan* in

the above context can be seen as "*embodied knowledge*", where knowledge results from experiences of physical presence.

Ti is to embody one's action or one's practice, or to make something happen in action and practice. In a deeper sense, there is always a *"self-cultivating circle"* in the *Ti-Yong* relationship, so that the change as the unformed, unlimited, and the creative would continue to bring new forms into the world and sustain the process of formation and transformation (Cheng, 2002). *Ti* and *Yong* mutually determine each other and they are the basis for creativity among things. As Wang Yang-ming stated, *"The substance (Ti) and function (Yong) of the mind-heart (Xin) cannot be equated with its tranquil and active states. Tranquility and activity are matters of time. When we speak of substance as substance, function is already involved it, and when we speak of function as function, substance is already involved it."* In this sense, each individual participates in the change and interaction of all individuals. The result is a transactional style of relationship where individuals are fulfilling their potentiality and developing a new network of relations. More importantly, one needs to put knowledge into practice so that the self-fulfilling cycle would become practically efficient.

In Western philosophy, *Inter-Subjectivity* rightly challenges the Cartesian mind/body dualism that splits science, culture, and language. It questions the notion of "inner" life and "outer" reality, subject and object. Inter-subjectivity is an attempt to understand that we are both subject and object, where *"the subject is his body, his world, and his situation, by a sort of exchange"* (Merleau-Ponty, 1964: 72). Furthermore, Eugene Gendlin (1997: 15) argued that we can move beyond the subject/object distinction if *"we become able to speak from how we interact bodily in our situations"*. Interaction signifies the connecting field in which perception is possible. Interaction does not divide into two perceptions - between two people, there exists one interaction. At this point, inter-subjectivity certainly challenges the everyday sense of having one's own 'pure' experience of being a self-contained and defined subject standing back from and perceiving a world of objects and others.

3.2.2. Wu-Xing succession, human nature, and logic of knowing processes

In the previous section, I argued that the term of *Ti-Yong* distinction refers to an open-ended creative function and the relation of reason and experience, mind and body, form and

substance in oneness. In this section, I introduce the Chinese *Wu-Xing*[4] succession as dynamic states of change. The concept of *Wu-Xing* is central to all elements of Chinese thought, including science, philosophy, medicine, astrology, and *Fengshui*.

In the Chinese view, knowledge is a human fulfillment of nature or natural fulfillment of man. *Oneness* is capable of both experiencing and reasoning. As man is one, so reason and experience are one. Therefore, in the Chinese philosophy of knowledge, reason and experience are so combined that we cannot distinguish one from the other. Therefore, *"Human nature"* (*Xing*) is a term used to indicate the basis for such a relation between reason and experience.

In the Chinese philosophy, the human nature is that which comes out naturally in a person. Here, we come to the Mencian notion of the human nature (*Xing*). Mencius point is that *human nature is naturally born and shines out in its natural expression of moral sentiments such as benevolence and righteousness.* By *Xing*, Mencius means the state of being that humans can be expected to attain given the proper nurturing conditions. Let me briefly explain it from five principles of Wu Xing: *Ren*, *Yi*, *Li*, *Zhi*, *Sheng/Xin*, for the purpose of understanding the inner logic of *Wu-Xing* succession.

- *Ren,* clearly Mencius has come to see *Ren* as a principle for motivating one's own cultivating development and *Yi* as a principle for ordering things and people according to the natures of things and people. In other words, *Ren* is one's own feeling toward unity with things and people. It is the principle of affectivity toward all things so that there is no blocking between oneself and people and things. The very notion of *Ren* in fact implies the notion of <u>identity</u>, for in order for things to hold together as a whole, identity is a requisite.
- *Yi,* on the other hand, is the kind of <u>interface</u> for distinguishing and ordering things within the totality of things. But any distinction and ordering must be made in a correct way and there is no correctness without taking into account the nature of things and the context and ways of their expression and realization. In this sense

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[4] The term of "Wu Xing" is generally translated as "five elements". This is incorrect. The word Wu does indeed mean "five", but there is no simple translation for xing. Translations such as "five elements", "five phases", "five agents", "five courses", "five stage of changes" are all used.

the *Yi* represents an objective assessment of the natures of things and their relationships.

- *Li,* is related to the words "worship" and "sacrificial vessel," both of which have definite religious overtones. But the term *Li* came to include all social habitual practices, as kind of <u>social norm</u>, it refers to propriety, that is, to the proper social behavior. *Li* is a personal performance revealing one's worth to oneself and one's community. In this sense, *Li* becomes a comprehensive notion embracing all social habits and customs acknowledged and accepted as a set of action-guiding rules or norms. Here, *Yi* determines whether specific rules or norms of *Li* are the right sort of rules or norms to regulate different types of conduct and the application of *Li* requires *Yi,* in the sense of reasoned judgment for their application to particular cases.

- *Zhi*, which means <u>wisdom or knowing</u>, is the ability to distinguish the true from the false, the correct from the incorrect. It occupies the central position of *Wu Xing*, plays the role of coherence to serve coordination and integration in the way of generating new things or means.

- *Sheng or Xin*, which means saint, <u>honest</u>, sage (wise and learned person) and <u>belief</u>. Mencius argues that sage can gather, realize and change the new things from experience, and is more closes to knowledge. Sage has such talent means *Sheng-Zhi* (*Saint Wisdom*). Here, *Sheng-Zhi* is a kind of tacit sensitivity feeling, which from experience represents one kind of knowledge, with the body, appearance and related intelligent judgment. Liu Xinfang (2000) states that *Sheng-Zhi* is knowledge. He argued, *"Smells, is the human's feeling, intelligent is human's ability, the Sheng-Zhi (Saint wisdom) is human's knowledge."* This may be a wrong explanation of *Sheng-Zhi*. In fact, *Sheng-Zhi* is a sort of tacit understanding and knowing process of *Ti,* and is coming form experience and practice.

What I find of specific interest in the *Wu-Xing succession* is its continuum logic that a logic complementing all others in the knowing processes. First, the notion of *Wu-Xing* provides a deep assumption of human nature, which comprehends both the material and spiritual sides of the human person. It is not only the source of motivation of self-cultivation, but also the source of their interrelation. Second, this notion of *Wu-Xing* also provides an identity of the person, which can be regarded as aspects of the sustaining nature. Third, there

is the autonomy of decision-making and initiative in the human person as an individual. *Wu-Xing* as an organic mechanism for a whole person not only provides an integration of all the personal qualities of the person but also provides the emergence of an integrated personality and a self-consciousness of the self. Fourth, *Wu-Xing* succession is considered a potential for knowing process and also a source of the knowledge creation.

3.2.3. Co-creativity interaction, Zhi Xing He Yi, and epistemological-pragmatic unity

Gerhard Fischer *et al.*, (2002) argue that *"…much human creativity arises from activities that take place in social contexts in which interaction with other people and the artifacts that embody group knowledge are important contributors to the process."* In Chinese philosophy, knowledge is not to be seen as an isolated phenomenon independent of individual, nor is it a construction related only to the basic functioning of the mind. The mutual support and mutual determination of knowledge and action perhaps can be understood on the basis of the philosophical works of Confucianism and Taoism. In the classical Chinese literature the process of *"co-creativity"* has many related expressions (*Ren, Junzi, Shenren, He, Zhongyong*), but in all cases it is, to use John Dewey's expression, "*doing and undergoing*" in an effort to get the most out of one's experience.

In the early sixteenth century, Wang Yang-ming (1472-1529) coined the slogan *"Zhi Xing He Yi"* (the unity of knowledge and action). In Wang Yang-ming's continuum view of *"innate knowledge"*, he wrote: *"the innate knowledge of man is the same as that of plants and trees, tiles and stones… Heaven, Earth, the myriad things, and man form one body. The point at which this unity is manifested in its most refined and excellent form is the clear intelligence of the human mind."* Zhu Xi argued that knowledge ought to precede any attempt to act. To think, we must use our preconscious or unconscious beliefs; to know, we need to take "pre-knowledge" actions, because these provide a context for knowing-what is, knowing directed toward action or toward transformations of our own being (Cheng, 2002).

Similarly, the American pragmatists (e.g. Peirce, James, Dewey, Rorty) initiated their own campaign to reconstruct our understanding of the relationship between knowledge and action. As I discussed in Chapter 2, pragmatists saw the world as a dynamic, pluralistic matrix of internally related entities. They concluded that knowing had more to do with interacting with world. Pragmatism and Confucianism both agree that the quality of our experience

determines our humanity. Experience is one of the most common words in our vocabulary. It also sets the stage for understanding the remarkable similarity between Pragmatism and Confucianism. Both epistemologies seek a category that can embrace in the widest possible terms the richest view of human existence. Dewey calls it "experience", while Confucius calls his fundamental category, "the Way" or "the *Dao*." Both depend on the act of undergoing experience. Situated experience for pragmatism is prior to any abstracted notion of agency. Experience is both process and the product of the interaction between human organisms and the social, natural and cultural environments. In Chinese epistemology, Confucius is always concerned with finding the right way to handle a situation. To find the way is to get one's bearings in a realm of constantly changing situations and to bring one into the most productive course of action (Grange, 2003).

In pragmatism, knowledge is always a form of action; it is the process whereby an organism actively values and responds to the things around it. Similarly, in neo-Confucius, knowledge, according to Wang Yang-ming, is not an abstract representation of reality; it is rather a way of being in relation with things (Frisina, 2000). However, the pragmatists had trouble communicating their insight regarding the relationship between knowledge and action to their contemporaries. Unlike Western pragmatism, Chinese metaphysical assumptions simply do not allow the bifurcation between knowledge and action, heart and mind that was implicit in pragmatism practice. Wang Yang-ming appeals to Zhu Xi's relational ontology and organismic cosmology in making his pragmatic dimension of knowing that knowledge and action is really one thing.

To conclude this section I have examined three interrelated principles in Chinese philosophy of knowledge, *Ti-Yong distinction*, *Wu-Xing succession*, and *Co-creativity interaction,* which serve to understand the dynamics of knowledge creation. Particularly, the reference to *Wu-Xing* is an ontological reality which not only makes the ontology of the human person possible but also makes the transformation of the human person possible. One of the most important values of *Wu-Xing* continuum logic is in its use as a most valuable analytic technique, to explore the relation of change and stability with all other systems at different levels.

From the second round literature review three main conclusions are clear. First, the emergence of norms influences the micro-macro linkages; second, there is evidence that

psychosocial attributes exert a strong influence on the willingness of individuals to engage in knowledge creation, which are critical for a micro-foundation formation; and third, that other personal and contextual factors may also influence the knowledge creation processes (*i.e. Wu-Xing* succession).

3.3. The Conceptual Model of Knowledge Creation: Alignment of Knowledge and Knowing

My research is based upon a number of research streams that together suggest an alignment of knowledge and knowing for new knowledge generation. For my purposes, I took the view that knowledge is a process situated in practice by providing an explanation of how firms interact with its knowing/knowledge communities to create knowledge. The research literature illustrates that knowledge is a process and knowing is an aspect of action and it is interaction that enables new knowledge creation. My research aims to explore an inductive theory of the knowledge creation dynamics, specifically examine the knowledge creation processes within and between organizations, communities of knowing/distributed groups and technology alliances.

3.3.1. Combining the main conceptual tools

The study of the psychosocial attributes of the individual and the analysis of collective property is the main strategy employed in this research. I aim to understand the factors that influence the knowledge creation processes at individual and collective level by extracting information about some dimensions of micro-macro links, social capital, human nature and continuum logic of knowing processes. In order to do this, I utilize three main conceptual foundations/tools: social capital theory, socio-cognitive theory, and co-creativity theory.

For social capital theory is useful for understanding this phenomenon because it deals with the formation of social normative systems, focusing on how and why individuals form groups and networks and measuring networks' strength and stability. In addition, social capital is a key factor in understanding knowledge creation, due to social capital directly affects the combine action and exchange process and provides relatively easy access to network resources. More specifically, Nahapiet and Ghoshal (1998) suggested that four

features are especially important influences on knowledge creation: trust, norm, identification and obligation. However, social capital theory alone is not enough. Some scholars (Porter, 1993; Bandura, 1997, 2001) also point to the importance of integrating the theories of individual behavior when analyzing group formation and collaboration. Over time, sociological theory has recognized the need to include individual subjectivity as a factor in understanding why people collaborate with others. The social cognitive theory complements the social capital theory by providing a structured framework- self-efficacy, outcome expectations, intrinsic and extrinsic motivations of individuals, to analyze the dynamics of collaboration and interaction at individual and collective level. Finally, I also use the Chinese co-creativity theory for exploring other internal elements that determine the origins of collective-level variables, including the inter-subjectivity, *Wu-Xing* succession, and epistemological-pragmatic unity/Chinese co-creativity. Figure 3.3. illustrates the relationship between the main conceptual join used in this research.

Figure 3.3. Combining the Main Conceptual Tools
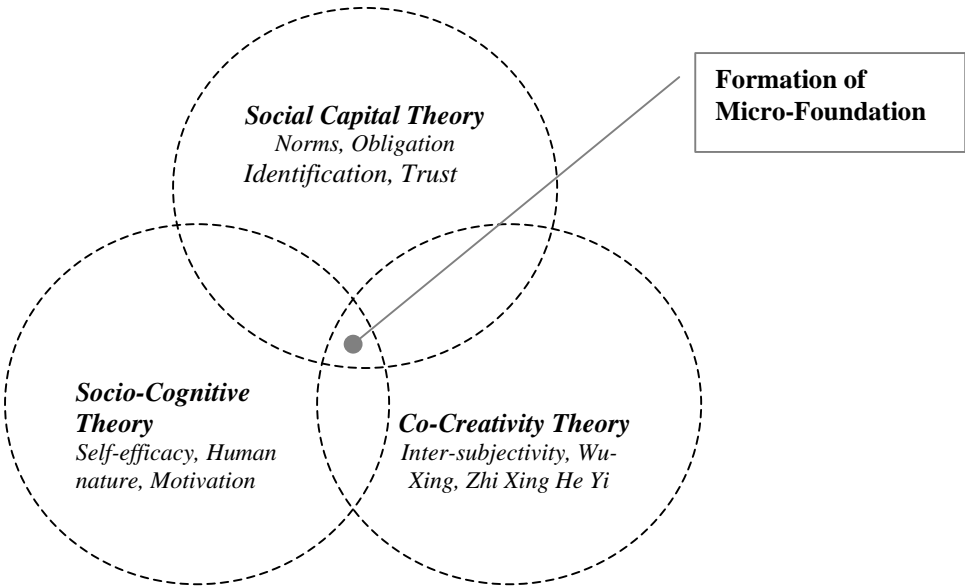
Even though these theories belong to distinct domains and respond to different hierarchical levels of analysis, certain elements link them together and provide us with an appropriate model to analyze the knowledge creation processes at individual, group/community and organizational levels.

Both social capital and socio-cognitive theories point to the importance of analyzing trust, norm, confidence, and outcome expectations in order to understand the knowledge creation processes. Social capital theorists argue that social capital depends on the existence of certain values, such as reciprocity, norms, obligation, and trust between individuals to exist; social cognitive theory emphasizes the importance of intentionality, personal standard, confidence in collaboration. The co-creativity theory also underlines the importance of human value (identity, interfaces, norms, trust and confidence) to produce specific behaviors, in agreement with the social capital theory. The literature on co-creativity in knowing process identifies "*Wu-Xing* succession" as a powerful mechanism to investigate knowledge creation at the individual and collective level.

Based on the first round literature review of organizational knowledge creation and literature of knowing communities, in a more comprehensive way, I consider the concepts of community building, situated learning, and Cook and Brown's (1999) notion of generative dance are also important conceptual tools for analyzing knowledge creation processes. Social capital reflects a heightened awareness in academic circles of real people's values, but without empirically explaining how people interact in their daily lives, in family, neighborhoods and work groups. Community as a social structure can better describe relationships among people (Bowles & Gintis, 2002). Importantly, communities are often capable of enforcing norms and provide an opportunity to develop theories of social capital in a novel context that lacks pecuniary incentives, hierarchical authority, and formal structure.

Specifically, I use community building and situated learning concepts to explain the term of collective efficacy and the structure of social interactions. In addition, they may help to gain additional perspectives about the different dimensions involved in interdisciplinary group formation. In addition, such theories are also useful for illustrating different motivational aspects of the process of knowledge creation. Generative dance is an important concept to examine the new knowledge creation processes, particularly where the interest is in the alignment of knowledge and knowing.

3.3.2. Factors contributing to the knowledge process creation

Knowledge creation is seen as a fundamentally social process as people collectively improve their understanding through social interaction. This means that knowledge is not

considered to reside in, or be created within an individual's mind. The assumption that knowledge consists of objects, which can be systematically produced, developed and accumulated, is referred to as the mentalistic concept of knowledge. In Nonaka's knowledge creation model, metaphors and analogies are used to help provide a framework for thinking about knowledge representation, and indeed, metaphors have been identified as one modality through which scientific ideas get transmitted (Lakoff & Johnson, 1980). For example, Nelson and Winter's notion of organizational routine is developed via metaphor from individual skill. However, the question of truly property of knowledge creation rarely gets answered beyond discussing analogies between individual level characteristics and the collective level. While making links with metaphor, or citing emergence, undoubtedly serves a temporary purpose, Felin and Foss (2006) believe that truly digging into the constructs of micro-foundation, beyond analogy, is required. They suggested that we should consider at what point and why we can talk about a collective capabilities without individuals.

By analyzing the relevant literature on social theory of action/social capital, social cognitive theory and Chinese philosophy of knowledge, I have sought to present more precisely the final conceptual framework. While there are many factors affecting the processes of knowledge building within organization/communities. I have identified, from the above literature, five primary factors that interact, acting both as independent and dependent variables, to influence knowledge construction processes. These five factors, which provide a focus for my investigation, are *identity, interface, norm, routine, and trust*.

Identity includes the individual identity and social/group identity. Individual identity is related to the way people conceive of themselves. People interpret and enact their social identities in response to the situations in which they find themselves (Weick, 2001). For example, people are likely to be comfortable in exchanging their knowledge with others in the social group, and this transformation may be facilitated by the use of a common language. Group can acquire an identity by developing a unique knowledge about ways of working successfully (Penrose, 1959). Identities can develop around a functional role, professional membership, gender, nationality, or a particular hierarchical status in an organization (Weigert, *et al.,* 1986; Ashforth & Mael, 1989).

Interface includes the standards dimension of social normative system. Social normative system is a complex system with a large amount of system interfaces. This could

be a challenge for human beings. The difficulties come from both individual human beings' cognitive capability and how people work together in organizations or groups. Individual human beings are incapable of dealing with large complex system interfaces without proper outside aids. As Simon (1957: 198) points out, *"the capacity of the human mind for formulating and solving complex problem is very small compared with the size of the problem whose solution is required for objectively rational behavior in the real world or even for a reasonable approximation to such objective rationality."* Hence, in order to work on large social normative systems, we must understand human limitations and identify the standards to overcome the limitations in order to create knowledge. At the group level, each group in the organization must collaborate to correctly address the interface issues. Further, the communication and negotiation are powerful tools to help people construct common understanding.

Norms include self-interest norms at individual level and social norms at the group level. Miller (1999) proposed that a norm in Western cultures that specify self-interest both is and ought to be a powerful determinant of behavior. This norm influences people's actions and opinions as well as the accounts they give for their actions and opinions. *Social norms* are standards of behavior that are based on widely shared beliefs about how individual group members ought to behave in a given situation. For norms to exist the group must have the ability to enforce its rules. When meaning[5] encourages one action and interests another, then enforcement is necessary to encourage people to act in appropriate symbolic ways, even if such behaviors are not in their personal interest. Thus for norms to be effective, there must be some mechanism that translates rules into action. In the rational choice theorist's world, norms provide common knowledge about the individual payoff to particular courses of action (Coleman, 1990; Ellickson, 1991).

Routines include the notion of knowledge repository and translation of routines. Routines are the memory and genes of the organization and encompass the organization's knowledge basis (Nelson & Winter, 1982). Routines are capable to store tacit knowledge.

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[5]The distinction between knowledge and meaning: Knowledge can be thought of generally as what we know, whereas meaning involves how that knowledge is applicable to us or how it relates to other knowledge. Meaning construction involves the interpretation of knowledge. In Corley and Gioia, semantic learning as Change Enabler: Relating Organizational Identity and Organizational Learning, *The Blackwell Handbook of Organizational Learning and Knowledge Management* edited by M. Easterby-Smith & M. Lyles, 2003

Routines represent stable sequences of actions that are triggered by certain stimuli contexts and which serve as knowledge repository for organization. Also, routines enable coordination, in which triggers play an important role in bringing about coordination. The process of translation of routines for knowledge creation is a particular type of modification of routine.

Trust includes predictive trust and normative trust both in the rational context. Trust emerges as a mediating factor when informal controls are lacking in the knowledge creation processes, which leads in turn to higher levels of cooperative behavior. In predictive trust, members of communities or groups cumulate trust and build identity through the loosen relation ties. The matchmaking positions in relation networks are related to normative trust towards developing groups or communities' collectivity. Where relationships are high in trust, people are more willing to engage in social exchange. In the context of knowledge creation processes, trust led to openness, dialogue and shared experimentation that are so important for knowledge creation (Nahapiet & Ghoshal, 1998).

The above understanding can also yield insights into how social capital, social cognitive theory, and co-creativity theory influence knowledge creation. The importance of social capital was illustrated by Burt (1992), who demonstrated that "brokers", individuals who connect otherwise disconnected actors, can exploit "structural holes" to advance more quickly in new idea generation. The between-group brokers are more likely to express ideas and more likely to have ideas evaluated as valuable (Burt, 2004). Predating Burt's structural hole theory, Allen (1977) and Tushman (1977) described how "boundary spanners" usually contribute the best identify, translate and relay information within and across organizations. Accordingly, broker and boundary spanner hold two correlated but different perceptions about individuals in each position. In the process of knowledge creation an important step is the validation of the new knowledge produced. This study emphasizes the importance of intermediary and integrating roles, for brokers within boundaries to integrate knowledge within communities, and for boundary spanners across cohesive boundaries to exchange knowledge and link communities. In my view, both brokering and boundary spanning roles can increase the likelihood of cooperation and coordination and can bind communities together.

Given the origins of individual and collective-level variables described above, the matter of the origins then requires more consideration of how change takes place, and what

key processes of knowledge creation exist both at the individual and collective levels. The next section will address a conceptual model of knowledge creation processes from a practice perspective.

The integrative framework of factors for knowledge processes is shown in Table 3.1.

Table 3.1. Factors affect knowledge Process Creation

Factors	Social Capital Theory	Social Cognitive Theory	Co-Creativity Theory
Identity *Individual identity, social/group identity*	Identification is important influences on cooperation, Structural dimension (Nahapiet & Ghoshal, 1998)	Intentionality, Proactive commitment, Self-perception changes (Bandura, 2001)	Observer, interpreter, definer *Ren,* feels of unity of people and things, for things hold together as whole, sense of belonging to a group (Mencian)
Interface *Size, standard Approximation*	Normative system interfaces (Coleman, 1990) Bounded rationality, Size of problem, human limitations, approximation (Simon, 1957) structural dimension (Nahapiet, et al., 2000)	Forethought, personal standards, self-direction, Outcome expectation between self and world (Bandura, 2001) Extrinsic motivation (Deci, 1975)	Observed, interpreted, defined, *Yi,* distinguishing and ordering things Objective assessment of thing and relationships (Mencian; Cheng, 2002)
Norm *Self-interest norm, social norms*	Self-interest, standards of behavior, informal rules, a means of micro-macro transition (Coleman, 1990; Ellickson, 1991) Reciprocity (Putnam, 2000) Rational dimension, (Nahapiet, et al., 2000)	Self-regulation, self-reactiveness, make choices, self-guidance via personal standards, self-monitoring, Matching personal standards (Bandura, 2001) Normative intrinsic motivation (Lindenberg, 2001)	Process of observing, interpreting, knowing, *Li,* Social habitual practice, customs, action-guiding rules, social regulation, and judgment (Mencian)
Routine *Repository, translation of routine, coordination*	Knowledge repository, memory and genes of organization, stable sequence of action, *"truce"* enable coordination (Nelson & Winter, 1982) Cognitive dimension (Nahapiet, et al., 2000)	Self-reflectiveness, self-examination, self-evaluation, Self-efficacy, adaptation (Bandura, 2001, 1997) Hedonic intrinsic motivation, extrinsic motivation (Lindenberg, 2001; Deci et al., 1985)	Observations, interpretations, definitions, explanations, *Zhi,* wisdom, correct form incorrect, problem solving, central foundations, coherence, coordination, integration (Mencian, Cheng, 2002)
Trust *Rational trust, Predictive, normative expectation*	Trust lead to openness, dialogue, cooperation Relational dimension (Nahapiet & Ghoshal, 1998) Rational trust, predictive, normative expectation (Hollis, 1998)	Well-being, building confidence, beliefs, emotion, Self-fulfilling prophecy, collective efficacy (Bandura, 1977, 1997)	Perspective, rejected, included, excluded, *Sheng/Xin,* tacit sensitivity, believe, intelligent judgment Honest, saint, faith, loyalty (Mencian; Cheng, 2002)

3.3.3. Conceptual model of knowledge creation processes

In this section, I develop a process model of knowledge creation based on Chinese epistemology, specifically, using *Wu-Xing* continuum logic to demonstrate the knowing processes. As I discussed in the previous section, *Wu-Xing* succession as an organic mechanism provides a potential assumption for knowledge creation, a kind of intellectual feedback loop of interrelating and inseparable knowing processes. According to Benesch and Wilner's (2002) interpretation of *Wu-Xing* succession knowledge and understanding occur within an experiential continuum with at least five aspects: knower, known, knowing, knowledge and perspective. These five aspects reflect the origins of change in individual choices and efforts made by individual and collective structure.

Logic comes from the Greek roots for "word," "speech," and "reason." Logic is a product of the reflexive self-awareness capability of the human intellect[6]. Chinese philosophy in general tries to achieve harmony and balance in reflexive self-awareness between distinctions as products and an awareness of distinguishing as process. Chinese continuum logic occurs within the interpretation of the world as a minding totality in which human beings are both spectator and participants in and of nature (Benesch & Wilner, 2002). Chuang Tzu's (*Zhuang zi*) theory of minding as emerging and merging might be seen as the metaphorical basis for continuum logic in its descriptions of the development stages of awareness. According to Chuang Tzu, the first stage refers to a time before there were things. At the next stage, there was recognition that there were things, but no distinctions were made between and among them. In the third stage, distinctions were made and judgments applied to them. In short, the continuum logic interrelates human perceptual and conceptual experience with a series of at least five variables, in my understanding these variables are identity, interface, norm, routine, and trust, and each variable positions at different levels, enabling one at each continuum level to develop the perspectives that lead into other levels. Figure 3.4. illustrates the impact of each of these variables on the others and their interaction is realized as various aspects of knowing processes.

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[6] Human reflexive self-awareness is "ordering awareness" in what is assumed to be an orderly universe. The human intellect as minding can be viewed both as an orderly aspect of nature and experience and the source of perspective upon order in nature and experience. In W. Benesch and E. Wilner, Continuum logic: a Chinese contribution to knowledge and understanding in philosophy and science, *Journal of Chinese Philosophy*, 29: 4, 2002

Figure 3.4. Wu-Xing Continuum Logic
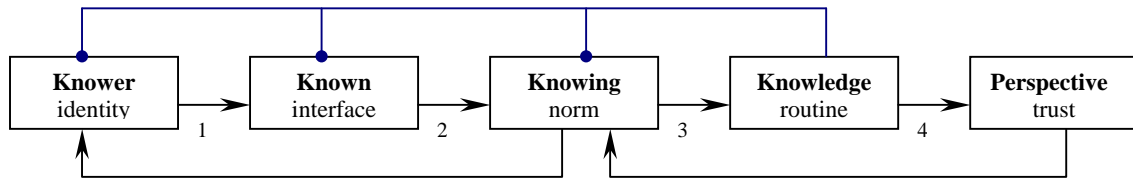
In the context of the *"knower-identity"*, one develops an awareness of a natural participant/spectator unity. Past experiences, assumptions, potential interpretations influence the observer's intention and attention to an event or object.

In the context of the *"known-interface"*, one develops his/her images and begins separate mind from nature. One might identify "what" and "why" and "how" questions: what are the relevant and irrelevant aspects and characteristics of the observed? Under what conditions and in what circumstances is the observed event or object experienced? What was included or excluded in terms of circumstances and characteristics and why? Are there relevant connections to other observations that are being considered or ignored?

In the context of the *"knowing-normative processes"*, one sets the standards for both knowledge and values and seeks to relate the vast detail of experience in any knowledge field to the cognitions with which the field has been defined. In this context, one uses the distinguishing contexts and assumptions of level 2 as a foundation, and identifies what techniques, methods, and instruments are matched in the observing, exploring/normative processes.

In the context of the *"knowledge-routine integration"*, the other three levels merge as aspects of knowing that can be conceptualized, symbolized and communicated as kind of combination of immediate experience. One needs to consider what the linguistic, categorical, procedural constraints are that will determine the integration of knowledge. The knowledge developed in this context should lead back to the context of the whole mind/nature developed in level 1, and awareness developed in level 2 and level 3.

In the context of the *"perspective-trust mediation processes"*, one begins to review and even question the interrelationships of the first four contexts. It provides an understanding of the basic perspectives and questions at the level of immediate experience, in which is emphasized or de-emphasized, assumed, rejected, included or excluded. At this level of continuum logic, one begins to discover and understand the experiential paradoxes and problems of the human intellect as spectator and participant in the world.

Wu-Xing continuum logic provides not only a valuable analytic technique for the acquisition of knowledge; it is also the source of human creativity in all fields. For the purpose of this study, I use *Wu-Xing* continuum logic to develop my conceptual process model of knowledge creation.

Based on the Chinese *Ti-Yong* distinction, which emphasizes that reason and experience or mind and body mutually determine each other and are the basis for creativity among things, I argue that in the analysis of knowledge processes we can rely on alignment of knowledge and knowing to explore the dynamics of knowledge creation. According to Cook and Brown's (1999) new knowledge arises from a generative dance between what knowledge is possessed by the individual and what is inextricably linked to practice. In my view, a further insight into the concept of generative dance is offered by the notions of formative and moderative context.

The *"formative context"* relates to the tacit dimension of knowledge within which routines are "formed" and from which they receive their scope and meaning. The formative context directs our attention to the social cognitive foundations of the context that inform actions. *"It constitutes a background condition for action, enforcing constraints, giving direction and meaning, and setting the range of opportunities for undertaking action"* (Ciborra and Lanzara, 1994: 70). The distinctive feature of the formative context, as elaborated by Ciborra and Lanzara, is its dual emphasis on the cognitive and the institutional. When enacted in a situation of action, formative contexts are expressions of a social cognition that transcends the individual. As Unger (1987: 72) highlighted *"such cognition may well be embodied in material or symbolic artifacts, organizational structures and procedures, institutional settings, and, most crucially, in the relationships or 'couplings' binding actors and their work tools in a sort of micro-ecology of stable uses and shared meanings"*. The context is "formative" in that it shapes the ways people perceive, understand, perform and get

organized in a situation bounded in space and time. Furthermore, it may help people to see and do things in new ways. Accordingly, the formative context sets a path for knowledge creation. The outcome of a formative context is a texture of routines, roles and tasks, a division of labor, and a set of coordination mechanisms (Patriotta, 2003).

The *"moderative context"* relates to the motivation, identity transformation, trust, norms, embedded dimension of knowledge processes within which a rational program is established with a set evaluation agenda and the study of how people collaborate. The moderative context shows how different kinds of motivation are crucial for generating knowledge and how trust and motivation cause successful cooperation between self-interested individuals. Motivation provides a means for representing and reasoning about an individual's overall objectives, guiding all aspects of individual behavior (Griffiths & Luck, 2003). In the moderative context, through social norms guidance we can translate normative rules into action. Individuals use their knowledge and trust of others to determine whom to ask to cooperate. The context is "moderative" in that it shapes the loose relational infrastructure for identity transformation, building trust, and developing collectivity. Also, through cognitive and experiential search, the moderative context leads us to advance understanding of social practices. These two contexts overlap and are intertwined for linking knowledge and knowing tends to generate new knowledge in organizations and communities.

In my view knowledge is not a commodity that can be packaged in one place, but a set of meaning or understanding generated out of and continually adapted by the social processes in which it is formulated, interpreted, and shared in the practices. Importantly, we do not know what the role of meaning/common understanding or adoptions in knowledge processes or how common they are with regard to other types of knowledge. Previous studies of knowledge creation, as we discussed in Chapter 2, typically do not take into account this loose coupling of disciplines permitted by the generation of meanings or understandings. In my study, I attempt to locate such generative processes through a detailed content analysis of case studies. My approach contributes to the new situated understanding of how knowledge is generated at individual, communities/groups, and organizational level.

In this section I develop a process model of knowledge creation based on the formative and moderative assumptions. The process model is shown in Figure 3.5.

Figure 3.5. Conceptual Process Model of Knowledge Creation
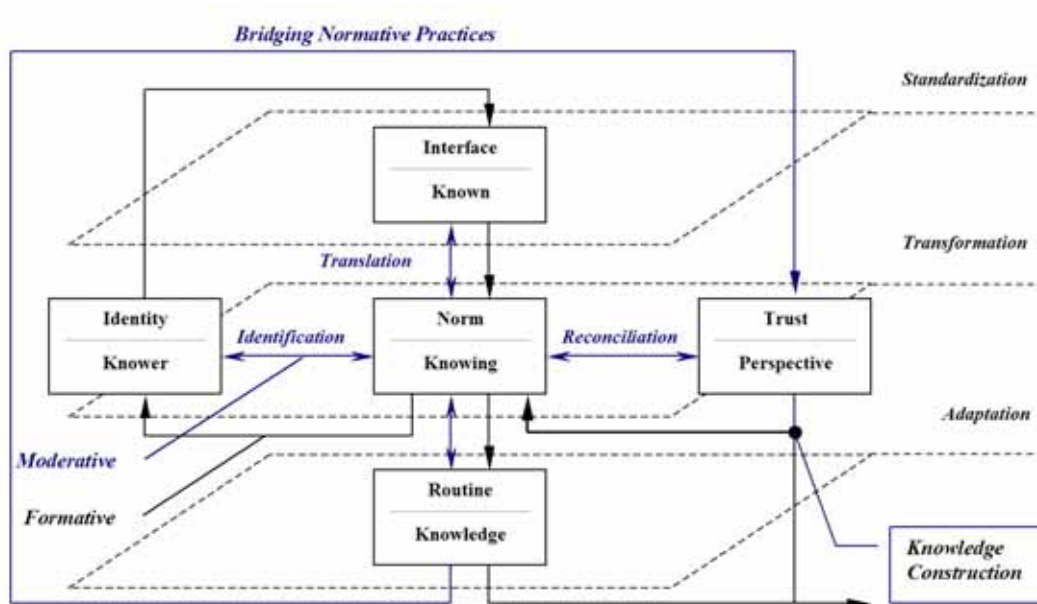
In the formative context, there are three configurations: standardizations, transformation and adaptation; the moderative context also corresponding three configurations: identification, translation, and reconciliation. These six configurations do not represent all forms of knowledge generation, but they represent six major configurations that I am using as a starting point for examining knowledge creation processes. In these representations, I go beyond previous work on knowledge creation by integrating into my conceptualization the role of loose social cognitive platforms and of formative and moderative contexts in knowledge processes.

Standardization/Identification describes how non-interpreted information or data can be transmitted from one individual to another or to a group/community. Actors from both sides try to identify the same term through what actually means, or how it might be related to a body of knowledge. Members of communities or group attempt to learn from experiences of others and try to first identify the significant features of such experiences. Thus, this process starts with the recognition by the individuals or groups that the experiences of others may be helpful in setting a joint agenda and generating new knowledge. This search effort is guided by characteristics of group/communities, types of experiences and structural arrangements. In learning together and forming common ground, group/community members create a collective or community memory that defines them, creating both a boundary and a definition

of who and what they are. Here, they gain a sense of the identity of the group/community, e.g. what makes someone belongs, and what the group/community represents.

Transformation/Translation suggests that actors of two parties that have different context and background come to construct common understanding of interpreted knowledge. There must be significant communication and interaction between members to create a context that can support shared embedded meanings. Group/community cannot take action based on identified experiences of others unless members of group/community are able to translate the experiences into their own context. Groups also learn when they monitor their own processes. Along this process comes the definition of protocols, data units, database, structures, computer interfaces, storage and standards. Furthermore, not only must group/community create standards/interfaces to bring their work together, but they also learn normative activities associated with accommodating distributed practice. Here, members of group/community establish a group/community's norms to guide and control interaction in internal and external fields.

Adaptation/Reconciliation describes the sharing of representations of knowledge embedded in community/group. This process involves the community/group taking an important piece of knowledge, converting experiences of others outside the group/community into action. In other words, through coordination mechanisms, group/community can translate rules into action. Representations make it possible for groups/communities with different background and disciplinary contexts to affect knowledge discovery by a synergistic pooling of their knowledge resources. This adaptation/reconciliation process requires various degrees of understanding of the experiences involved, in which a particular practice is successfully adopted from past situations. It is by these configurations, namely, socio-cognitive platforms that I believe new knowledge is created in communities/groups and organizations.

Overall, in the cases studies, I expect to find these configurations in knowledge creation processes as shown in Figure 3.6. to be the most common form. I also expect to see how change occurs in different configurations, and how it triggers motivation to engage in various processes within socio-cognitive platforms.

3.4. Linking levels and Units of Analysis: Individuals, Communities/Groups, and Organizations

My approach requires analyzing at least three levels of complexity: individuals, communities/groups, and organizations/technology alliances. My research units are the individual designer or engineer at individual level, middle managers, research directors, and engineers/researchers are the main unit analysis at the communities and organizational level.

The levels of research analysis are shown in Figure 3.6.

Figure 3.6. Levels of Research Analysis
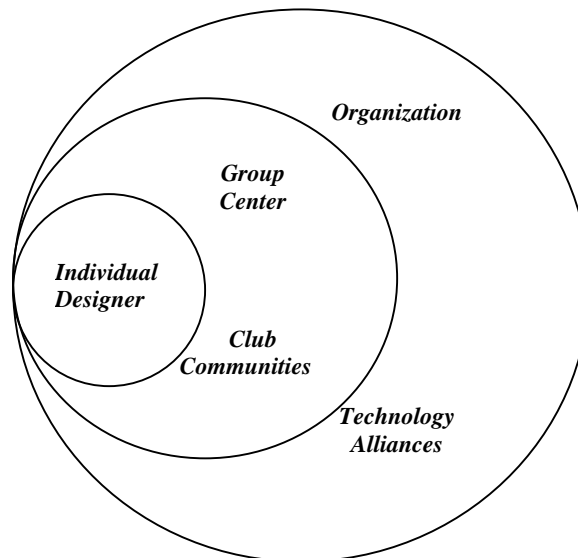
Relevant information lies in at least those three hierarchical levels, which, as a matter of fact, correspond to the levels addressed by the different definitions of social cognitive platforms. First, at the individual level, they are in the form of perceived self-fulfilling, values, motivators, and outcome expectations. Second, at the communities/groups level, they are in the form of the norms and regulations of the communities/groups in which knowledge creation. Third, at the organizational or alliance level, they are in the form of the cooperation and coordination of different collaboration partners, and the institutional features of technology alliances in which a rational program embedded. In any event, I addressed these levels by conducting a series of interviews in this study.

As a result, in order to appropriately identify and analyze the variables that more directly influence the knowledge creation processes, my study mainly focuses on the first level (individual) and analyzes the impact of the second (communities/groups) on it. Assesses first the significance of individual features, motivators and psychosocial attributes as determinants for knowledge creation towards collective level and second, at the communities level, intrinsic motivators receive special attention.

At the individual level, the study focuses on one dimension when looking at individual determinants of knowledge creation processes: the psychosocial attributes of the individual (perceived individual self-fulfilling, personal values, background and motivators)

At the communities level, the study tries to identify whether communities themselves exert any influence on the determinants of knowledge creation in individuals. The analysis of the communities level is relevant because the particularities of environment (including identity, norms, and regulations) may directly affect individual performance and behavior.

At the organizational level, due to the complexity of the organizational dimension, my study focuses on the cooperation and coordination mechanisms of different partners in technology alliances, and the institutional features of technology alliances in which the rational program embedded.

The overarching research question of this study is driven by:

How might we re-define and better understand the processes of knowledge creation?

Within that question, several topics/sub-questions were explored. The questions are:

1. What are the generative mechanisms through which new knowledge is created?
2. How does inter-subjectivity or interaction take place and what is involved in it?
3. How does human agency moderate knowledge creation processes?

The first question addresses the basic, but essential "mapping" issue that is subject of much of the theory aspect of knowledge creation. I took the view that knowledge is a process and situates in practice by providing an explanation of how firms interact with

knowing/knowledge communities to create knowledge. The second research question shifts the analysis to further examine the formative context of knowledge creation within the socio-cognitive modular platform. The third and final question explains the scope of the study from a focus purely centered on embedded moderative context of knowledge creation.

Answering these questions is relevant because it helps to begin to build a more contextualized theory of knowledge creation. Furthermore, the questions addressed in this thesis are inspired by a core debate about the nature of knowledge, interaction of knowledge and knowing, origin of routines, link of micro-macro, and constructs of individual-collective learning.

In order to answer the "how" question, Yin (1984) suggests comparative case studies, which allow us to understand deeply the knowledge creation processes at individual, communities/groups, and organizational level. Hence, in the next chapter, I present a comparative case study of four auto companies, in order to develop an empirically grounded theory of knowledge creation. I then present a research design of a cross-level study of technology alliances that enables us to assess the coherence of individuals, communities or groups and organizations that each affect and is affected by the other within technology alliances.

Chapter 4.

Comparative Case Studies: A Practice-Based Knowledge Spiral in Chinese Automotive Industries

- Research Setting and Methods: Case Selection, Data Collection and Analysis
- Research Results: Knowledge Spiral and Cross-Case Analysis
- Discussion and Conclusions

In this chapter I report on the comparative case studies of the knowledge creation processes in the Chinese automotive industry. This analysis was necessary to achieve a better understanding of how knowledge is generated through social cognitive platforms. As I discussed in Chapter 3., the mechanism of stability and change within the socio-cognitive platform has remained unclear. The analysis of individual cases enables us to answer the "how" or "why" questions (Yin, 1984) and to develop an empirically grounded theory (Eisenhardt, 1989). The purpose of this grounded theory study is to examine and understand how change occurs in knowledge creation processes, and how it triggers motivation to engage in various knowledge processes within socio-cognitive platforms.

To better understand the key processes of knowledge creation in the Chinese automotive industry, I interviewed 14 people in 4 firms: *PATAC Shanghai*[7], a joint technical research center between *GM* and *SAIC*[8]; *VW Shanghai*, a joint venture between *VW* and *SAIC*; and *Chery* and *Geely* auto Ltd. Both represent local automobile producers. I conducted the study as objectively as possible to see what is the effect of the knowledge creation spiral between individuals, communities and organizations. I allowed phenomena to emerge from the data. I found the inductive processes to be meaningful and worth the effort.

The present Chapter is organized in three sections. In the first section I discuss the research setting and methods, followed by the results and the propositions that emerged from analyzing each set of principles – individual level, communities level, and organizational level, and their impact on the knowledge creation processes – leverage point of knowledge creation, processes of knowledge creation, access to knowledge collectivity, and knowledge creation across multilevel. I then summarize, conclude, and briefly discuss what will follow.

4.1. Research Setting and Methods: Case Selection, Data Collection and Analysis

The case studies consist of the analysis of the processes and practices used to generate new knowledge in four companies. The companies were selected in order to achieve maximum divergence in the practices and processes, which are the independent variables. The study deals with detailed firm specific constructs in an emerging market context that

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[7] PATAC, Pan-Asia Technical Automotive Center, Co. Ltd.

[8] SAIC, Shanghai Automotive Industry Corporation limited.

quantitative research cannot easily obtain and analyze (Hoskisson *et al.*, 2000). In order to gain an in-depth knowledge and understanding of knowledge creation processes in the Chinese automotive industry, therefore, I took an inductive multiple case studies approach.

Inductive research seemed the most efficient way to capture much of the actual complexity of the research setting, which should serve to identify appropriate theoretical lenses and levels of analysis for follow-up research (Freeman 1979; Parkhe, 1993). The research therefore followed the standard methodology for case study research, as described in Yin (1989). According to Yin (1981: 59), a case study does not produce a single factor or variable but an entire story. *"As a research strategy, the distinguishing characteristic of the case study is that it attempts to examine: a) a contemporary phenomenon in its real-life context, especially when b) the boundaries between phenomenon and context are not clearly evident";* the case interviews in this dissertation serve exactly that purpose.

This research tends to examine knowledge creation dynamics as the new product development phenomenon. Although in the knowledge-based view of firm we do not have a good understanding of knowledge creation, we can make use of the product innovation literature that has discussed it directly. Un and Cuervo-Cazurra (2004) suggested that product innovation is about knowledge creation in the sense that it explains some factors that facilitate new product development processes. I base the study on interviews with managers and engineers in the Chinese auto industry who have taken part in new product development activities. This setting offers several strengths. First, auto new product development includes substantial knowledge creation processes. Second, evidence from preliminary fieldwork suggested substantial variation in cross-case choices of knowledge generation mechanisms. Third, the use of a single industry helps control for industry-level factors. Moreover, I expect the results concerning knowledge creation processes in this setting to generalize to other industry settings, such as semi-conductor, telecommunication.

4.1.1. Case selection and data collection

Today, the automotive industry represents a kind of model. It relies on traditional technologies such as assembly lines. Knowledge is produced from the complex joint of equipment, conventions and institutions underlying organizational practices. Furthermore, car

manufacturing embodies a mature sector characterized by consolidated industry recipes (Spender, 1989) and where competition is most strong.

The Chinese auto market is the one with the biggest potential in the global car market. Many world-renowned car manufacturers have entered the market in recent year. The attraction is obvious: Chinese vehicle sales have grown at an annual rate of more than 22% over the last ten years, making China easily the fastest growing market in the world. China's emergence as a global automotive superpower persists in 2005 as continuing strong demand enables it to displace Germany to become the world's third-largest automotive market in 2005, behind the US and Japan. When China's auto industry opened to foreign investors in the early 1980s, its R&D capability in the passenger vehicle sector was weak (Buck *et al.,* 2000). State owned enterprises in this sector initially produced commercial vehicles rather than passenger vehicles. The Chinese government views the auto sector as a pillar industry. Chinese industrial policy places strong emphasis on developing indigenous R&D capabilities in the automotive industry. The Chinese government has prevented the takeover of its domestic industry by foreign players by allowing them a maximum 50% stake in a Sino joint venture. In addition, the government provides financial and taxation support for joint R&D projects between foreign and local car manufacturers.

The Chinese car market, unlike the commercial vehicle market, which remains under the control of the domestic 'big three', First Automobile Works (FAW), SAIC and Dongfeng Motor Corporation, has been dominated by foreign-led joint ventures. Global giants VW, GM and PSA Peugeot-Citroën have dominated through the establishment of 50:50 joint ventures with local partners. However, as Chinese auto manufacturers are becoming more technically advanced, the Chinese government has sought to establish local auto manufacturers to challenge foreign domination of the local market. For example, the local independent carmakers Chery[9] and the Geely Group[10] are coming into direct competition with joint

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[9] Chery, controlled by the local government of Wuhu in East China's Anhui Province, started to produce own brand cars in 1999. Accumulated sales of the firm have exceeded 300,000 units so far. Its product lines include Chery Qiyun, Fenyun and Oriental Sun sedans, QQ mini cars and Tiggo sport utility vehicles (SUVs).

[10] Private carmaker Geely, founded by a local entrepreneur, Li Shufu. The company, based in East China's Zhejiang Province, has sold more than 300,000 cars since it began to make own-brand cars in 1998. The company now produces Geely Haoqing, Merrie, Ulion and Beauty Leopard, and Maple.

venture automotive giants Shanghai-VW and Shanghai-GM. Both Chery and Geely, which have not tied up with foreign auto giants, have been successful in building independent research and development capability and brands in the low-end car segment. Chery and Geely were China's sixth and seventh largest by sales volume in 2004.

The multiple case study research approach suits my setting. The approach is appropriate for research that poses "how" or "why" questions. This method can be especially revealing for knowledge-based research topics, because of its ability to address the depth and breath of managerial intentions and mechanisms related to knowledge creation and organizational capability (Almeida & Grant, 1998; Leonard-Barton, 1992; Rouse & Daellenbach, 1999). Case selection of this study derived from three principles: (1) choosing cases that help extend theory, rather than provide statistical randomization (Eisenhardt, 1989), (2) obtaining variance in constructs (Yin, 1984), and (3) capitalizing on personal relationships with respondents to ensure interview access and data quality (Inkpen, 1997). These criteria enabled me to discover the origins of knowledge and dynamics of knowledge creation processes at individual, community and organizational level.

Data collection includes two steps. In the first step, following Eisenhardt (1989) about theory building, I focused on finding as many categories as possible by collecting and analyzing data on Chinese automotive industries. I collected data by examining secondary sources such as existing studies, books, newspaper articles, industry and company news, company website and publications. I also did a lot of interviews, talking to academic people who are familiar with the questions I was trying to address. In this process I became more familiar with the firms and their industrial contexts. The second step is more systematic data collection in four Chinese auto firms. In this step, interview is the key method used to collect data, although the collection of secondary data also continued. I used five different collection methods: trade journals, company archival records, interviews, direct observation, and a short questionnaire (Yin, 1984). Before visiting the companies for the purpose of making observations and conducting interviews, I analyzed each company using annual reports, company-supplied archival data, and secondary sources of information such as trade journals.

Table 4.1. summarizes the methods of data collection.

Table 4.1. Methods and Respondent Background

Cases	Case A. PATAC research center/Individual level	Case B. Shanghai SVW clubs/Communities	Case C. Chery auto Ltd. /State owned enterprise	Case D. Geely auto Ltd./ Private enterprise
Interviews	2 car designers 1 project manager 1 center director assistant	2 training managers 2 corporate trainers 1 R&D manager	1 R&D manager 1 training manager 1 project manager	1 project manager 1 human resource manager
Length of interviews	1-2 hours	1-3 hours	1-2 hours	1-2 hours
Time of interviews	Dec. 2002 - March 2003; July 2004 - Sept.2004	Dec. 2002 - March 2003; July 2004 - Sept.2004	Dec. 2004- Feb. 2005; Dec. 2005- Jan. 2006	Dec. 2004- Feb. 2005; Dec. 2005- Jan. 2006
Observation time	Two months	Three month	One month	One month
Total interviews	4 interviews	5 interviews	3 interviews	2 interviews

I conducted interviews in two phases. During the first phase, in Winter 2002, I conducted a field study involving open-ended interviews with six respondents from four companies operating the Chinese auto industry. The purpose of this phase was to understand the context, as well as develop on initial framing for constructs and relationships. The second phase was an in-depth case study at these four companies. In Summer 2004 and Winter 2005, focusing more explicitly on the new product development processes. I used multiple data collection methods, including face-to-face interviews, field observations, telephone interviews, and secondary sources of information about the company and their R&D projects. At each site, I interviewed multiple respondents ranging from car designers/engineers to senior managers to allow multiple perspectives on the new product development. I administered semi-open questions with 14 respondents from the four companies. Each interview section, which took place in Mandarin, lasted from one to three hours. I verified the case write-ups with the respondents and asked for clarifications by telephone.

Each of the four companies had multiple R&D capability involving collective and non-collective knowledge, and applied various new product development processes. Among the companies, one is R&D joint venture (PATAC) between GM and SAIC, one is OEM joint

venture (Shanghai-Volkswagen), and the others are two local car manufacturers (Chery and Geely). Respondents from the recipient community of PATAC indicated that the general focus of firm's R&D is on the conceptual car design by particularly individual actors. Respondents from Shanghai VW engineering clubs focus on the community building and knowledge management systems. Training managers and trainees of Shanghai VW had a deep understanding of their firms' learning needs and results. The respondents from Chery and Geely presented a strong confidence and capability to develop their own new products and brands.

All interviewed partners either received in advance written information about the purpose of the study, or, where not feasible, were given brief descriptions at the beginning of the interview. The interview started with a list of questions that came from the first step of data collection. The interview partners were also assured that all information would be treated anonymously and confidentially. As the interviews progressed, more specific questions were asked. The interviewees did not always answer the questions in the order I asked. In that case, I would make sure that all questions I want to collect data were covered whenever possible. When new themes emerged in the process of interview, I would add new questions to the following interviews, and also came back to the people I had interviewed to have them answer the new questions whenever it was possible. During the interviews, I took intensive notes, because most of the interviewees preferred not to have the interviews taped. The interview questions were used as a means of guiding the interviews, however, I allowed the interviewees to discuss at length. I interviewed the presenters until I believed that I had reached a point of saturation or redundancy.

I paid particular attention to the following aspects of the interviews: (1) how respondents described details of new product development activities they engaged in, (2) what knowledge management strategies they perceived as effective or ineffective, (3) what benefits of knowledge management strategies the respondents deemed effective, (4) how respondents compared various knowledge management practices, and (5) the sequence of knowledge creation processes involved in R&D development that the respondents described, along with the rationale behind the sequence. The analysis generated a practice-based knowledge spiral. I developed six propositions based on these inductive findings.

4.1.2. Data analysis

I analyzed the data by first building individual case studies. I then compared across cases, both within and across companies, constructing a conceptual framework (Eisenhardt, 1989). Following early indications that more accurate and detailed information could be collected if interviews were not taped, notes were taken and edited as early as possible after interviews. Fieldwork began with unstructured interviews to identify key issues and events within the study. In keeping with the principles of a grounded theory case study, I had to step back from the data sometimes, maintain an attitude of skepticism and follow research procedures. I had to minimize my own bias to help inform me as to what the data showed.

The analysis proceeded as follows: First, I entered all responses into a database indexed by company and interview questions. Second, I constructed a single version of interviews for each case. I wrote a case study for individual level, community level, and organizational level knowledge generation by using the interviews and second sources. Once the individual case studies were complete, I used a cross-case analysis, relying on methods suggested by Brown and Eisenhardt (1997), Eisenhardt (1989) to develop conceptual insights. Initially, I compared the cases to identify common processes, enablers, and constraints on each particular case within each company. I created tables to facilitate comparisons, and checked for similarities and differences to develop the emerging constructs and theoretical logic.

4.1.3. Principles and definitions

This study focuses on principles related to three main constructs: at the individual level, at the community level and at the organizational level. Table 4.2. summarizes the principles and definitions classified according to construct. The selected principles are analyzed either because previous literature has indicated that they are relevant for knowledge creation or because interviews and direct observation indicate that they influence the knowledge creation processes. The analysis was developed during and after the study.

Table 4.2. Summary of Principles

Constructs	Principles	Indicators	Definitions
Individual level	Personal background/ identity	Gender, age, current position Origin, nationality	Defines the individual as he/her is.
	Participation in collective/ interface	Actual participation in group or situation	Serves as verification about tendency to collective learning
	Outcome expectations and personal values/ self-interest norms	Intrinsic and extrinsic motivators, individual self-fulfilling	Gives concrete information about individual relational choice and selection
Community/group level	Community identity, existing groups	Nature and location of the communities	Defines the group or communities' prestige and levels
	Community norms, groups rules, regulations	Types of existing incentives Awards systems, intentions	Guides members behaviors, translates rules into action
	Brokers and boundary spanners, translators	Training managers, club leaders, experts, consultants	Gives the interfaces between communities, bridging normative practices
Organizational level	Organizational identity and goals	Brands, independent development capability	Defines the industrial value chain and represents the core competitiveness
	Organizational rules and regulations	Intellectual property rights Training and awards system	Provides guideline for organizational action, resolves the conflicts

4.2. Research Results: Knowledge Spiral and Cross-Case Analysis

This section presents the results of the comparative case study and derives propositions organized by level of analysis. I organize my findings in four major areas: leverage point of knowledge creation, knowledge creation process, access of knowledge collectivity, and knowledge creation across multilevel. Under each major area, I discuss my findings from the individual level to the collective efficacy of communities/groups and organizations. First, I discuss the general features of each case to explore the gateway of knowledge creation. Then I discuss the structural and relational aspects of knowledge creation processes in individuals, communities/groups and organizations. Finally, I consider that these three levels are not separate categories, and I analysis the four case studies at a multilevel perspective.

The framework of knowledge spiral that emerges from the study is depicted in Figure 4.1. , which indicates the propositions that are explained in the later sections.

Figure 4.1. The Practice-Based Knowledge Creation Spiral
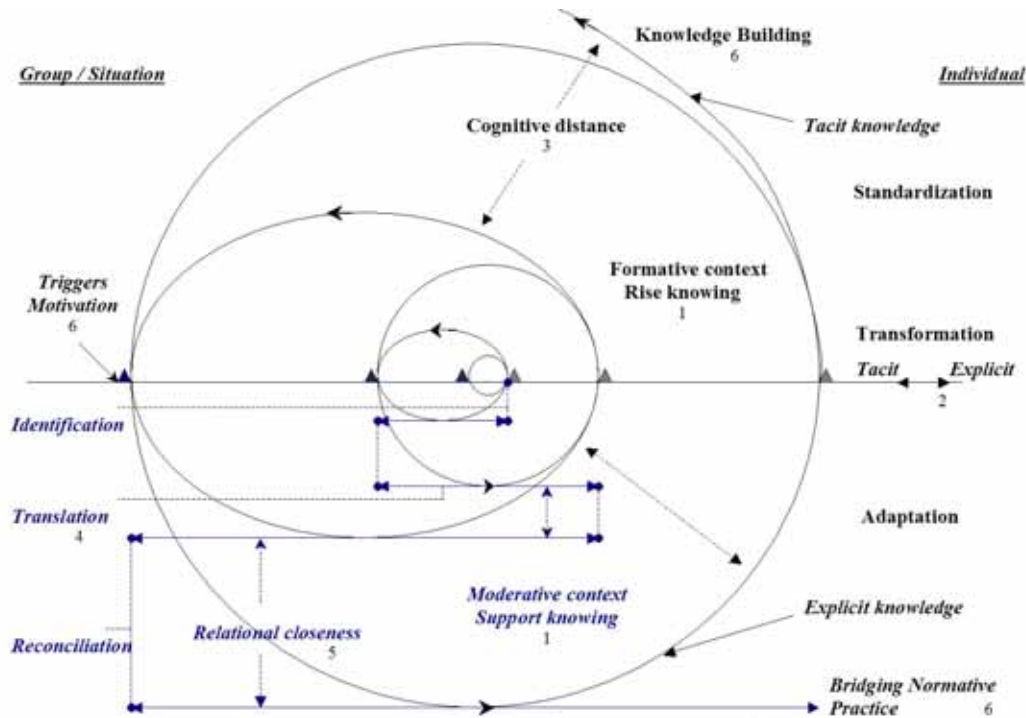
The propositions address practice-based knowledge spiral from the individual level to the collective level in communities/groups and organizations. These propositions are all derived from new product development processes in Chinese automotive industry. I deem the choice of industry context might influence my findings, and I do not believe these propositions apply only to the automotive industry. Thus, in the next chapter, I will investigate whether these propositions or part of the propositions could be applied to other settings, such as the semi-conductor and telecommunication industries. Table 4.3. summarizes the propositions that I develop from the discussions.

Table 4.3. Propositions and Case Summary

Major areas	Proposition	Influence on knowledge creation	Cases with consistent patterns
Leverage point of knowledge creation	1	To cope with knowledge creation processes, there are two interrelated generative mechanisms to deepen knowledge generation: 1) formative context: raises knowing; 2) Moderative context: supports knowing.	All four cases reported relevant examples
Process of knowledge creation	2	The processes of knowledge creation involves three movements: 1) standardization: observe, select and choice to verify the interface; 2) transformation: allow the inner knowing to emerge and experiences are transformed; 3) adaption: create new routines and convert experience into action.	All four cases reported relevant examples
	3	Matchmaking, modularity, and process network can create the place and keep rhythms of the movement of knowledge spiral and cognitive distance provides magnitude and rate of change for generative knowledge building.	Case B, C and D reported relevant examples
Access to knowledge collectivity	4	In order to access the deeper learning and knowledge collectivity, human agency needs to moderate three instruments: 1) identification: open mind, guidance, identify type of experience to support selection; 2) translation: translate rule into action, resolving conflicts and accelerate knowing 3) reconciliation: evaluate procedures and facilitate imitation.	All four cases reported relevant examples
	5	Social norms, trust, and relational network serve to keep stability of collective learning; to legitimate coordination and encourage creativity and relational closeness supports judgment in bridging normative practice.	Case B, C and D reported relevant examples
Knowledge creation across multilevel	6	Knowledge governance means shifting knowledge spiral at multiple levels: from individual (micro) /group/communities to the institutional (macro)/global system level.	All four cases reported relevant examples

4.2.1. Leverage point of knowledge creation

As I discussed in Chapter 3., the cyclic nature of knowledge creation can result in a formative context (increasing knowing and practice) and moderative context (supporting knowing and bridging practice). The respondents in my study found that the spiral nature of knowledge creation processes at individual, groups/communities and organizational level was meaningful. There is indirect evidence that practice-based knowledge spiral can occur at the individual, communities or group and organizational levels of analysis. Among the firms I studied, the field data identified two types of overlap knowledge contexts (formative and

moderative) among individual, group or communities and organizational knowledge creation. In addition, moderative context is kind of invisible territory that is the most important in creating the conditions for knowledge creation at individual, groups/ communities and organizational level. All of the four firms I studied helped demonstrate where the leverage point is in the knowledge spiral. The discussions led me to refine the definition and provide an understanding of the relation between knowledge and knowing.

<u>Conceptual vehicle design at PATAC</u>

The Pan Asia Technical Automotive Center (PATAC) is a $50 million, 50:50 joint venture between General Motors and Shanghai Automotive Industry Corporation Group (SAIC). Situated in the Pudong New Area of Shanghai, PATAC opened in 1997 as China's first joint venture vehicle engineering house. PATAC offers a range of automotive design, engineering and testing services. A crucial part of this case study was identifying whether the individuals from different design projects differ in their perceived self-fulfilling, motivators, including values, and obstacles. This step allowed me to distinguish whether differences between the new product design projects are due to the personal constructions of the individuals involved. For example, through the collective learning among GM's experts and Chinese engineers, the first Chinese concept car- *Qinlin* was designed by Chinese engineers and designers in 1999. Later, China's first fuel cell concept vehicle- *Phoenix* was developed based on GM technology platform in 2001. In April 2003, the second concept vehicle- *Kunpeng* totally developed by Chinese designers, the *Kunpeng* CAV (compact activity vehicle) concept vehicle takes Chinese vehicle design to a new level. PATAC also has strongly supported Shanghai GM's development of products such as the *Buick Regal, Excelle and Sail* families.

I treat these design projects as social cognitive learning processes. Cognitions reside in the individual engineers and designers, but there are certain cognitions that group members have which are quite different and distinguishable from the beliefs they experience as individuals in isolation. The interviews confirmed that those that are closely related to the constitutive element of the individual's values and beliefs are mainly related to external factors in the surrounding environment. *Kunpeng* CAV design of PATAC could be a good example. At the individual level, individualistic design seems to result from a social cognitive process of individual construction, mostly based on values, self-interest, motivators and other

psychosocial attributes. The personal background seems also to be relevant as a determining factor of knowledge creation processes. At the collective level, individual self-interest and motivation shape interaction and construct meanings among group members. In other words, individuals interact with others to test and confirm their own perceptions of themselves and their surroundings. Importantly, this study produced evidence that individual self-interest and motivation are strongly correlated with professional goals.

<u>Knowledge architecture of Shanghai VW</u>

Shanghai Volkswagen Automotive Co., Ltd. (hereinafter called SVW) has been a Sino-German 50:50 car-making joint venture since 1985. Currently SVW has four major production areas including Car Plant 1, Car Plant 2, Car Plant 3 and Engine Plant plus a technical center with a prototype making & testing base and a proving ground. So far, SVW has taken the lead in the Chinese car-making industry in the past 20 years. Facing the competitive and more complicated auto competition in Chinese market, SVW places high importance and funding in technology development and research, introducing the advanced production control system to intercommunicate better within the firm and with the major suppliers. Along with the technology investment, SVW strived to foster a strong force of independent development capability. It remains a challenge for Chinese enterprises to develop a competitive R&D capability, and build up core technologies of their own. SVW started to expand its technical center in July 1997. Following the expansion, the technical center now consists of a testing ground and a prototype making and testing base, which has already been put into operation.

SVW boasts the largest platform in Asia for car styling, acoustic lab, analogue environment room, emission analysis lab, road analogue test stand, electromagnetic compatibility lab, bench-impact test room, etc. CAD technology has been widely applied to the design of the bodywork, chassis, engine, electric & electronic parts, styling, ergonomic analysis, etc. Further, SAIC and VW AG jointly invested in an engine plant in Shanghai in September 2003. The plant will produce the world advanced EA111 engine in its initial stage, which will be installed in the SVW-made Polo. Being a globally advanced environmentally friendly product, it is the only engine that will be made in China for compact cars that can satisfy the EU IV emission standard. While upgrading the hardware, SVW attaches great importance to the training of the vehicle development team. Currently SVW has a

development team of nearly 800 people, the strongest in the car-making industry of the country. The development team received training in VW AG in the entire process of vehicle development, and are now the backbone of SVW's product development.

Nowadays, knowledge management is becoming an important part in the SVW's operational strategy. SVW denoted in 2002 annual report that *'for an enterprise to make continuous success, it is imperative to accumulate and pool intellectual resources, and turn the shared knowledge and innovations into the company's competitive edge.'* For this purpose SVW built up knowledge management architectures/platforms for all employees to share both their dominant and recessive knowledge and turn it into a new productive force and competitive power.

In addressing the recommended two contexts of knowledge creation, I present this case study in two parts. First, I discuss the hard and soft architectures of knowledge in SVW, Such as the rules based idea management platform, yellow book of experts/data bank of best practice and intra-net seminar, norm-based five clubs. These infrastructures provide a good evidence of the formative context of knowledge creation processes. Through the "idea management" concept can improve the flow of rationalization proposals, and stimulate all SVW employees to evolve highly in creativity, maintaining an intensive innovation process. Furthermore, the use of computers and information technologies as media to create and sustain collaborative networks in knowledge creation also appeared as a significant factor in collaboration at the individual and organizational levels. At the communities' level, an important part of the role of brokers leads to the emergence of a community structure and boundary spanners in linking firms and communities. Second, the interviews confirmed that the main motivators for members in communities/groups are the nature of the task at hand, the degree of closure with others, and the level of trust among individuals. Interestingly, at the communities/groups' level, an important driving force is the existing incentive framework which promotes and reinforces individualistic behavior rather than collaboration.

Independent R&D development in Chery and Geely

Chery Automobile Co., Ltd. was founded in 1997 in Wuhu China. Despite its humble beginning, Chery has achieved many breakthroughs and become the fastest growing independent automaker in China. Chery is committed to developing world-class automobiles

via cooperation with top engineering firms such as Lotus engineering of the UK, and Mitsubishi automotive Engineering of Japan, and leading auto designing firms such as Bertone and Pininfarina of Italy. In its relentless pursuit of quality, Chery adopted DURR Paint Systems in its paint shop in 2004. As a groundbreaking event for Chinese automotive industry, Chery started producing China's first high-performance Euro IV engines in cooperation with AVL list of Austria. With an ambition to become a global player, Chery so far launched its products in 29 countries. For the time being, Chery is developing a new line-up of products aiming at auto markets in the US and EU.

The Geely Holding Group was founded in 1986 in Zhejiang China. It is a large business group mainly engaged in the production and sales of automobile and its components. Geely entered the automobile-manufacturing field in 1996, it has rapidly grown into a key brand for the economical car in China through its flexible operation mechanism and continuous concept innovation. The company now has four major manufacturing bases in Linhai, Ningbo, Taizhou and Shanghai. Zhejiang Geely Holding Co., Ltd. now has nearly 8000 staff members, having recruited and trained large groups of specialists and excellent technical talents from home and abroad, having the competence of complete vehicle, engine, gear box, tooling design, and factory design, plan and manufacture. Geely has established several major development centers including Geely Automobile Research Institute, Geely Engine Research Institute, Geely Gear Box Research Institute, and Geely Motorcycle Institute. Geely introduces 2-3 new car styles every year on the Chinese automotive market. In addition, the company takes the lead among the Chinese car producers for self-independent development and production of the four-cylinder electric spray engine.

The interviews of both companies confirmed that Chinese auto makers are required to develop more independently-created technologies or products instead of completely imitating or importing technologies from foreign auto manufacturers. It is critical to nurture innovation capabilities and develop core technologies. The Chery Automobile Co Ltd, for example, has gained a large market share thanks to its self-developed technologies and products. However, innovation does not exclude co-operating with foreign companies. On the contrary, domestic automakers can draw advanced experience from foreign counterparts, so as to improve themselves by upgrading their technologies.

An important feature of the automobile industry in China is that some firms rely on technology transfer from their foreign joint venture partners. For example, SAIC acquires its product technologies from its joint venture partners-Volkswagen (VW) and General Motors (GM). While some firms chose to control the product development process by themselves, and have the final decision in the outsourcing process. Chery and Geely are typical examples that have the capabilities to develop their own products. However, the empirical data indicates that although SAIC is the largest car producer in China and has two foreign joint ventures, it has no domestically developed cars. Most foreign auto companies in joint ventures are purely profit-motivated, and did not substantially contribute to improving Chinese vehicle technological capabilities because litter knowledge was transferred along with the product. Chinese firms have acquired good manufacturing and also acquired some product adaptation capabilities. Parts suppliers appear to have more advanced capabilities due to local content requirements. Foreign firms view their counterparts in China as manufacturing partners, not potential sources of innovation (Gallagher 2006).

On the contrary, although Chery is a new company and had no experience in car design, it was able to produce its first car in December 1999. Similarly, Geely developed their first car in 1998. Chery designed its first cars by imitating the platform of the *Jetta* cars made by the First Automobile Works (FAW), which bought the technology from VW. Geely designed its first car by imitating the body and platform of the *xiali* cars made by Tianjin Xiali, which licensed the technology from Toyota. It is worth mentioning that both firms are independent enterprises. They have all the autonomy to develop their own new products. They have the freedom to set up their own formative innovation infrastructures to allocate the resources more quickly. Accordingly, from a moderative point of view, these firms can develop a car independently and also attract some highly local talented car designers and engineers to join the new product development. Furthermore, learning and joint development with advanced international partners can help them to accumulate knowledge and skills.

As I noted above, the fieldwork and case studies provided a further implication concerning the formative and moderative contexts in knowledge creation processes. The main determinants of leverage point in the knowledge spiral within the following categories: value, self-interest, degree of trust and motivation. My argument is that the formative knowledge context can help us to generate new knowledge in the new ways and set a path for knowledge creation. The moderative context can help us to bridge practice and support the interaction

between knowledge and knowing to generate new knowledge at individual, communities, and organizational level. These two overlapping knowledge contexts are the essential elements of the knowledge spiral and the coherence of interaction between two contexts defines a knowledge spiral.

The following proposition highlights aspects of generative mechanisms to deepen knowledge generation.

Proposition 1: To cope with knowledge creation processes, there are two interrelated generative mechanisms to deepen knowledge generation: 1) formative context: raises knowing; 2) normative context: supports knowing.

4.2.2. Knowledge creation processes

The key insight that has emerged from my explorations and investigations is that there are three fundamentally different configurations of knowledge creation processes that manifest three levels of standardization, transformation and adaptation. The three levels differ in the knowledge spiral from which attention/intention originates. Every level by individual, community, and organization can be enacted in three ways, from different place within knowledge spiral. Let us first take the example of the conceptual car design in PATAC to demonstrate knowledge creation processes at individual level.

The creation of "Qinlin" conceptual car is a milestone in the Chinese automotive design history. It was the first time that the Chinese automotive designers went through the whole design process from "market survey to concept vehicle build" based on the international standard. Chinese engineers and designers fully improved their capabilities on the design, development and built of concept car through learning and teaching with foreign engineers and experts. Based on the GL8 business vehicle architecture, "Phoenix" fuel cell vehicle used fuel cells provided by GM and integrated by PATAC. Scientists and engineers from GM also provided some assemblies and technical support. The design concept of "Phoenix" is demonstrated by an image of a bird of wonder. The second design of the Kunpeng CAV was created with the aim of transforming the outdated look of minivans in China and bringing it up to global design and styling standards. The design concept of "Kunpeng" is demonstrated by the image of a swimming fish with its lilac body, just like the

fish scale, shinning under the water. The design of "Kunpeng", including the fish-like body styling, fisheye-like lamps and fin-like handles realistically embodies the features of a fish in terms of its streamlined body with low resistance, simplicity and flexibility.

The designer integrates the traditional Chinese culture into the design. The Kunpeng CAV takes its name from the legendary Chinese animal that transformed itself from a gigantic fish into an enormous bird. The chief designer of Kunpeng finds his inspiration in nature and history. As for the new product design processes, it is important to construct idea/meaning at the beginning. Through the careful Chinese market survey, the chief designer found that the mini vehicle has a potential for development on the Chinese domestic market. The designer also believed that Chinese people advocate nature. Thus, the designer generated the original idea- "fish" which is based on the study of traditional Chinese literature. Referring to the traditional concept of Chinese people such as "fish" which is capable of jumping high enough to get across the dragon shaped gate and the surplus remains year by year. In order to solve the problem of the twining of the fish movement into car design, the designer often watched the fish swimming near the pool to observe its movements and talked with zookeepers to confirm the habit of fish swimming. In this sense, listening and observing are important for stimulating the new idea. The desginer asked questions and carefully observed the responses that nature/data gave to him. Through this process the chief designer formed the standard of his own mental cognitive organization. Then, the designer used CAD tools to help him with new car design processes. The application of CAD tools in the car design process also helps with the fast development of "tacit knowledge", which is of critical importance in the new product development. The Kunpeng CAV combines the aerodynamics of a bird in flight with the simple yet breathtaking styling reminiscent of a fish in motion.

The recent new conceptual design of ALA.s, represents the first digitally designed vehicle developed by GM's unique automotive engineering and design joint venture with SAIC. It is completely developed by PATAC in China by local engineers and designers. Like its predecessors, the Kunpeng, Phoenix and Qilin, the ALA.s is an innovative and modern vehicle with design cues taken from traditional Chinese culture. PATAC engineers combined East with West in the ALA.s through the adoption of traditional Chinese elements. Its exterior boasts the free-flowing and chic profile of a modern car while its interior fully reflects the gentleness and elegance of Chinese culture. The interior design also carries on the traditional Chinese theme. One of the most notable features is its side dashboard, which is in the shape of

a *ruyi*, a symbol of good fortune in old China. In addition to having a beautiful shape, the *ruyi* dashboard embodies the wish for a safe journey. Unlike a traditional vehicle design, which starts from a physical model, the ALA.s began with a digital model, in essence reversing the development process. This represents the first time PATAC used digital technology to design a vehicle.

At the individual level analysis, I find that individuals try to identify/confirm what they already know and pay attention to confirm/disconfirm the data. During the interaction, they attend to ideas about reality rather than denying them. When individuals are engaged in real conversation, their perception shifts from their own mental model into action. In this transformation level, individual selection and judgments lead to evaluation of meaning constructs. As Weick and Roberts (1993: 358) argued, through social interaction people *"often discover higher-order themes, generalizations, and ideas"* that transcend any differentiated parts. At the adaptation level, individuals connect to their knowledge source - experience and no longer to change meanings. As processing becomes automatic, the knowledge spiral becomes stable, routines are established very quickly to integrate new knowledge.

At the individual level of knowledge creation processes, individuals interact with others to test and confirm their own perceptions and the social effects on individual self-efficacy judgments by including both a social influence process and a social comparison process (Bandura, 1982). Just as individuals compare and discuss individual performance, they also compare and discuss group and organizational performances. In this sense, I argue that the knowledge spiral should occur at group/community and organizational levels, and these configurations- standardization, transformation and adaptation should lead to a consensual version of collective efficacy. The connection between the individual and the social can be understood as mutual influence and collective building.

The three configurations can be thought of as a prerequisite infrastructure for changing a movement of generative dance at the communities level. The central proposal is that human interaction is essentially a process in which people account to each other, negotiate with each other, in a collaborative process in order to "go on" together. In doing so, they express that their individual and collective identities are important aspects in the human joint actions. When group's members engage in more durable relations, they may form new kinds of

overlapping communities, which present a dominant model of learning and collective behavior. These communities are collective structures with shared, highly decentralized communication patterns.

Within these communities, people share and exchange useful, new and sufficiently comprehensible knowledge, and respect each other to make an effort in collaboration, and make the required attempt to achieve mutual understanding. People contribute and absorb tacit knowledge resulting form specific investments in matching common sense. Furthermore, people may create new knowledge containing tacit and explicit elements, and these may be brought into contacts through various interaction processes of which some require overlapping activities and close interaction. In this regard, interaction is needed to develop shared cognition, norms, identity, as well as shared common goals.

The respondents of SVW demonstrate a hard architecture of knowledge. Such knowledge infrastructure is designed to facilitate the positive interactions between creating and using knowledge throughout the company. Around that foundation, knowledge brokers/training managers designed a hard architecture of knowledge, including forward-looking personnel development programs, made a "Yellow Book of Experts" (YBE), and created a data bank of experts, a Bank of Best Practice (BBP), an intra-net seminar, and "Idea Management" concept.

SVW has initiated the "forward-looking" talent development plan, according to which SVW's elite has been sent to German Volkswagen to assume important positions. So far, 4 people have been sent to German Volkswagen as exchange professionals, while German Volkswagen also exchange its backup human resources with Shanghai Volkswagen. Such a talent-training plan has accumulated abundant "energy" for the development of Shanghai Volkswagen in the future. Now SVW boasts well-trained teams of employees good at technological, managerial and commercial affairs, which is a kind of precious wealth for SVW s constant advancement.

Furthermore, it is important to consider a different level of analysis, that of SVW's own ability to acquire and apply knowledge. In this case study, the absorptive capacity is linked to the SVW's ability to learn and utilize new knowledge. The absorptive capacity is defined as '*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). Knowing how to implement and sustain mechanisms for knowledge creation and application is essential in the SVW's organization and system division. This requires an understanding of the needed knowledge, skills and abilities at every phase of what is sometimes termed a value stream in SVW's various departments.

In practice, SVW has adopted the "Idea Management" concept through established advice panel system to improve the flow of rationalization proposals since 2002, in order to compete in the VW's new issues of 'Ranking of Rationalization Proposals'. As a result all SVW employees can participate and log on advice panel platform to contribute their new ideas and advices related to various aspects of SVW. As we noted, relying only on information technology could not create a creative environment, which promotes knowledge use and sharing. In this sense, management group of organization and system division developed a new kind of network of intermediaries and facilitators in each department to promote ideas sharing and choose the best ideas/advice to compete in the advice panel ranking. The facilitators play a pivotal role in communication and coordination for the efficient transmission of SVW's policy and issue to each employee, stimulating the potential and the creative performance in their department. The facilitators establish good interpersonal relationships amongst individuals and also between management groups and other departments. The facilitators identify the demographic characteristics, the specific identity and the value from various subgroups and stimulate their creativity towards building shared group identity. In this way, creativity is the central value.

Through the direct face-to-face interaction and the indirect advice panel platform mediated communication, the facilitators collect the good ideas/advices and transmit them to the pool of evaluation system, which include staff of expertise and experience who select and interpret these ideas/advices. SVW's experts and knowledge engineers integrate the collected subjective data and create a BBP, which makes the new knowledge accessible to the whole organization just in time, when it is required by managers or individuals to enhance their work. Interestingly, most of the facilitators play the dual roles in the advice panel system. When the management group established the boundary spanners network initially, they negotiated with managers of departments and nominated some of them to be facilitators. In this case, the voluntary boundary spanners not only engage in coordinating the patterns of group creative behavior but also undertake the responsibility to select the best ideas and

translate them directly into the practice within their department if the ideas/advices target on the emergent inner problems. More efforts to manage value stream effectively are built YBE and intranet seminar helping the flow of new knowledge and providing a place/platform for storytelling, learning and solving the problems amongst managers and individuals.

Given the emerging debate on the just-in-time knowledge flows approach, the basic problem is the difficulty of using artefacts to develop expert systems. It is costly to transform expert skills into information that can be used by others. Another potential problem is that people are not always rational, and that the experts may not automatically share all their knowledge on request. The hard architecture of knowledge is intended to free stewards from the routines, system-development aspects of knowledge capture and enable them to concentrate on developing a fictional space of discourse/narrative database, which allows ideas to be tested and evaluated before they are implemented. Boundary spanners, including facilitators, mobile interfaces/advice panel platform interfaces, and intranet seminar interfaces, can bridge the division of labor and division of knowledge which is very much an overlapping social process involving exchange of new knowledge and personal experiences, and support of knowledge creation and knowledge sharing across organizational boundaries. However, using technology as a supporting tool to build hard architecture of knowledge is costly. In this case, the management group of organization and system division tends to build another alternative architecture of knowledge, which is the tendency to form and cultivate naturally occurring communities, where working practices and trust are already developed.

In the context of SVW's soft architecture of knowledge, local communities are small size groups of people with the characteristic of face-to-face meeting regularly. Due to the characteristics of diversity and situated interaction of autonomous communities, making matchmaking patterns of coordination and communication between various communities is crucial within soft architecture of knowledge. SVW formed five clubs that were designed to bring the employees from different departments/product platforms together to share knowledge again. In the same period, SVW established an "Innovation Forum" (IF), which is a community-initiated forum of individuals, five clubs, company executives, middle level managers, experts and other practitioners.

Five clubs are organized by a group of secretaries, as an important part of IF, which maintain deep expertise in specific areas across product platforms and various departments,

such as new product and technology development, supply chain management, new market development, corporate culture and environment protection. Members of clubs meet regularly to discuss questions in the specific topics that are proposed by club mentors. At the very beginning, the management group of organization and system division appointed a group of secretaries by chairs of IF's committees (committee members were elected or appointed from different functional areas of SVW during the IF preparatory conference), the group of secretaries intends to use social network analysis/*Guan Xi* relationship ties to identify naturally occurring communities in the specific practices. When a naturally occurring community is hard to identify, they use the media to distribute their invitation to call for participants and see who swarms. In this case, community membership is open and members of the community are volunteers who are involved in the specific club according to his/her personal interests.

Once communities of practice/clubs are established, club mentors were selected by all community's members and played the role of intermediary between the group of secretaries and the different communities of practices. Club mentors organize regularly a seminar in analyzing variations in practice, set standards, new technological proposals, and market trends, and recommend actual core synergy for efficient performance in workplaces. Members who participate in the clubs are responsible for developing and maintaining a BBP, a database that captures technical know-how and best practices. The BBP is hosted on the company intranet, so that all employees are able to access the knowledge stored there. Within clubs where all members know each other, and face-to-face interaction as a generative matrix for moral action-building trust, a club norm typically formed very early. Members of the club must find their way together via a sense making/storming process of understanding each other and their topics/tasks. Club norms need not be explicit at all in order to be operative, normally members take the informal rules for granted and apply them automatically. Thus, club norms are something members apply in their practice and regulate communication processes within and between clubs. For instance, the way of generating of specific topics of each seminar not only result from the meeting with the group of secretaries, but also club members contribute, and during the seminar, mentors also welcome other club's participants, in order to stimulate creativity and enrich the diversity of the knowledge base. Best practices are identified, refined and entered into BBP before knowledge is entered into the BBP, the ideas are first evaluated by the club closest to that area, the club mentor makes a summary and it is reviewed for accuracy, completeness, and relevancy before it is submitted. These clubs are embedded in

the formal product platform and functional divisions and much of their work is done on a voluntary basis.

Within the communities of practices/five clubs, matchmaking support is not a major issue and communication can be handled with direct face-to-face interaction or existing media. While communities of practice are focused on exploitation, they may break out into exploration. If epistemic communities are focused on exploration, they may consolidate into exploitation (Nooteboom, 2002). In order to achieve this shift, matchmaking support is critical. Knowledge brokers and boundary spanners, including the group of secretaries and club mentors, can help club members to generate research a proposal and transmit it to the evaluation task force on the one hand, and arrange necessary resources and match the appropriateness with specific expertise towards a joint research project between communities and various departments on the other hand. In this sense, knowledge brokers intend to open up to a more diverse, flexible existing architecture for knowledge creation and building trust.

In the mainstream of thinking on organizational knowledge production, it is usually individuals who learn and creation knowledge and the principal concern is how individuals learning and knowledge might be shared across an organization. New products development and processes embody innovations in value within a firm, resulting in higher quality products at lower units cost, given prevailing factor prices. Groups of people with diverse specialized knowledge engage in cooperative interaction and communication between each other to develop new products, with the characteristics of cumulative, collective and uncertain, that can be involved in the innovation process. However, creating a new product from scratch can be quite challenging. People tend to either underestimate or overestimate the amount of lobbying, research, designing, planning, time and cost of new product development (Lazonick, 2002). Further, in order for a product to be valuable, it must address the particular needs or desires of the customer, it must perform adequately along these particular dimensions, and it must do so reliably and at low cost.

At the organizational level, the data show that one of the key factors contributing to the Chery and Geely's fast growth is the low price of their product. Chery and Geely usually have limited product design capabilities and started their product design by imitating existing products. They have a lower cost in developing a product. As mentioned earlier, Chery started to develop its first product by imitating existing products. Geely also started to develop its

first product by imitating existing products. Both companies have been very successful. However, they adopt different new product development processes. Geely designed its first cars by imitating the body and platform of the Xiali cars made by Tianjin Xiali. Since the weak of design capabilities, the first conceptual car is handmade product. Therefore, its blueprint was generated by engineers and designers late sever years after production. On the contrary, Chery adopt more standardized new product development approach. Chery designed its first cars by imitating the platform of the Jetta cars, and worked with a firm in Taiwan to develop their first concept car. Furthermore, since Chery and Geely as late comers, partially learned from the experience of the "big three", they have chosen to invest step by step in the new product development, partially constrained by their limited financial resources.

The traditional innovation process is centralized in one function department of organizations. But innovations can take place everywhere in the organization, not only in the research and development division. Good ideas and new knowledge for new products of further development of services can come from different sources like other employees, customers, and even competitors. The essence of empirical research shows that Chery and Geely are very flexible to involve internal and external resources to integrate a decentralized innovation process. For example, Chery even hired a production manager from Japan to help with shop floor management. Geely also improved its production management by hiring professionals to take charge of manufacturing. In addition, organizational autonomy also made it possible for Chery and Geely to hire engineers to develop their own cars. In fact, the key designers and engineers of Chery are former employees of SAW. These engineers left SAW because SAW was not interested in developing its own cars. Both companies use new technology development tools to help with product development and product upgrading, and the result is that the development cycle is shortened sharply. More importantly, disintegration of the value chain of the automobile industry helps Chery and Geely to develop product technology through technology integration. For example, although Chery has no strong expertise in engine design, it is able to ask AVL Austria to design 16 engines for it, ranging from 0.8 L to 4.2 L. Similarly, Geely is working with firms in South Korea, Italy, and Germany on car development, especially to learn from them to accumulate experience and skills.

This case study shows that there are a many opportunities for the local firms to develop core technologies and innovation capabilities. Among these opportunities, the role of

imitation, the disintegration of the value chain of the automobile industry, and the use of new technology development tools are of special importance. In addition, modularity as a production strategy has been used in the automotive manufacturing and in the supply chain. Modular innovation means that innovation takes place through change in the modules (Langlois & Robertson, 1992; Sanchez & Mahoney, 1996). Sako (2002: 15) argues that the notion of product architecture causes organization architecture not to be so deterministic in automotive industry. *'Product modularization may be considered to go together with outsourcing, if not straightaway but ultimately, because open and well-defined interfaces lower barriers to entry'*. However, at the moment, the term 'modularity' itself is still somewhat ambiguous in the Chinese automotive industry.

Knowledge creation in spiral thinking is described by distinguishing between the individual level and the social level. On the basis of the above discussion, I propose that the large majority of knowledge creation processes take place in groups/communities that share a common understanding to ensure stability of meaning. When people are new to a job, communities or an organization, they are more open to disconfirming information and feedback. In this sense, the possibility of interrupting a knowledge spiral when a task is novel is also highest.

In the previous sections I discussed the influence of different configurations on knowledge creation dynamics at individual, communities/groups, and organizational level. I find that individuals interact with others to test and confirm their own perceptions and this process starts with the recognition by the individual or groups that the experiences of others may be helpful in the setting a joint agenda and generating new knowledge. I also find that knowledge spiral can apply at group/community and organizational level, and that configurations- standardization, transformation and adaptation should lead to a consensual version of collective efficacy.

I conclude this subsection with the following proposition, which highlights aspects of knowledge creation.

Proposition 2: The processes of knowledge creation involves three movements: 1) standardization: observe, select and choice to verify the interface; 2) transformation: allow the

inner knowing to emerge and experiences are transformed; 3) adaption: create new routines and convert experience into action.

From the above discussion, it is argued that human cognition is based on mental models constructed in interaction which are also influenced by one's physical and social environment. People share the physical environment, such as social norms to a great extent of mutual understanding and social environment (Nooteboom, 2000). The shared understanding can be reached by communication, which is self-motivated and voluntary.

People in networks have diverse expertise and there exists high task specialization but people are nevertheless able to coordinate their activities with others in order to realize a smooth flow of operations. In my view, within the knowledge spiral, cognitive diversity refers to the number of units with cognitive capabilities, and cognitive distance refers to the 'distance' between them. Within the formative context, I argue that the effect is that of *cognitive distance*. The notion of *cognitive distance*, according to Nooteboom (2000), is defined as *'the terms of overlap of, and mappings between, ranges and domains of perception and cognitive construction'*. Cognitive diversity yields opportunities for knowledge creation, in which the interaction with others is the only path to correct errors. However, the problem is that the greater the cognitive distance, the hard to cross it. In addition, groups/communities with diverse knowledge find it more difficult to learn from each other, if they have too much in common there is no incentive to proceed with exploring new ways. Thus, there is an optimum cognitive distance: large enough for groups/communities to tell each other something new, and small enough for communicability (Nooteboom, 2002). Accordingly, I assume that the magnitude and rate of change of cognitive distance may be an indicator of the strength of intensity of the knowledge spiral. Rates of change of cognitive distance also may fluctuate as spirals accelerate or decelerate without stopping.

The discussions led to the following proposition.

Proposition 3: Matchmaking, modularity, and process network can create the place and keep rhythms of the movement of knowledge spiral and cognitive distance provides magnitude and rate of change for generative knowledge building.

4.2.3. Access knowledge collectivity

The concept of "motivation" plays a central role in research concerned with understanding the determinants of individual behavior in knowledge creation. Motivation can be linked to a set of underlying goals, from whose accomplishment individuals derive a certain level of utility (Deci, 1976). This then creates a motivation to engage in a behavior that is perceived by individuals to be useful for meeting their goals. The motivation to behave in a certain way is determined by: (a) the degree to which the behavior helps individuals to meet their goals; and (b) the relevance of each goal to the individual (individual motivational preferences).

Let us take PATAC, as an example. This study produced evidence that individual perceptions and beliefs are strongly correlated with professional goals. As we discussed in previous section, the first challenge for designing Kunpeng conceptual car is to open the mind. When designer observes the fish and establishes analogical mapping in accessing our real creativity and presence. As the chief designer said, *"Taking from a source of nature and traditional Chinese culture is my initial motivators, also my experience helped me to refine the concept of design."* The chief designer further mentioned that without other colleagues' support he could not finish this design project in a short time. Thus, interaction and communication can help him to meet his goal. In the latter, individual psychosocial attributes also do play a role, but mainly in the way they shape people's reactions and constructions.

Orilikowski (2002) suggests that a sense of common identity as well as appropriate social relations and amounts of common knowledge can be achieved through organizational practices. For Orilikowski, knowing and practice are mutually constituted, as knowing is something that is created and sustained through ongoing practice, and vice versa. At the organizational level, Fiol (2002) proposes a multiphase and multilevel model of identity transformation and tends to explore the dynamic processes of identity generation and renewal between individuals and organizational identities. She highlights the role of rhetoric in marking phases of the process and as a tool for guiding changing identifications. In my view, within the context of knowing communities, I would like to highlight the role of relational closeness in the processes of knowledge creation. The moderative context relates to the tacit, informal dimension of social interpretation and identity transformation, it is governed by social norms that guide people's interaction and communication in action. One of her

contributions to the knowledge creation theory is that she introduces the concept of trust into the identity transformation model. As Kramer and Wei (1999) state, identification is based on trust. Without trust, identification is not possible. Once people trust, identity changes can be seen as violations of that trust. In my view, it is not a trust building and breaking process but norm building and breaking processes within the notion of knowing communities. When new members join the community, leaders must thus renegotiate the formation of norm with other members. Such norm interpretation processes also can be seen as a moderative context. Managers or community leaders should keep the balance of relational closeness in order to build trust and transform identity.

The fundamental part of the knowledge creation processes, common understandings across all levels, is the need to address human motivation issues. The empirical data indicates that at the groups/communities level, the moderative context shows us that different kinds of motivation are important for knowledge creation. For example, the management group of SVW realized that it is critical to provide incentives, which result the need for employees to share their knowledge and to make use of new knowledge in different departments. In order to enhance natural knowledge flows, SVW has implemented a series incentive mechanisms. Concerning the promotion of individuals participating and contributing their ideas, the reward and promotion system at SVW needs to be changed to acknowledge the contributions of people to the rationalization proposal system. This could involve including a knowledge management component to the SVW prize of the best contributors, job promotion of key personnel, ownerships, etc. It also means providing resources to assist people in converting personal or local knowledge bases into sharable resources. About to the utilization of new knowledge in workplaces, an evaluation and new project funding structure should at the heart of SVW's innovation strategies to recognize the value of potential innovative proposals to research and development departments. This is the meaning of developing multifunctional teams in the new product development, including individuals, experts, and mangers from various departments.

As I discussed in previous section, the main motivators for members in groups/communities are the nature of the task at hand, the degree of closeness with others, and the level of trust among individuals. At the communities level, the central challenge is how to motivate people to get involved in the knowing communities. As the director of organization and system division of SVW says, *"changing the beliefs of people and*

acceptance of knowledge sharing and reuse by the individual is more challenge than designing the soft architecture of knowledge". Club members should assist each other free of charge, such beliefs should relate to the norms. In this account, the motivation to contribute knowledge to a pool derives from self-interest. The psychological reward of being evaluated and this process may also lead to reputation effects. As Nooteboom (2002) argues the possibility exists that reputation can have both an extrinsic value in securing a potential for future relations, and intrinsic value in gaining social recognition.

Considering the typical characteristics of more socialized interaction with soft architecture of knowledge, the SVW's management group recognized that employees are more than capable of achieving results beyond hierarchical control. In this sense, the attention of SVW policy makers turns to the issues of developing community-based morality. This orientation has been extended to processes of community building, which composes creation of practical resources for sustaining the process of morality. Once a quarter, the group of secretaries organizes a meeting of the innovation forum, and it is opened to all employees. During the meeting, people exchange ideas and experience, some members of communities are awarded "SVW Mental" to encourage their contribution to the organization, also gave the floor to some community actors to describe their stories of innovation processes, to show others how to create something new within communities. This approach not only stimulates other employees to understand the soft architecture of knowledge, but also provides an opportunity to active communities members to achieve social recognition and reputation. Individuals can derive benefits from building a good reputation as well as by getting a good promotion in key personnel.

The main challenge for the SVW was to make their joint venture successful. There is a need to have a mechanism for communicating the strategic priorities internally, which fit with the overall strategy. As the president of SAIC states *"The key to a successful joint venture is one team walking the same pace"*. SVW promotes that all the Chinese and expatriate employees should work together in sincere cooperation with all the relevant partners, to bring SVW to a higher level morality of *"one team, one mission, one goal and one pace"*. The biggest advantage of SVW is the combination of the two cultures. Through the more than 20 years cooperative work together, SAIC and VW learned from their partners' experience or best practice, and then shared and disseminated the knowledge throughout their organization,

and had greater success. Further, the corporate spirit[11] also plays an important role in today's SVW operations, which rely on passion, efficiency, self-disciple and self-confidence.

Incentives are crucial to the success of socio-cognitive platforms and to changing the culture and people's beliefs from knowledge hoarding to knowledge sharing. At the individual level, individualistic creativity seems to result from a process of individual construction, values, motivators and other psychosocial attributes. At the communities and organizational levels, an important part of the existing incentive framework promotes and reinforces individualistic behavior in the collective learning.

In summary, the main determinants of the moderative context of knowledge creation fall within the following categories: open mind, values, incentives, social norms, trust, motivation, personal background and information technologies-related skills. In addition, the moderative context shows the ability of self-correction and the redefinition of knowledge creation processes within the knowledge spiral.

I conclude this subsection with the following proposition.

Proposition 4: In order to access the deeper learning and knowledge collectivity, human agency needs to moderate three instruments: 1) identification: open mind, guidance, identify type of experience to support selection; 2) translation: translate rule into action, resolving conflicts and accelerate knowing 3) reconciliation: evaluate procedures and facilitate imitation.

Within the formative context, I argue that it is the effect of *cognitive distance*. As discussed in Nooteboom (1992) in order to achieve a specific joint goal, the categories of thought of the people involved must be co-coordinated to some extent. Different people have a greater or lesser 'cognitive distance' between them (Nooteboom 1992, 1999). A large cognitive distance has the merit of novelty, but the problem of incomprehensibility. Managers need to adjust the cognitive distance, to achieve a sufficient alignment of mental categories, to understand each other, and achieve a common goal. Within the context of moderative I argue

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[11] *Passion* that means being proactive and friendly; *Efficiency* that describes making every second count and always seeking for the better; *Self-disciple* that indicates abiding by disciplines, regulations and laws, being self-learning and precise; *Self-confidence* that denotes being perseverant, pioneering and innovative.

that there is a measure of *'relational closeness'*. For instance, deeply motivated people can be a challenge for management because they tend to interpret group or community's purposes in their own way. Deeply motivated individuals are not easy to get along with. Thus, managers or community leaders must balance the relational closeness according to codes and language. Also, the analysis of relational closeness supports measures of cognitive distance. Both of them cannot be separated.

The discussions led to the following proposition.

Proposition 5: Social norms, trust, and relational network serve to keep the stability of collective learning; to legitimate coordination and encourage creativity and measurement of relational closeness supports judgment and selection program in bridging normative practice.

4.2.4. Knowledge creation across multilevel

This subsection compares the individual level of knowledge generation, communities/groups level of learning practice and organizational level of new product development as a whole, each affecting and being affected by the other within the practice-based knowledge spiral. Also this subsection examines the compositional and cross-level effects of knowledge spiral. Individuals are embedded within the context of the groups/communities, and groups/communities are embedded within organizations. When this multi-level knowledge spiral model is developed, it is important to consider explicitly both the compositional effects and the cross-level effects. In doing so, I assume that the individual level contributes to communities or groups level and that groups/communities level contributes to organizational level.

Individual level knowledge generation

The case study analysis suggests that individuals' self-interests are partly a function of their group membership. People define themselves and others through a relational, comparative categorization process. Categories, such as age, race, or group membership, enable the individuals both to segment and order the social environment and to locate themselves within their surrounding. In interviews, the designers and engineers repeatedly pointed towards the national origin or educational background as potential explanatory factors

for differences in collaborations. According to my data, academic background in general is a highly relevant factor influencing communication and interaction between individuals and knowledge creation in new product development projects. For example, in PATAC, Chinese engineers and designers usually work with their Chinese colleagues in conceptual car development. The relationship between Chinese and US engineers is some kind of learning and teaching mechanisms. The Center is actually expected to contribute to the localization of car models from GM rather than developing new cars. Similarly, such a situation might occur at SVW. Although knowing communities contribute many good ideas and suggestions to R&D center, the problem is that the foreign partners are not interested in improving innovation capabilities in their local partners. On the contrary, Chinese talented engineers prove to be effective in helping Chery and Geely to develop product technology. The differences among companies are not only in the technology strategy used, but also in the group/community and organizational factors followed, and in the outcomes of new product development.

Communities/groups level of learning practice

The result shows that SVW's communities had the highest level of knowledge creation, as indicated by frequent interaction and high quality of communication among members of communities. The between group/community brokers can help to generate new idea and evaluate the knowledge in the practice across the organizational boundaries. Boundary spanners are strongly linked to their colleagues and have extensive links outside their divisions. They also play an important role to bridge practice from individual level to collective level. The evidence shows that brokers and boundary spanners play valuable roles in knowledge creation. Interviews at PATAC indicate that motivations and past experiences were the most important factor in knowledge creation processes among groups. Chery and Geely seemed to have a high motivation and ability for converting individual knowledge into organizational knowledge, as indicated by the fact that they shared common goals and had the high level of group overlapping knowledge. In general, variance in knowledge creation processes was greater across SVW than other two companies. This indicates that knowledge generation may rest at the community level rather than at the functional group level. Table 4.4. presents the results of a cross-level comparison of knowledge creation processes among these four companies.

Table 4.4. Knowledge Creation Across Multilevel

Constructs	Principles	Descriptions	Effect on knowledge creation			
			PATAC	SVW	Chery	Geely
Individual level of knowledge generation	Personal background/ identity	Individual interdependence	Positive for individual practices	Positive for collective knowledge	Positive	Positive
	Participation in collective/ interface	Movement and utilization of resources	Positive for individual less effective for collective	Positive, with limits of R&D interaction	Positive	Positive
	Outcome expectations and personal values/ self-interest norms	Intrinsic and extrinsic motivators, individual development	Positive, With limits in long-term development	Positive, With limits in long-term development	Positive	Positive
Community/ group level of learning practice	Community identity, existing groups	Communities/ groups interaction and communication	Positive	Positive for collective learning	Positive	Positive
	Community norms, groups rules, regulations	Incentives, motivation and Awards systems	Positive	Positive	Positive	Positive
	Brokers and boundary spanners, translators	Build process network and cross organizational boundaries	Negative	Positive for across boundaries	Negative	Negative
Organizational level of new product development	Organizational identity and goals	Brands, independent development capability	Negative	Negative	Positive	Positive
	Organizational rules and regulations	Intellectual property rights (IPR) Training and learning	Positive	Positive	Positive, with limits disputed by IPR	Positive, with limits disputed by IPR

Organizational level of new product development

At the organizational level, Chery and Geely seemed to have highest level of independent product development capabilities. A strong development capability and brands are at the top of the car industry's value chain and represent the core competitiveness. For example, Chery developed six concept vehicles – including a sports car and a multipurpose vehicle – and 18 types of engines. In contrast, due to a lack of strong independent development capability and brands, SAIC/PATAC and SVW pay large technology transfer

charges to foreign partners. With China's auto manufacturers still dependent on foreign OEMs for high tech core components, disputes over property ownership rights are becoming problematic issues. For example, Chery and Geely have been involved in intellectual property rights disputes with foreign auto giants. Toyota said the Geely logo is similar to Toyota's alleging the Chinese firm intentionally gives consumers the impression it has links with the Japanese brand. The Japanese carmaker lost the case. GM claimed that Chery's QQ copied the design of its South Korean affiliate GM Daewoo Auto & Technology Co Ltd's Matiz. Chery denied the allegation and there has not yet been a decision on the case. It is the Chinese carmakers' lack of strong development capability and brands that has generated these intellectual property disputes with foreigners. The empirical data also indicated that local automakers could catch up the emerging technologies through learning, cultural, incentive, and industrial networking.

The results of the comparison across companies suggest that companies can use three different strategies in developing the capability to creation knowledge for innovation: SAIC relied on setting up joint research center with foreign partners to acquire knowledge, and develop their design capability. SVW chose to build knowing communities to enhance collective learning and accumulate knowledge. Chery and Geely adopted independent new product development strategy to develop their own product technology. But for knowledge creation processes at group level shared common understanding/meaning model of collaboration, there are no significant differences among these four companies. When individual tasks are independent, each one is unaffected by the others, and group is simply the sum of the individual contributions. As task interdependence or complexity increases, individuals separate their own performance cognitively and rely more heavily on group level of collective efficacy. Even though individual knowledge spirals may have transmissible effects, I also propose that communities/groups level knowledge spiral can have centripetal effects on individuals.

Knowledge creation processes is a highly complex process when the content of collective knowledge is high. Simultaneous application of communities can facilitate knowledge creation processes. Knowledge governance is taken up with how the deployment of administrative system influences knowledge creation processes (Foss, 2005). Thus, I consider cross-level effects of practice-based knowledge spiral that will enhance the management of knowledge assets at different levels.

This leads to the proposition that:

Proposition 6: Knowledge governance means shifting knowledge spiral at multiple levels: from individual (micro)/group/communities to the institutional (macro)/global system level.

4.3. Discussion and Conclusions

The comparative case study analysis served to answer the question, how knowledge is generated through social cognitive platforms. In attempting to answer this question, I put forward six propositions regarding the knowledge creation processes in Chinese automotive industry and I developed a knowledge spiral based on the case studies. The data analyzed in this chapter generates mixed results. Some indicators are quite similar in all four companies. While others strongly vary from company to company. The analysis showed differences at individual, communities/groups and organization-level of knowledge creation processes. However, these differences are still not completely clear.

This chapter describes practice-based knowledge spiral as involving a range of distinct knowledge creation processes. The differentiation between formative and normative knowledge creation context, well established in theories on knowledge creation at individual, communities/groups and organizational levels of analysis, is important since it reveals distinct patterns of human behavior that have not been systematically addressed until now. It also highlights brokers and boundary spanners in communities as a potentially under-explored dimension of knowledge creation processes.

As an exploratory study, I believe that I have identified important potential conclusions concerning knowledge creation processes. Nonetheless, this study has several limitations.

First, larger samples test my conclusions would be necessary to show that these conclusions are not due to the choice of specific cases. Second, the choice of industry context might influence my finding. I do not believe that any of propositions apply only to the auto industry. Other industries may have greater room for study of knowledge creation dynamics.

A central venue of further research is to explore the boundary conditions of knowledge creation processes. This would include questions about where and when knowledge creation is a productive learning strategy for organizational groups and communities. I have emphasized the coordination aspects of governance underlying the knowledge creation, such as matchmaking, cognitive distance, relational closeness, modularity, community norms, trust and motivation. These observations are highly speculative, further research is needed both to identify possible source of knowledge governance and to investigate them empirically. Furthermore, my limited sample did not permit me to analyze the role of the country. For example, there may be systematic differences between the knowledge creation practices of China and Japan. Third, the research presented here represents a first step in establishing practice-based knowledge spiral as a construct, but more work is needed before its implications can be fully understood. Importantly, the role of brokers and boundary spanners in evaluation knowledge and building links between communities has not yet explored.

Qualitative data suggest that all three levels of knowledge creation processes highlighted here should be seen as complements rather than substitutes. The nature of this complementarity is an important area of further research. My hope is that this research will have provided a conceptual stepping-stone toward a fuller and more fine-grained model of knowledge creation based on the recognition that knowledge creation by engaging in a number of different strategies. The next chapter will reveal the findings of this study and present a cross-level analysis for the knowledge creation processes and management practices in Chinese technology alliance.

Chapter 5.

A Cross-Level Exploratory Analysis: Brokerage and Boundary Spanning Lead to the Formation of Chinese Technology Alliances

- Introduction
- Conceptual Background and Hypothesis
- Research Setting and Methods
- Analysis and Results
- Discussion and Conclusions

5.1. Introduction

Technology alliance is a collection of organizations or institutions that have entered into collaborative relationships usually involving diverse knowledge and different background and knowledge diffusion across organizational boundaries (Gulati, 1998; Kogut, 1988; Doz, 1996). There are tremendous resources devoted to this effort, from private sector investment to large-scale government investment in infrastructures, projects and joint centers. The main problem is that of creating and transmitting knowledge across organizational boundaries. In this chapter, I draw attention to one aspect of knowledge creation processes across boundary that is the role of brokerage and boundary spanning. Specifically, I argue that occupants of brokerage and boundary spanning positions have great influence over the knowledge creation processes and bind knowing communities and distributed groups together.

A central idea in the literature on alliances is that they are useful mechanisms for knowledge creation (Hamel *et al.*, 1989; Rosenkopf & Almeida, 2003). An alliance in its general form has been properly defined as a voluntary arrangement between two or more independent organizations involving *"exchange, sharing, or co-development of products, technologies, or services"* (Gulati, 1998: 293). The typical characteristic of alliance is its intensive exchange of critical resources and specific know-how across organizational boundaries (Doz & Hamel, 1998; Parkhe, 1998). In addition, alliance can facilitate quick entry on new geographic markets; fast access to complementary resources and knowledge that embedded in other companies, and achieve sustainable competitive advantage (Dyer, Kale and Singh, 2001).

From a knowledge-base perspective, distributed alliance units with diverse knowledge have more trouble creating and sharing knowledge, and collaboration is limited by the members' different interpretive schemes, the codes. As Arrow (1974) argued, organizations deal with the complexity of the environment by creating specialized codes, and organizations use such codes to facilitate communication. For distributed alliance units there is a need for some common ground for members to interact and communicate in rounds, with the aim to create common codes (Wernerfelt, 2003). As Argyres (1999: 173) argued, *"Common code allowed for designers proceeding from different companies to participate jointly in the design. Allowed Integration of several teams"*. For example, when several firms come

together in a joint development project, they usually create a project management *'dictionary'*.

An emerging knowledge-based approach in such a distributed environment is open innovation. The *open innovation* paradigm assumes that firms can and should capture external as well as internal creativity through external channels, social networks as well as knowledge communities. Open innovation offers exciting possibilities to benefit from local partners and suppliers using their technologies through licensing agreements, joint ventures and alliances within a value network (Chesbrough, 2003; Kline, 2003). In contrast, closed innovation is a view that innovation process requires control. When the locus of innovation is internal to the boundaries of the firm, innovation is managed through a hierarchical governance mechanism. The hierarchical governance mechanism is a closed model, because knowledge is private as Intellectual Property (IP) to the firm, and the innovation process is directed by a full control system. However, the closed innovation approach for a technology alliance is no longer sustainable. It does not allow the firm to benefit from the creativity, diversity, and agility of its partners. As Sawhney and Prandelli (2000) argued, *"in a world where innovation, change, and uncertainty are the rules, knowledge socialization is needed for increasing flexibility and reducing the risk of autonomous knowledge production. Firms that function, as closed systems have no way to renew themselves."*

Chesbrough (2003: 37) proposed an *open innovation model*, which emphasizes that firms can commercialize both its own ideas and innovation from other firms and seek ways to bring it in-house ideas to market by developing pathways outside its current business. In his model, he uses the concept of *innovation funnel* (Wheelwright & Clark, 1992) and considers that the boundary of the firm and its surrounding environment is porous, enabling innovations to flow between firms and its customers. In this sense, the locus of innovation has migrated beyond the confines of the central R&D developments of the large companies and is situated among various startups, universities, research consortia and other outside organizations. However, it is still not clear how knowledge can flow across firm's boundaries and if the innovation is outsourced through *funnel' porous* how the return of new technologies or ideas to the firm is made possible. In my view, it is important to describe how to build a linkage between firm's hierarchical innovation and more innovative social Institutions. In this case, using the innovation funnel to explain open innovation is limited and, we should think about

the better infrastructure or model to demonstrate the coherence of firm, knowledge creation across organizational boundaries and effective knowledge governance mechanisms.

This chapter is based on the assumptions of a knowledge-based approach to alliances to test three propositions that emerged from the case studies of Chinese auto industries and that relate to the generative mechanisms which affect the knowledge creation capability. In Proposition 3, I put forward the idea that matchmaking, modularity, and process network can create the place and keep rhythms of the movement of knowledge spiral and that cognitive distance provides magnitude and rate of change for generative knowledge building. In Proposition 5, I argue that social norm, trust, and relational network serve to keep the stability of collective learning; to legitimate coordination and encourage creativity and mediating relational closeness supports judgment in bridging normative practice. In Proposition 6, I suggest that knowledge governance means shifting the knowledge spiral at multiple levels: from individual (micro)/group/communities to the institutional (macro)/global system level. The focus in this chapter hence is on knowledge governance and I lay out the argument that brokerage and boundary spanning can provide a path to understanding social dynamics of coordination and cooperation in knowledge creation processes. Figure 5.1. presents, within the general framework of the thesis, an extended theoretical model tested in this chapter.

Figure 5.1. Framework of Brokerage and Boundary Spanning for Knowledge Creation
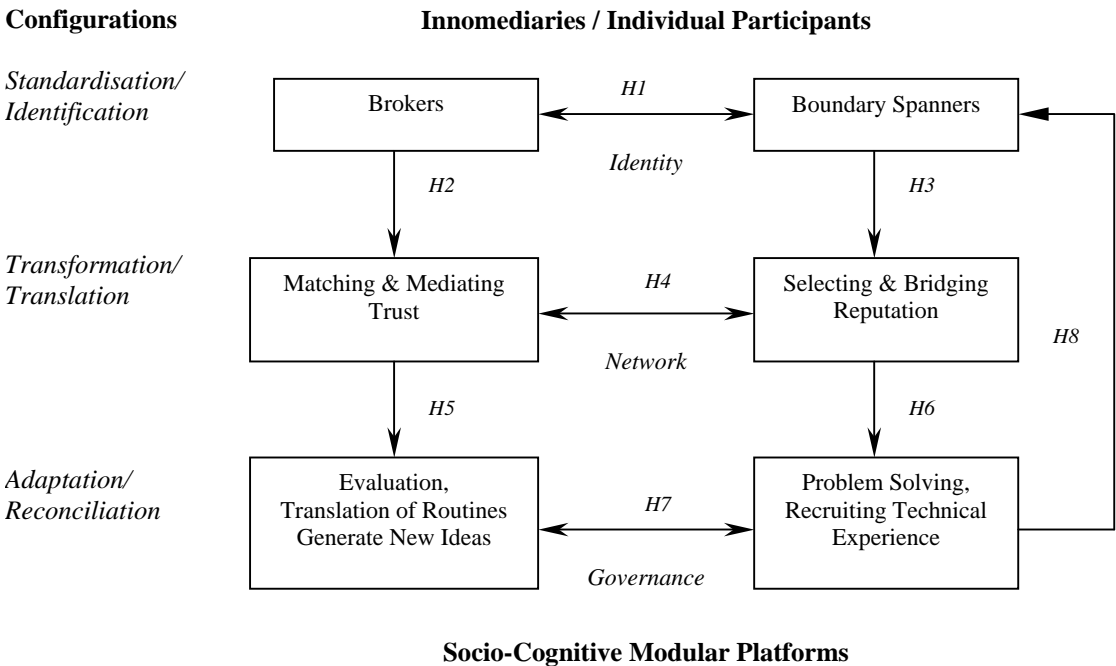
The overarching objective of the chapter is to uncover the different faces of brokerage and boundary spanning in communities/groups and to make the case for the importance of viewing knowledge creation processes as a multi-dimensional construct. Thereby, I hope to provide a conceptual springboard for the knowledge governance of inquiry.

I organize this chapter as follows: in the second section, I present the hypotheses for testing each proposition; these hypotheses build on the assumptions of the micro-foundation of knowledge creation and theoretical discussions presented in Chapter 3. In the third section, I briefly describe the research settings and methods for this chapter, which is based on the case study analysis and which is described in the research designs in Chapter 4. In the fourth section, I present the results and analyses, followed by the discussion and conclusions in the last section.

5.2. Conceptual Background and Hypothesis

The main hypothesis of this chapter is that recognitions of the optimum scope of knowing processes and mediation of moderate effect on motivation and trust are the main knowledge governance mechanisms within the community-based socio-cognitive modular platforms. New knowledge is generated by repeated interaction between product architecture platforms and social cognitive platforms. Brokers and boundary spanners bridge the normative practice between two kinds of platforms. Furthermore, brokerage and boundary spanning are the main forces to make matchmaking happen within the socio-cognitive modular platforms and bind knowing communities together. This is about a new kind of go between across boundaries to create new knowledge and understanding, primarily through direct and indirect contact and two ways exchange, from internal and external exchange.

Based on work related to knowledge creation processes in technology alliances I begin this subsection by identifying, comparing and contrasting two sets of innovation platforms: *product architecture platforms* and *socio-cognitive platforms*. I refer to these different sets of innovation platforms as "knowledge creation strategies" to signal that they involve knowledge creation processes within technology alliances.

5.2.1. Community-based socio-cognitive modular platforms

As I discussed in the introduction, recent empirical work has brought an increasing clarity to the way in which the platform strategies of new product development, but our understanding of different platform strategies that alliances are developed is still limited. Yet a careful reading of the literature provides the outline of a multi-dimensional new product development model consisting of different platform strategies rooted in different behavioral foundations and different performance mechanisms.

<u>Modularity and product architecture platform</u>

In the knowledge-based economy the main drive is technological innovation, and the key source of sustainable competitive advantage and superior profitability within an industry is how a company creates and shares its knowledge (Tushman & Anderson, 2004). Achieving successful innovation is difficult, due to the fact that lack of creativity is seldom the problem, and that managers often claim that knowledge resources or greater ideas already exist within their companies, but the problems are, they do not know how to analyze them according to knowledge activities. Furthermore, organization leaders do not have a clear, well-developed framework for managing innovation as an organizational capability. And since they do not have the framework, they do not know how to build it.

One approach for achieving this objective is to implement *a product platform strategy*. By implementing a product platform strategy, high-tech industries can reduce the overall production costs and times, while meeting diverse customer demands (Weck, Suh and Chang, 2003). A platform strategy to product development is essentially instrument in design and manufacturing and market development. As Robertson and Ulrich (1998: 20) highlighted, *"By sharing components and production process across a platform of products, high-tech firms can develop differentiated products efficiently, in crease the flexibility and responsiveness of their manufacturing process, and take market share away from competitors that develop only one product at a time."* Due to the product platform advantages, a product platform strategy is aggressively implemented by various high-tech firms. Product developments based on platforms include airplanes, computers, powerful tools and automobiles.

First, there is a need to clarify the concept of platform. Ulrich and Eppinger (1995) defined platform as a collection of assets, including component designs, shared by multiple

products. Simpson and Souza (2002) defined platform as a group of related products that share common components and/or subsystems. However, it is observed that there is very little research on defining platforms clearly to drive the industry innovation process, especially, the related issues to the current argument on the notion of open innovation. In Chesbrough's (2003) notion of "open innovation", there is very weak of concrete model and several undetermined questions remain, such as, which new products are in the process, what acquisitions they have consummated, what agreements they have reached?

For the purpose of this study, we argue that *"the platform concept reflects the inherent tension that must be managed between maintaining distributed, varied and evolving sources of distinctive knowledge bases on the one hand and ensuring the development of knowledge forms that guarantee coordination and adaptation between these different sources on the other within and cross firms at the industry level"* (Cohendet, 2004). Also Gawer and Cusumano (2002: 7) claim that behind outsourcing actions and open innovation, there is a large game at stake, the game of technological platforms. They argue, *"In industries that center around platform products, the value of a platform increases when there are more complements. The more people who use these complements, the more incentives there are for complementary producers to introduce more complementary products, which then stimulate more people to buy or use the core product, stimulating more innovation, and so on."* This definition highlights two fundamental phenomena currently impacting the high-tech industries: the increasing interdependency of products and services and the increasing ability to innovate by more actors in the high-tech industries. Since platforms are made of components that interact following standard interfaces, then managing and balancing the standard interfaces are necessary parts of platform strategies (Gawer & Cusumano, 2002). The issues of platform strategies involve not only how to open up to create interfaces and how much complement to flow in-house innovation, but also how best to influence open innovation activities occurring outside the firms.

The reasons for high-tech industries to develop this platform strategy approach are widely discussed, however, a central principle of many theories is the concept of *modularity*. Modularity is increasingly proposed as an approach to product innovation, deeply changing the trade-off between costs and diversity. Modularity is becoming more important in many different kinds of platforms/systems. Modularity in use can stimulate innovation in design, managing current knowledge assets effectively and for guiding strategic organizational

learning (Sanchez & Mahoney, 1996). Many industries of complex products have evolved toward a more modular architecture, including the computer, telecom, and automotive industries. Modularization denotes the building of a complex product or process from small subsystems that can be designed independently yet function together as a whole (Simon, 1981). Ulrich (1995: 435) points out that modular designs change the content and importance of different design phases, and that design teams become more *"... 'Supplier-like' in the sense that interaction is structured and relatively infrequent."* Referring to modularity in product platform, Baldwin and Clark (1997, 2000) define modularity as the decomposition of a system/platform into modules that requires visible design rules, which consist of three elements: the architecture, the interfaces or the standards[12]. These three elements need to be widely shared and communicated, and the literature on modular platforms tends to merge these three kinds of information together.

Modular designs provide the means for people to divide up the work in tasks or groups of tasks that are relatively independent of each other. Modularity in product design has a powerful impact on innovation. Furthermore, Schilling (2000) points out that modularity within the firm not only enables economies in product design but also greatly simplifies coordination. In other words, modularity is describing the degree to which system components are separated and recombined and characterized by communication, interaction and grouping between components and the degree to which "rules" of the system architecture enable mixing and matching components. These rules effectively set the boundaries within which each subsystem group may act autonomously, and ensure that this autonomous action does not undermine the capacity of designed subsystems to function together effectively in the finished product. However, it is not clear how to generate, communicate and control these rules, especially as such rules are socially constructed (Galunic & Eisenhardt, 2001).

Another important point to implement platform strategy towards open innovation is that high-tech firms need to perform a delicate balancing act between competing and collaborating with other partners, suppliers or institutions. More precisely, the high-tech firms

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[12] An *architecture* that specifies what modules will be part of the system and what their functions will be; *Interfaces* that describe in detail how the modules will interact, including how they fit together and communicate; *Standards* that test a module's conformity to design rules and measure the module's performance relative to other modules. In Baldwin and Clark (1997: 86) Managing in an Age of Modularity, *Harvard Business Review*, Sep-Oct., pp. 84-93.

rely on various means to influence outside firms, ranging from specific technical choices and organizational decisions to initiatives to enhance their external relationships and reputations. Here technological choices were related to sharing interface specifications with complements producers, such as open or closed interfaces. Disclosing information about interfaces is a powerful way to encourage external innovation. But disclosing too much may also facilitate imitation (Gawer & Cusumano, 2002).

All in all, modular architectures with open interfaces between components make it possible for many firms to participate in the innovation process and open a way to allow the task of innovation to be subdivided and allocated across different firms. Successful firms need to build modular architectures and openly disclose external interfaces necessary to create complements, while still protecting their competitive advantage. Accordingly, implementing a platform strategy has many advantages. It supports systemic architecture innovation, stimulates and coordinates open innovation that extends across many firm's boundaries. However, platform strategy has shortcomings.

Gawer and Cusumano (2002) argue that it is quite possible to fail to implement platform strategy and to mismanage the process of stimulating and channeling complementary innovation. Even successful platform strategy can fall prey to problems that *from too much of a platform-centric mentality.* Also, a platform can *become tied to certain technologies.* Platform evolution is often important to long-term survival. It is dangerous to limit their views of the world and potential options for the future and they tend to become less aware of possible radical change in their environment or product lines. Except above limits to platform strategies, I add two other important factors for improving the efficiency and effectiveness of the innovation process, which maybe neglected during the implementing the technological platform strategies. First, because a modularized platform is seen as a rule-based approach, and the standard interfaces are based on a set of "rules" that are early set in the design effort and communicated to all parties, one must specify how to interact with others and how to meet interfaces requirement. Due to such rules which are often tacit and socially constructed, and not neutrally technical in nature, the critical challenge is *how to create, communicate and manage these tacit rules.* Are there any coherent mechanisms for implementing such process? Second, platform leaders consider that building trust relationships is akin to convincing partners/suppliers/institutions to *"dance with the elephant".* However, maintaining trust is difficult because the relationships can be ambiguous. It is not always clear whether another

firm is a partner, supplier, or competitor. There is a real risk to *"dance with the elephant"*. Then the question arises of, *how to build trust and maintain trusting relationship* in the joint development with third parties becomes more challenging to today's high-tech industries.

New innomediaries and community-based socio-cognitive platforms

Currently, some high-tech firms are struggling with the issue of what is their real "platform" in industries where the technology is rapidly evolving or consists of multiple types of potentially compatible or interoperable alternatives. Some initiatives develop such as building communities of customers and third parties who are interested in adding complements or offering complementary services. As a result, many propose new interface standards or join with other firms and organizations to create standards that enable their platform or core product to connect to other products. In my view, new product development is both a cause and an effect of the industrial and social process, and there is also the challenge caused by the interactions between the technological architecture platforms and the social cognitive platforms. In the next paragraph, I proposed a new model for "open" innovation - *Community-Based Socio-Cognitive Platforms* as an alternative to firm's platform strategies and a new framework for knowledge governance.

On the basis of theoretical assumptions of the socio-cognitive platforms in Chapter 3., also on the foundation of diversity and situated action[13], I propose the community-based social cognitive platforms for new product development as kind of loosely coupled infrastructures. The notion of socio-cognitive platforms emphasizes the fact that knowledge does not reside in the heads of the individuals, but rather is situated in a variety of modularized community interfaces and brokerage and boundary spanning device connecting the communities' activities in a coherent whole. I look at the role of brokerage and boundary spanning as new kinds of innomediaries, who help firm translate routines across domains, synthesizing new ideas from multiple disciplines/mobile communities, aggregating and disseminating internal and external potential innovation sources across organizational

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[13] The situated action approach has offered a pragmatic definition of knowledge, which is oriented towards the interpretation of organizational performance through the observation of everyday practices in the workplace. It involves issues of identity, trust and commitment. See Lave, J. and Wenger, E.C. (1993), Situated Learning: Legitimate Peripheral Participation. *Cambridge University Press* New York, NY; Brown, J.S. and P. Duguid (1991), Organizational Learning and Communities of Practice, *Organization Science*

boundaries. Knowledge is embodied in practice and it has to be retrieved by innomediaries in their everyday dealings. In addition, Knowledge is situated in the sense that it is highly reinforced by the interaction between community's interfaces in a given socio-cognitive platform.

As I discussed before, high-tech firms are increasingly rethinking the fundamental ways in which to break out of the 'innovation box'. By following the increased global expansion and technological advances, the boundary between "inside" and "outside" the organization is blurred. In my view, the prominent feature of the community-based socio-cognitive platforms is a set of rules/norms and loosely coupled structures that encourage critical evaluation of existing knowledge, legitimate coordination and support judgment in bridging normative practice. In this sense, the community-based socio-cognitive platforms pays special attention to how generative mechanisms drive the process of knowledge creation between communities and interdisciplinary groups. I consider the community-based socio-cognitive platform as an alternative platform strategy for the following reasons.

First, the informal hierarchical infrastructure of socio-cognitive platforms enables knowledge creation and sharing across organizational boundaries. Within organizations, the hierarchical structure is one way to coordinate a complex system comprising multiple specialized units and hierarchies have authority to create and coordinate the horizontal and vertical division of work based on existing bodies of specialized knowledge. However, coordination by hierarchy is unable to manage the complex process of production, validation, and diffusion of knowledge, which often occur through long-term constructions (Amin & Cohendet, 2004). In contrast to the hierarchical organizational structure, "*heterarchy*"[14] relations comprise a more voluntary and personal mode of coordination. Heterarchy relations become important as they coordinate activities across different organizational units and substantially improve the design of a formal organization. Heterarchy relations often occur naturally, they can be fostered through internal and external social arrangements and

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[14] Heterarchy, As Anderson, T (1995: 18) describes "Hierarchy governs from the top and down, and heterarchy governs through the other…more common words for a heterarchical relationship might be 'democratic relationship,' an 'even relationship,' or a relationship with equally important contributors". In the reflect team in action, New York: Guilford Press

communities[15], which promote horizontal communications and interaction among different organizational units, at the same time creating and sharing knowledge across firm's boundaries.

Second, knowledge transformation is described as a practice-based spiral within the socio-cognitive platforms. Making tacit knowledge explicit is extremely difficult. As Amin and Cohendet (2004: 23) argue there are three forms of tacit knowledge: 1) *know-how*, which is gathered from the accumulation of practice; 2) *mastery of language*, which is gathered from accumulation of ability of practice; 3) *representations of the world*, gathered from the accumulation of wisdom. 'Know-how' refers to the skills required to carry out certain actions or the ability to do something. It should be noted that the utilization of information technology at product architecture platforms cannot create a knowledge-based environment that promotes knowledge creation. For any new technology to be optimized, it must be augmented by strategy, process, culture, and behavior that support knowledge creation (Cross, *et al.,* 2002; Kochan, *et al.,* 2002). Spender (1996: 58) has observed that the core competencies of a system "*emerge from its activity.*" Managers should not be dissuaded by a traditional scientific approach with certain limits of the *methodologies of prediction* to control the complex organization, but we may continue to employ the socio-cognitive platforms, which may be termed *methodologies of sensitization*, to bring new and potentially useful ideas into new product development processes. Furthermore, language plays a key role for the creation and coherence of the community. "*It enables collective interpretations, signals group members, and helps the enactment of practical actions*" (Amin & Cohendet, 2004: 30).

Third, socio-cognitive mechanisms are essential to the recognition of knowledge within community-based platforms. Amin and Cohendet (2004: 30) propose that cognitive mechanisms are essential to the recognition of knowledge within the firm and that routines play a major role in maintaining the internal coherence of the organization. Langlois and Savage (2003) argued that standard "*reflect interpersonally shared knowledge. We might even say that a standard is a certain kind of public routine that helps to coordinate private (individual or organizational) routines.*" Also Nelson and Winter (1982) argued that much

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[15] As Langlois, R and Foss, N (1999: 10) argue the absence of a visible hierarchy and the fact that unlike other institutions, communities do not need alternatives of bundles of contracts understood as mechanisms for creating and realigning incentives. In capabilities and governance: the rebirth of production in the theory of economic organization, Kylos 52

operational knowledge in organizations exists at a tacit level and that routines are the carriers of such knowledge. These notions lead us to underline the fact that standards or design rules are an emerging property of inter-firm operational or collective learning routines. These routines may consist in codified, formal information channels, manuals, protocols, databases, computer aided tools and standard interfaces. In the context of recognition of knowledge, knowledge creation is not property of the individual but is collective learning processes within the community-based social cognitive platforms.

In line with the above argument, it has been argued that the new product development processes tend to move toward a bottom-up vision of firms, and the brokerage and boundary spanning as new kind of organizational devices which can build the linkages between the product architecture platforms and the social cognitive platforms. However, it is still not clear how about linkages/matching mechanisms between two platforms. There are very little evidences on the use of matching mechanisms to facilitate knowledge creation and sharing across organizational boundaries. In the coming discussion, I will introduce matchmaking mechanisms in this particular phenomenon.

5.2.2. Brokerage, boundary spanning and process network

The latest development of innovation shows that finding ways between high-tech firms to actively share their knowledge, technologies, and other capabilities, at the same time, without risking the unauthorized appropriation of intellectual property would is the central debate in the fostering of knowledge creation for innovation (Wolpert, 2002; Sawhney *et al.*, 2003; Chesbrough, 2003). Wolpert (2002: 82) proposes a new kind of go-between, the use of independent intermediaries to facilitate the exchange of sensitive information about innovation between firms while keeping their secrets. He writes: *"sitting at the intersection of many companies and industries, a network of innovation intermediaries would be in a unique position to visualize new opportunities"*. Similarly, as Sawhney *et al.* (2003) put in, third parties or knowledge brokers help companies overcome the gaps in knowledge about customers that impede innovation. They call this process of mediated innovation *"innomediation"* and the third-party actors who facilitate it *"innomediaries"*. Innomediaries can also overcome the problems of interpretation by providing a deeper understanding of the specific context within communities for specific industries.

In this study, I propose that the community-based socio-cognitive platforms are privileged places and repositories for knowledge generation, in which knowledge creation occurs among the members of fluid knowing communities or interdisciplinary groups composed of very different organizations. In the context of community-based socio-cognitive platforms, there is a need to explain: how is the dynamics of interaction between the product architecture platforms and socio-cognitive platforms? What are the roles of innomediaries and how to make matchmaking happened within the socio-cognitive platforms? I have so far identified the following terms that may help to solve the above questions. I list the main characteristics of the product architecture platforms, the socio-cognitive platforms, and the innomediaries, in order to provide the logic thinking of new governance mechanisms for knowledge creation at organizational setting. Table 5.1. presents the comparisons among these three units.

Table 5.1. Product Architecture Platforms vs. Socio-Cognitive Platforms

| Configurations | Product Architecture Platforms | Innomediaries | | Socio-cognitive Platforms |
		Brokers	Boundary Spanners	
Standardization/ Identification	Development teams, functional groups, membership is based on selection, control by hierarchical organization structure	Matchmakers, go-between, third party actors, brokers, dual role of membership in firms	Experts, consultants, translators, guardians, gatekeepers, mentors	Knowing communities, Membership is open, members are volunteer in exchange for their work, control by social norm
Transformation/ Translation	Exchange knowledge is limited by the boundary of the firm, coordinate by common codes, standard interfaces, product architecture	Across boundaries, overcome the gaps of distance, decision making, upon physical interaction	Linkage, across firms, identify and translate information, Upon direct interaction	Exchange knowledge extends beyond the boundary of the firm, coordinate by the common understanding or meaning model
	Incentives rely on the promotion and reputation, contracting relationship, design interface and matrix structure	Mediate by trust, balancing cognitive distance and relational closeness, draw upon social networks	Rely on reputation, do not suffer from a lack of trust, redirect information, managing conflict interests	Incentives based on reputation and trust, shared identity, independence and loosely infrastructures
Adaptation/ Reconciliation	Knowledge is private, close innovation, competence development, routines, engage in knowledge imitation	Aggregating, disseminating knowledge, evaluation of knowledge, mediation and routine translation	Problem solving, guide the technical and social evolution, Recruit the technical experience, reflection and mentoring	Knowledge is public, open innovation, community temporal routines, engage knowledge creation

Table 5.1. summarizes the main differences between three units: product architecture platforms, innomediaries and social cognitive platforms. There are three forms of knowledge generation: standardization/ identification, transformation/ translation, and adaptation/ reconciliation. As the table describes, product architecture platforms are controlled by hierarchical organizational structure, while social norms are the guidance for the action of social cognitive platforms, and innomediaries are involved in building identities, mediating trust, balancing and matchmaking cognitive distance and relational closeness between two platforms. In this sense, the dynamics of innomediaries interaction between two platforms constitutes a fundamental aspect of the communication amongst disclosing standard interfaces and modularized communities interfaces. Hence, I argue that the innomediaries play a key role in facilitating of communication and interaction between academic community/ commercial community and distributed groups, which adds to our understanding of factors facilitating knowledge creation in technology alliances.

In the following paragraphs, I further describe an operative infrastructure-*matchmaking* that demonstrates the structural relationship between practice-based knowledge creation spiral and knowledge process networks. The matchmaking infrastructure contributes to the organization and management of the process networks and seeks to coordinate innovation activities across organizational boundaries. I also claim that effectiveness of matchmaking rests on more than just structural configurations of knowledge processes. In addition to *structural embeddedness*, *relational embeddedness* is also important. We consider how the process network affects knowledge creation, the quality of relationships are matter (Granovetter, 1985; Gulati, 1998). On the one hand, the loosely coupled process networks cannot function without trusting relationship. On the other hand, matchmaking needs trusting relations to expand the scope of shared meaning (Hagel & Brown, 2005). Thus, the innomediaries should build long-term, trust-based relationships with the participants in the process network.

Linkages of individual-collective constructs

As I discussed in Chapter 3., bridging links between individual and collective constructs has been problematic in the organizational knowledge creation theory. Human capital explanations of brokers and boundary spanners with the capabilities of knowledge creation and building linkages between individuals and groups across boundaries are more

likely to get promoted. In my view, such explanations can be seen as another way to resolve the individual-collective dilemmas.

Marsden (1982: 202) defines brokerage as a process *"by which intermediary actors facilitate transactions between other actors lacking access to or trust in one another"* (Gould & Fernandez, 1989). Burt (1992, 2004), who defines a broker as the only social connection or bridge among a group of actors, argues that individuals who connect otherwise disconnected actors, can exploit "structural holes" to advance more quickly in generating new ideas. He further argues that brokers gain first access to information and control of its diffusion, can present different strategies to different groups, and will be considered for an expanded set of opportunities because they will be known to a wider set of groups (Fleming & Waguespack, 2006). Hargadon and Sutton (2000: 158) define knowledge broking as *"intermediaries... between otherwise disconnected pools of ideas. They use their in-between vantage points to spot old ideas that can be used in new places, new ways and new combinations"*. Knowledge brokers can integrate knowledge into new contexts and help foster a cycle of continuous innovation that is essential to sustain competitive advantage. In this sense, knowledge brokerage is one of the fundamental dynamic capabilities of the firm (Eisenhardt & Martin, 2000).

Allen (1977) and Tushman (1977) illustrated a widespread correlation between ability and ties across multiple organizations, and leadership. They described "boundary spanners" who redirected crucial information both within and outside the firm. They further argued that Individuals who occupy boundary spanners positions tend to hold advanced technical degrees, make the most important technical contributions, earn the respect of their colleagues, and communicate with peers in other organizations. In this sense, boundary spanners stimulate the innovation process because formal organizational boundaries correlate with technical boundaries (Henderson & Clark, 1990).

Accordingly, brokers and boundary spanners hold two correlated but different perceptions about individuals in each position. While boundary spanners might be collaborative linkage between groups, they can also be collaborative brokers. In the context of social cognitive platforms, knowledge brokers and boundary spanners are the potential source of innovation and creativity. They make it easies for diverse individuals to pool information and combine ideas voluntarily, which may stimulate problem solving, thereby providing

innovative performance. Boundary spanners, being more aware of other efforts within the platforms, can better negotiate the boundaries of their own groups' efforts. In my view, that both brokering and boundary spanning roles greatly increase the likelihood of cooperation and coordination that can bind knowing communities/groups together.

H1. Brokerage and boundary spanning are the main forces to bind knowing communities and interdisciplinary groups together.

Process network and innomediaries matchmaking

The concept of brokerage is rooted in the social network theory, notably the theory of structural holes that helps to explain how certain individuals can play a key role in bridging knowledge gaps between groups/communities (Burt, 1992). Evidence suggests that some types of individual networks, such as bringing in new knowledge from outside the community, boundary spanners can benefit both individual and presumably the community (Ibarra *et al.,* 2005).

Illustrating Burt's arguments in the context of socio-cognitive platforms, brokers can draw upon inter-communal process network, they bring greater and less redundant resources to bear upon a problem. Knowledge creation requires that brokers and network members jointly experience problem-solving processes and spend time together discussing, reflecting, observing, and interacting (Seufert, von Krogh and Bach, 1999). Knowledge brokers know the skill sets and technical experiences of individuals in a wider diversity of social arenas and are able to recruit them for appropriate future projects (Fleming & Waguespack, 2006). Furthermore, because of their position as the sole intermediary of an information bottleneck, brokers are themselves more likely to come up with innovative ideas (Burt 2003). In my argument, the inter-communal process networks is important for knowledge creation, because knowledge is combined and shared with network members and the new ideas are generated and evaluated through networks. Inter-communal process networks can be conceptualized as transformational engines that facilitate knowledge creation and sharing. However, what is not clear from the existing work is whether and when the emergence of "new" knowledge represents transmission of ideas familiar in one part of the network across a structural hole by brokers to those unfamiliar with the ideas (Burt, 2004). A further empirical study may contribute to a better understanding of this phenomenon.

H2. Brokers can draw upon process network to bring with innovative ideas.

In addition to providing the advantages of social brokerage, boundary spanners are in a stronger position to call upon more diverse resources between groups. They have expanded personal creativity and greater likelihood of having observed or directly participated in conflict resolution. Boundary spanners can span technical boundaries, choose where to work and, in doing so, create more or less intense areas of social interaction (Fleming & Waguespack, 2006). In this sense, technological design boundaries become social boundaries as engineers focus on the immediate technical challenge. Furthermore, boundary spanners can help to create the inter-communal process networks. Boundary spanners are strongly linked to their colleagues and have extensive links outside their subunits (Tushman & Scanlan, 1981). In the context of social cognitive platforms, a boundary spanner is usually an expatriate from one community who has relations with experts in another community and works in this community either as a consultant or a mentor. With an inter-communal process network, members of communities/groups can form direct ties with experts of other communities/academic communities.

This has provided insight into how indirect interpersonal exchange ties facilitate knowledge creation (Hansen, 1999; Tsai, 2001). In addition to the indirect ties, direct ties are more central to knowledge creation (McFadyen & Jr, 2004). As Burt (2004) argued, an idea that is new and potentially useful to an individual's company counts as new knowledge, regardless of its true origin. Thus, individuals must manage the tension of having an *optimal* number of direct relations in order to *optimize* knowledge creation. The inter-communal process network can help individuals to engage into multiple contacts at the source, which helps to increase an individual's potential for creating new knowledge. As we discussed, boundary spanners play valuable roles in building process network. In particular, boundary spanners provide access to people who do not fall within a process network. Therefore, we could use both collective and individual knowledge creation mechanisms within the social cognitive platforms.

H3. Boundary spanners help to create an inter-communal process network.

Knowledge exchange and incentives are influenced by firm boundaries. Knowing communities do exist across firm boundaries, and the decentralized governing mechanisms

foster communities with distributed information technology by the movement of people. Concerning the matchmaking between the product architecture platforms and the socio-cognitive platforms, a key management challenge is to hold communities networks in place, to align autonomous centers of innovation towards common goals and core priorities (Amin & Cohendet, 2004). Within the community-based social cognitive platform, the rule of hierarchy is not fit in the network due to the fact that the distributed communities are not open top-down management. Modularized independent communities with mobile knowledge overlap and interact with each other, driven by common projects, passions, and varied expertise. The people who work on a project may belong to a number of communities. In this case, how are such networks held in place and with what means of governance?

The main challenge in the social cognitive platforms is to find the right people and resources just in time for cooperative interaction. In the context of socio-cognitive platforms, innomediaries create distributed modular infrastructures to leverage resources and knowledge. They develop shared meaning or common understanding to meet at the interfaces connecting each module or specialized participants in order to achieve effective mobilization in the innovation process.

As I discussed in the previous section, modularity is making knowledge more distributed in high-tech industries. Strategies based on modularity have emerged as the best solution to deal with the heightened pace of change initially faced by high-tech industries. When modularity is applied to knowledge creation, the loosely coupled infrastructure can be gained by decomposing the knowledge required in the innovation process into modules that must first be produced and then combined. Within social cognitive platforms, mobile interfaces can be seen as communication and interaction matchmakers, to provide a *medium* that can be used for the interaction amongst community members. In this sense, brokers and boundaries engage to identify problem components and provide modular expertise to solve problems. Then the value and new resources are delivered through matchmaking mechanisams upon process networks within the social cognitive platforms.

In Chapter 3., I discussed routines as programs of action which cannot be separated from individual's behaviors. Routines are embedded in experience and practices and need to translate from rules/codes to action. In addition, translation of routines should not be limited by the boundaries of firms, instead of social temporal routines that embedded in the socio-

cognitive platforms cohesive integrated with organizational routines at the interval overlapping level. In this sense, knowledge brokers can translate routines between two platforms, and accumulate and evaluate knowledge from both sides. Boundary spanners can guide the technical and social evolution, recruit the technical experience across organizational boundaries. I argue that innomediaries can *change* and *recombine/separate* distributed units through integration processes, in the meantime bridging normative practice throughout platforms. Figure 5.2. illustrates the dynamics of matchmaking in inter-communal process network.

Figure 5.2. The Dynamics of Matchmaking in Inter-Communal Process Network
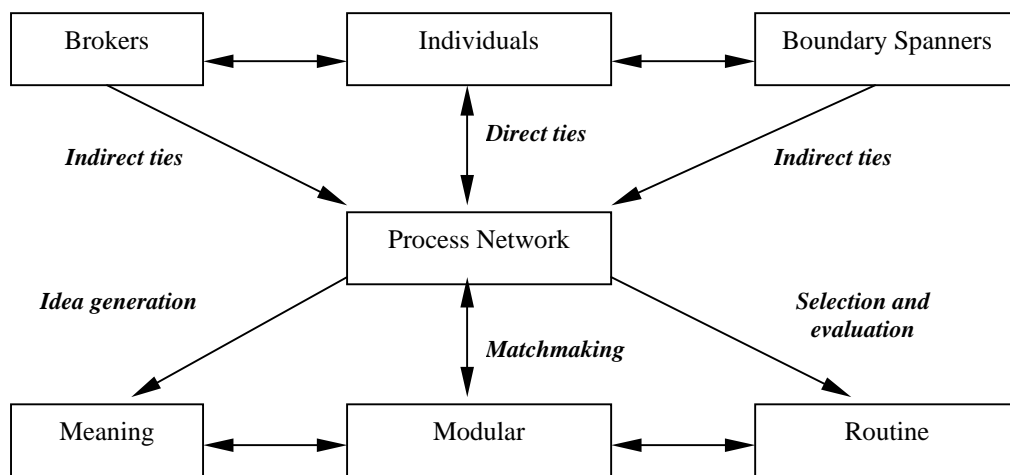
Consistent the above argument, I hypothesize that

H4. Brokers and boundary spanners can bridge the normative practice between academic/commercial communities and interdisciplinary groups across organizational boundaries.

5.2.3. Formation of trust and relational embeddeness

The pivotal challenge for fostering knowledge creation processes in organizations is to build trust. The loosely coupled inter-communal process network cannot function without trusting relationship. Shared meaning or common understanding is a prerequisite for trust to emerge. On the other hand, matchmaking needs trusting relations to expand the scope of shared meaning (Hagel & Brown, 2005).

Burt (2001) recognized that *"the social capital of brokerage depends on trust - since the value created by brokers by definition involves new, and so incompletely understood, combinations of previously disconnected ideas- but trust is often argued to require network closure, precisely the condition that brokers rise above."* If we consider an individual who spans multiple boundaries and simultaneously brokers collaborative relationships, his collaborators will be less familiar with one another, either because they have not worked together previously, or they contribute to different technical areas, and will be less aware of the technologies, objectives. In such a situation concerns about trust will be magnified if an individual invests serious resources in another group's efforts (Fleming & Waguespack, 2006). Consequently, the innomediaries should build long-term, trust-based relationships with the participants in the inter-communal process networks. In addition, technology alliance also needs to develop networks of trust facilitating the emergence of cooperation among members of alliances to reap the benefits of inter-unit knowledge sharing.

In the next subsection, I examine the quality aspect of relational embeddedness and its relationship to the formation of trust into two correlated parts. First, I introduce the relational basis of trust, and present a socio-cognitive model of trust. Then I discuss the role of innomediaries in building trust and implementing reputation mechanisms within the socio-cognitive platforms.

Relational basis of trust

Trust has been the focus of organizational studies since the mid-1980s with most research emphasizing building trust and confirming the importance for organizational development (Adler, 2001). However, most research either focuses on the question of who is trustworthy or an individual's propensity to trust; the relational basis of trust in organizational setting is still not fully understood. In the following paragraph, I discuss the formation of trust from the relational quality perspective.

Trust can be seen as a kind of tacitness agreement. As Zuscovitch (1998) argued trust is a tacit agreement in which rather than systematically seeking out the best opportunity at every instant, each agent takes a longer perspective to the transactions, as long as his traditional partner does not go beyond some mutually accepted norm. Furthermore, according to Shapiro *et al.* (1992), there are three dimensions to knowledge-based trust. First, the

simplest one, information contributes to the predictability of the other, which contributes to trust. The better one knows the other, the more accurately he or she can predict what the other will do. Second, predictability enhances trust even if the other is predictably untrustworthy because the ways the other will violate the trust can be predicted. Third, accurate prediction requires an understanding that develops over repeated interactions in multidimensional relationships.

In this study, the notion of trust is closely related to the community's activity and aims to develop the considered practice and the individual competences. I argue that trust is based on the process of interaction and the process of trust is accumulative and progressive. Such process refers to a trade off of mental cognitive categories between trustor and trustees, which is triggered by motivation or self-interest through *predictive* and *normative* models within the social cognitive platforms. Trust could be conceived as an attitude that the trustor has towards the trustee in which the trustor, due to their relationship of mutual respect, normatively expects of the trustee on social or moral ground, that he will intentionally gratify the trustor within a wide scope of matters (Hollis, 1998). Such a relationship of mutual respect is often described as one of goodwill and trust.

The most basic point of analysis of trust is that we should distinguish between two-sidedness of trust: trustor and trustee. Trust entails a subject, a person who trusts, called the trustor, and an object, something or someone that is trusted, called the trustee (Nooteboom, 2002). In this study, I used *A* to represent trustor and *B* represents trustee. The notion of trust as an expectation that carries risk has caused the widespread diffusion of the notion of trust as a subjective probability of favorable actions and outcomes (Gambetta, 1988; Dasgupta, 1988; Gulati 1995). Here, the process of trust can be divided into two expectations: predictive and normative. Both processes are also influenced by the relational networks in a particular environment, where the level of hierarchy and the degree of pressure occur. Since trust is cognitively embedded in social relations, an individual's position in a relational network structure should influence his or her trust toward a particular person.

The social network theory has been deeply involved in trust studies. Social network theorists argue that social ties and types of network structure play important roles in the process of producing trust in specific other (Granovetter, 1985; Uzzi, 1996). Most research has been focused on the relational level studying what kind of social ties encourage the build

up of mutual trust, such as exchange relations (Blau, 1964), strong ties and weak ties (Granovetter, 1985; Krackhardt, 1992; Uzzi, 1996). I consider *relational ties* as embedded in *relational networks* that as the specific features of the processes of trust within the social cognitive platforms. Strong relational ties, including friends and persons to whom one feels particularly close, fit in the next ring under common interests, and values, by which particularistic trust can be built up from frequent exchange between two parties. Weak relational ties fit in the outermost ring with fear and norms and many come to be personally trusted based on ethical principles of fairness and the conservative process of repeated exchange. There is a need to clarify how people can infer trustworthiness from observed behaviors, and how calculative and non-calculative trust can be combined or intertwined in the socio-cognitive platforms. Figure 5.3. presents a socio-cognitive model of trust.

Figure 5.3. The Socio-Cognitive Model of Trust
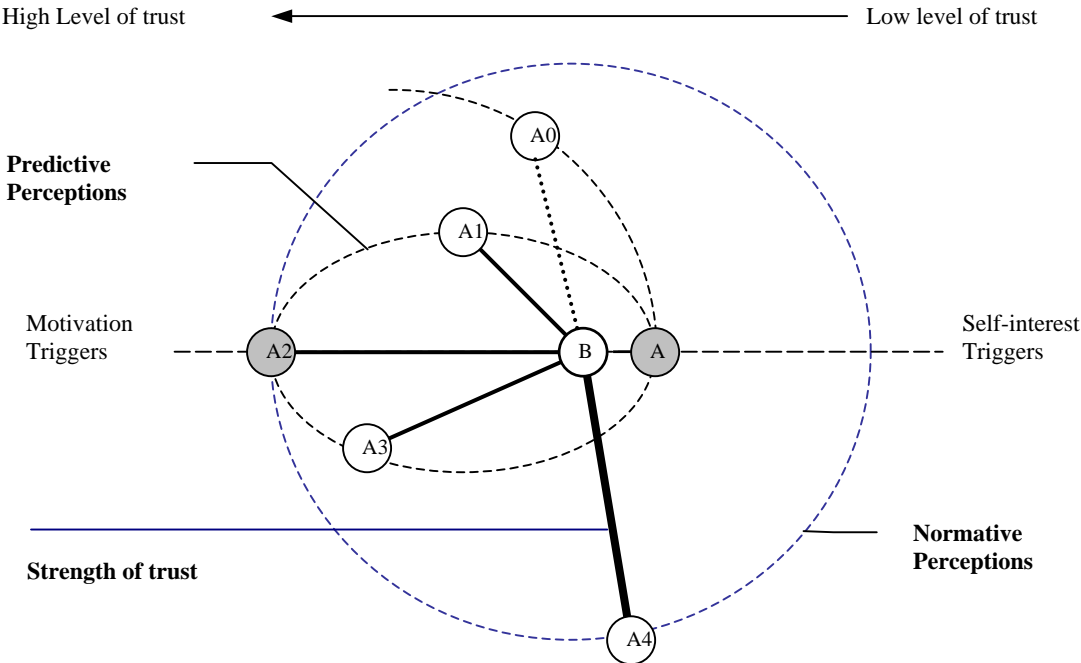
A-B, I consider here that the first stage is when trust does not exist; this situation typically emerges in the newly founded groups or communities. In the absence of prior trust, people must take into account the possibility of lack of competence and of opportunism, Williamson (1993) argues that it is misleading to use the term "trust" in this case since behaviors are purely calculative. Situations of "trust" are merely involving risk and what

economists think to be "trust-based" decisions just rest on a calculative economic reasoning. Calculus-based trust means that trustworthiness is based only on calculative self-interest, and that the trustor knows that this is the case.

A0-B, A fundamental assumption in this model is that human behavior is driven by self-interest. When individuals observe an action and try to understand it, he or she often first asks what interest persons would have that would cause them to take that action. Such a belief is related both to fairness and norms. As Coleman (1999: 91) argued *"the usual arrangement is simply an incorporation of risk into the decision of whether or not to engage in the action."* For example, one may claim *"if I assist others today, I will receive assistance in the future"* (Franke & Shah, 2003). I argue that trust does not come easily to community members who fear co-optation by self-interest or forking over disagreements. In this account, the motivation to contribute knowledge to a pool derives from self-interest, with the psychological reward of being evaluated. If an individual fails to accommodate self-interest, the process of trust tends to break. They have no willingness to join the social cognitive platforms.

A1-B, I argue that trust emerges as a mediating factor when informal controls are lacking in the knowledge creation processes, which leads in turn to higher levels of cooperative behavior. I also recognize that trust is part of the basis of the relations and is produced by relations. The main purpose of the relation may be to learn, that is to obtain new insights from individual behaviors or jointly produce new knowledge. As Luhmann (1988) proposed, people learn to be trusting from infancy onwards, by a process of generalizing from isolated experiences, which is closely tied to the *self-developing identity* of the learner. Therefore trust is entwined with personality, and people identify and categorize objects use predictive criteria embedded in the mind as cumulative signals, which are constructed from past experience with similar contexts of action; such predictive criteria change until people situate into experience that violates their criteria. In addition, networks also help to build identity. At this stage, the degree of trust reaches a high level.

A2-B, I argue that motivations can be thought of as the trustor's high level desires, guiding all aspects of his/her behavior. At this stage, the trustor responds to changes in his/her beliefs, resulting from predictive perception. When the trustor selects a particular intention to pursue and acts toward collective learning, he often uses motivational value as the guiding

measure. In such a situation, the trustor uses his knowledge and predictive perceptions of others to determine whom to ask for assistance.

A3-B, Normative trust is the process of development of shared cognitive categories. Nooteboom (2002) argued that trust goes beyond self-interest, on the basis of social norms, common values or bonding that arise within a relation. Social norms and values of behavior tend to be internalized, to a greater or lesser extent by people as part of tacit knowledge, assimilated in socialization. Thereby, people can develop empathy for partner's objectives and weaknesses, and be willing to accept more risk and exchange best knowledge with each other. In this sense, trust is not based on the rational evaluation, but based on the tacit assumption. At this stage, coordination and translation of routines are important for the social norms to exist in the social cognitive platforms. Such tacit categories are needed to interpret and store the tacit knowledge and transmit it in shared underlying categories. Barber (1983) believes that a person might trust a complete stranger because he believes that the latter is acting in agreement with according to dominant norms and standards. If the trustor cannot receive recognition, here is risk to break trust.

A4-B, At this level, trust exists because the parties effectively understand and appreciate the others' wants. This mutual understanding is developed to the point that each can effectively act for the others. Normative trust thus permits a party to serve as the others' agent and substitute for the others in interpersonal transactions. The others can be confidant that their interests will be fully protected and that no surveillance or monitoring of the actor is necessary. In the context of the social cognitive platforms, it develops as one both knows and predicts the other's needs, choices, and preferences and also shares some of those same needs, choices, and preferences as one's own. More importantly, members of communities obtain more knowledge and experience, construct a pool for inferring limits of trustworthiness, and also for setting tacitness levels of trust (Nooteboom, 2002). At this point, normative trust helps to develop a groups/communities' collectivity.

To sum up, as the trusting relationship develops in the social cognitive platforms, there is maybe a convergence of cognition, with a mutual understanding and appreciation of competencies and motives, with an emergence of shared social norms, in order to construct cognitive structures as the basis of trust. Therefore, social cognitive trust needs much flexible information transition, and exchange of information is voluntary. The process of trust is not

based on demand but on reciprocity. Furthermore, such information tends to be less codified and explicit, and more tacit and implicit. In my view, such social reciprocity can be seen as the key engine to form trust in social cognitive platforms. Members of communities engage more in social reciprocity through intensive interaction to develop their trusting relationship within the social cognitive platforms.

<u>Innomediaries and trusting networks</u>

For the brokers as innomediaries, the trustor places trust in the performance capability and integrity of the broker, as the broker does in that of the trustee. For the boundary spanners as innomediaries, the trustor trusts the advisor's judgment, leading him to place, in the ability and integrity of the trustee. The boundary spanners are not full innomediaries, but in the brokers' cases, the trustor must place trust in the trustee (Coleman, 1990; Fleming & Waguespack, 2006). If the trustor believes the innomediaries' judgment is better than his own, and better than that of others who have made the opposite decision about trusting the trustee, he will place trust in the innomediaries' judgment and follow their action (Coleman, 1990: 183). Furthermore, these innomediaries trusting relationships by definition must span the boundaries within social cognitive platforms. Innomediaries will thus be observed by mutual acquaintances on both sides and be trusted by both sides to resolve technological and organizational boundary conflicts.

The brokers' position in relational network is related to predictive and normative trust towards other individuals in the networks. Predictive and normative processes of trust, in turn, support trust building. Both processes overlap and coherently generate trust. A broker's position in a network enables access to important knowledge at the appropriate time. Further, because brokerage positions or 'bridges' have control over such knowledge, they have power in the process network. Knowledge creation cannot happen through the network without them. This is because the others who are dependent on the brokers for information must behave in a trustworthy way to earn the trust of the go-between information broker. The broker knows that they are less likely to be cheated by those who depend on them for information than by those who do not. The brokers not only strengthen control over his or her dyadic relations, but also reduce uncertainty within the whole working environment; this aids his or her tendency to trust others in general.

H5. Trust developed through predictive and normative models will increase the likelihood that a broker will achieve mediation.

The social cognitive model of trust is also applied to the models of individual reputation or trustworthiness. That is, it is tempting to think of boundary spanning across cohesive technological boundaries. As we discussed in previous sections, brokers must overcome a lack of trust to simultaneously span boundaries within social cognitive platforms. Boundary spanners, in contrast, do not suffer from a lack of trust (Fleming & Waguespack, 2006). Boundary spanners gain reputation to identify and translate information within and across technical boundaries.

A reputation, as defined by Wilson (1985) is: *"A characteristic or attribute ascribed to one person by another. Operationally, this is usually represented as a prediction about likely future behavior. It is, however, primarily an empirical statement. Its predictive power depends on the supposition that past behavior is indicative of future behavior."* Reputation may reflect either what is known about the person or what is known about the person's group. So, this step involves explaining the role of boundary spanning reputation. As Kreps and Wilson (1982) state if the situation is repeated, then it is worthwhile to maintain or acquire a reputation, The power of the reputation effect depends on the nature of one's opponents, notably on whether they also seek to acquire a reputation.

I consider that the repeated interaction/model can analyze the constitution of relationships between boundary spanners and members of the social cognitive platforms. The repeated model focuses on the role of long-run self-interest in overcoming short-term temptation, and according to the repeated game approach, if one can understand another's long-run self-interest, then one might "trust" another not to yield to certain short-run temptations. Trust, reputation, attraction, cohesiveness and mutual expectation to interact are crucial for facilitating cooperation among community members. Open communication increases the degree of trust and mutual understanding between individuals and communities, which in turn increases their cooperative behavior. Hence, boundary spanners play a bridging role between individuals and communities to encourage open communication, handle and resolve technical and organizational boundary conflicts.

H6. Boundary spanners gain reputations through repeated interaction to resolve technical and organizational boundary conflicts.

To sum up, the study suggests that in the predictive trust, members of communities or groups accumulate trust and build identity through the loosen relation ties. Further, the matchmaking positions in relational networks are related to predictive and normative trust towards developing groups or communities collectivity. The above arguments offer an integrated explanation of the formation of social cognitive trust in distributed groups and knowing communities.

5.2.4. Knowledge governance and individual-collective constructs

Knowledge governance means choosing administrative governance and coordination mechanisms, in order to maximize the net benefits resulting from processes of transferring, sharing and creating knowledge. Governance structures and governance mechanisms are important because they define the incentives and coordinate the actions of organizational members in knowledge processes (Foss & Mahnke, 2003). In this subsection, I employ March's (1991) notion of exploitation and exploration to discover the potential governance mechanisms for knowledge creation within the social cognitive platforms.

The central challenge for management is to find ways of combining exploitation and exploration (March, 1991). In the literature on organizational learning, two levels of learning are proposed. One is learning to do existing things better, which has been called "single loop learning" or "learning for exploitation", and the other is learning to do new things, called "double loop" or "exploratory learning" (Argyris & Schon, 1978; Hedberg *et. al.,* 1976; Holland, 1975; March, 1991). In my view, the problem of exploitation and exploration could be reformulated in the practice-based knowledge spiral, in which the interaction between the formative and moderative contexts of knowledge can be conceptualized into a dichotomy of balancing of exploration and exploitation. Similarly, Nootboom (2000) proposed a cycle of discovery to balance the exploration and exploitation, but his model focuses on the general processes of innovation development. The reformulated knowledge spiral is illustrated in Figure 5.5.

Figure. 5.5. Balancing Exploration and Exploitation with Knowledge Spiral

Group/ Situation   Individual

Formative Context I

Formative Context II

Moderative Context I

Exploration

Cognitive Distance

Exploitation

Relational Closeness

Moderative Context II
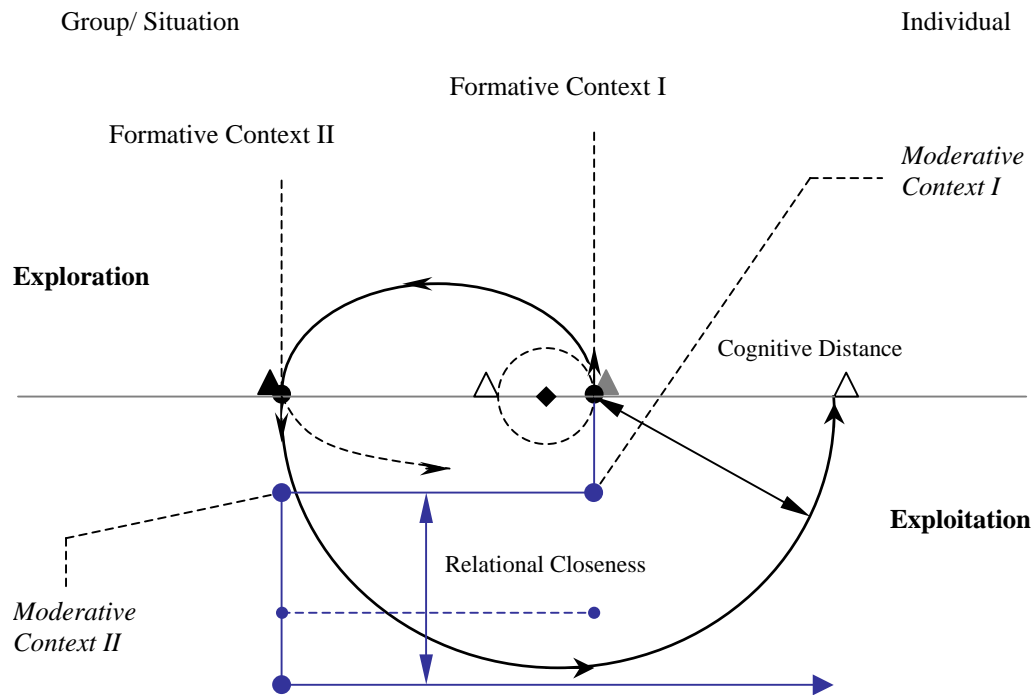
As suggested in Figure 5.5., in exploration, the knowledge creation process is linked with *formative context I* and triggered by *moderative context I*. Sequentially, in exploitation, *formative context II* is triggered by *moderative context II* and engages knowledge integration. Selection and recognition are structured by the frequency of interaction and density of communication between these four contexts. Cognitive distance and relational closeness are the key indicators to measure the degree of interaction and communication among members of social cognitive platforms. In addition, the degree of closeness between the individuals in a relational network also emerges as an important determinant of collaboration.

New knowledge creation is also dependent upon the quantity of structural ties and relational ties, which the numbers of contacts of members of one community have with other members of another community. Granovetter (1973) called this notion the 'strength of weak ties', which have the advantage of yielding more novelty. In particular, when knowledge is tacit, strong ties on the one hand, based on enduring and intensive interaction may be needed. On the other hand, strong ties may have the disadvantage not only of adding little novelty, but also of generating too much personal interaction and loyalty, to the detriment of productive work, criticism and flexibility (Nooteboom, 1999). In my argument, knowledge is generated between direct and indirect relations and the amount of knowledge created is nonlinear. The

great challenge for knowledge governance is to make coherent matching and mediating between these actors.

In addition, I argue that the socio-cognitive platforms do bring about knowledge modularization, in which matching and mediating between cognitive distance and relational closeness should be the main social governance mechanisms to synthesize knowledge creation and transformation and facilitate coordination of interdisciplinary groups and communities as they create new knowledge. The notion of cognitive modular platforms emphasizes the fact that knowledge does not reside in the heads of the group members, but rather is situated in a variety of modular units and sense-making devices connecting the group's activities in a coherent whole. In my view, each group/community can be seen as a modular unit. The actions of those modular units are always shaped, to some degree, by situations in which they find themselves. In addition, knowledge is situated in the sense that it is highly reinforced by the interaction between modular units in the given platform. At this point, narratives and sense making are fundamental aspects of the communication and interaction between modular units within the socio-cognitive platforms. In this sense, they establish a loosely coupled infrastructure with capabilities to map and to code of the quality of communication and the repetitiveness of interaction between individuals and groups/communities which is extremely critical in the knowledge governance.

H7. The quality of communication and the repetitiveness of interaction are an important index of evaluation and selection in knowledge creation processes.

A high degree of repetition of interactions between knowing communities contributes to stimulating the processes of knowledge creation; also frequent quantitative interactions between communities can lower the cognitive distance between communities but do not guarantee in the long term the existence of shared meaning and codes between heterogeneous units (Cohendet, 2005). Knowledge creation in the social cognitive platforms is based on sharing common understanding and codes/language that allow interaction and communication between communities/groups. As a result, the specific combination of the repetitiveness of interaction and the quality of communication could lead to four distinct matchmaking contexts which fit the bridging practice and generate knowledge within socio-cognitive platforms. Table 5.2. presents different types of matchmaking contexts.

Table 5.2. Different Types of Matchmaking Contexts

	Low repetitiveness of interactions	*High repetitiveness of interactions*
Low quality of communication	**Formative context I** (Weak structural ties, sparse cognitive distance)	**Moderative context II** (Weak relational ties, sparse relational closeness)
High quality of communication	**Moderative context I** Strong relational ties, dense relational closeness).	**Formative context II** (Strong structural ties, dense cognitive distance)

As illustrated in Table 5.2., the first phase dedicated to the exploration of knowledge, includes *formative context I* and *moderative context I;* while the second phase involves the exploitation of knowledge, includes *formative context II* and *moderative context II.* This dichotomy was originally coined by Schumpeter as exploration of new possibilities and exploitation of old certainties (Schumpeter, 1934), and presented to the organizational studies by James March in a famous *Organization Science* article (March, 1991). According to March, *"Exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation. Exploitation includes such things as refinement, choice, production, efficiency, selection, implementation, execution,"* (March, 1991). Balancing exploration and exploitation means trade-off between investing in exploration of new knowledge and utilization of current knowledge. As Table 5.2. suggested, each matchmaking context contains two sets of measures: the *numbers* of structural ties/relational ties, and the *strength* of the cognitive distance and the relational closeness. I propose that the interplay between exploration and exploitation also moves along a knowledge spiral, in this case given by the configuration of ties in the network. The cognitive distance is sparse in the exploration phase and dense in the exploitation phase, corresponding to weak ties during exploration and strong ties during exploitation. The relational closeness is dense in the exploration phase and sparse in the exploitation phase, corresponding to strong relational ties during exploration and weak relational ties during exploitation.

From a situated perspective, I propose that innomediaries as kinds of matchmakers/ moderators trigger the task when a change occurs in social cognitive platforms. Innomediaries focus on the analysis of mutual dependence among the task, individuals, the representational artifacts and equipment supporting the activity of particular communities/groups. In this regard, these innomediaries should have entrepreneurial insight monitoring *selected paths* for changes and report to the management teams. Managing and *mapping* codebooks/indicators that individuals develop and maintain during the knowledge creation process is important to balance exploration and exploitation. There exists a shared codebook or common language that helps groups to make the different *selection criteria/program* for problem solving or accomplish specific tasks. In other words, rational selection describes *when and how* individual should interact with one another in order to create and exchange knowledge within social cognitive platforms. For example, in the exploitation phase, all communities/groups applied more or less the same selection criteria in the sense of the same methodology *in the formative context II*. Members of communities/groups tend to frequently interact and communicate in order to solve problems and integrate knowledge. Thus, in this phase, high density of interaction and a high frequency of communication seem to be needed. However, before a common understanding/language is developed, interaction and communication are indicated at the low level *in the formative context I*. Because members of groups/communities do not know clearly how they estimate the chances from each other for success as the whole and they do not know from each other the estimated contributions and expectations for success from the diverse disciplines. As a result, members of groups should build a common understanding/language through negotiation and discussion with other members of platforms. Shared selection criteria result from negotiation, but also from sharing the common ground for interaction and communication. In this sense, a shared selection program should be seen as a result from interaction and communication. From the above discussion, I argue that share selection program is the result of *translation* and *recognition* of the interplay between *cognitive distance* and *relational closeness*. However, a more comprehensive empirical study of such mechanisms is needed.

In the moderative context I, innomediaries help to build linkages and create relational networks. In this exploration phase, innomediaries should have very good contacts and background from both sides in order to bring different groups/communities or individuals/experts to together. As we discussed, the individual is driven by self-interest at the beginning stage, in order to build common understanding/ground, innomediaries need

intensive communication and negotiation between members of different communities/groups. Just because the motivation to contribute knowledge to a pool derives from self-interest, individuals also need downloading data or information from others, communication is important, just as listening and discussion help to build shared meaning between individuals. *In the moderative context II*, once members of platforms establish a common language, community norms, shared selection programs, they attempt to help recruiting the technological experience, aggregating and disseminating knowledge and guiding the technical and social evolution into exploitation. In this phase, more frequent interaction between actors is needed. Through multiple channels of communication, knowledge is shared across boundaries and innomediaries helps to generate common knowledge through collective input, investigation and negotiation with knowing communities. In this thought, they are engaging in exploitation of knowledge.

To sum up, both the repetitiveness of interaction and quality of communication influence the knowledge created, managers should also be aware that the strength of cognitive distance and the relational closeness have a higher marginal impact on knowledge created than the number of ties. In addition, managers or community leaders should match or balance the relational closeness according to codes or languages and indicators of the cognitive distance. At this point, I argue that the analysis of relational closeness supports measure of cognitive distance. Both of them cannot be separated. Consequently, my models hold that various knowledge processes are dependent upon these matchmaking contexts and communication and interaction patterns.

Consistently with the above argument, I hypothesize that

H8. Recognitions of the number of structural ties and relational ties, the strength of cognitive distances and relational closeness are the main knowledge governance mechanisms.

An Exploratory Field Study

He who first occupies the field of battle to await the enemy will be rested; he who comes later and hastens into battle will be weary. Thus the expert in battle moves the enemy and is not moved by him.

<div align="right">—Sun Tzu, The Art of War</div>

Although the term *practice-based knowledge spiral* was not used in the past, the general concept is not new (*e.g.* Nonaka & Takeuchi, 1995). However, Nonaka and Takeuchi left one question unanswered: *What is the main force that drives the knowledge spiral itself?* This question leads directly to the matchmaking context, which focuses attention on the quality of communication and repetitiveness of interaction that allow the knowledge spiral to evolve without stopping. I build on existing research and argue that while matching the *structural* and *relational* dimensions of knowledge processes has been acknowledged as important, it has not been given the scholarly attention that corresponds to this importance. Consequently, systematic research is lacking on which activities are involved in a rational selection program, and what the performance effects of social cognitive platforms are. My goal, hence, is to situate matchmaking in the context of our knowledge creation processes, and to theorize about how it works and how it matters.

5.3. Research Setting and Methods

To build this argument a conceptual foothold is needed. Therefore, I start by anchoring the notion of matchmaking and mediating in descriptive detail from an exploratory field study of brokerage and boundary spanning across technological boundaries in Chinese technology alliances. I collected data from 4 Chinese industrial technology alliances: *Shanghai Santana Community, GM Shanghai Joint Development Center*, *Godson Chips Industry Alliance*, and *TD-SCDMA Industrial Alliance.* These alliances belong to the auto, semiconductor, and telecommunication industries. In this field study, I analyze the formation of alliances, practice bridging between academic/commercial communities and interdisciplinary groups, and motivation, processes of trust and knowledge governance at individual-collective knowledge constructs. First, I present the research setting, followed by a description and explanation of the data collection procedures. I then present the results of the case studies.

5.3.1. Research setting: The Chinese technology alliances

One reason for the rapid increase in global knowledge is the massive investment in global R&D. China's R&D spending is only 0.66% of the world's, therefore China needs to tap into the rapidly growing stock of global knowledge. It is to be noted that China still has much to gain by catching up with global knowledge (Dahlman & Aubert, 2001). China must shift away from resource-intensive development and move efficiently into knowledge-based development.

Currently, the networked organization, or alliance, is an increasingly common structural form within and between government, scientific institutions, business, and non-profit organizations for innovation development in China. Particularly, in the development of indigenous Chinese standards has increased the use of distributed, interdisciplinary, collaborative technology alliances. Chinese technology alliance is a prototypical next generation enterprise, and is a new type of academic-industry alliance. Technology alliance produces new knowledge (Gulati, 1998; Leonard-Barton, 1995). Government, stated-owned enterprises, private enterprises, universities, public and private research centers are the main actors to form technology alliance. But it is not clear how effective they are in creating, adapting and disseminating knowledge to the people, firms, government, and other organizations, that then put it to use. That is why a technology alliance is critical. In addition, the Chinese government is calling for more domestically developed Chinese technology in Chinese products and the development of indigenous Chinese standards is to be encouraged in the context of reforming and reorganizing the country's standards regime (Suttmeier, 2004). The results of the case study also show that Chinese innovators are being asked to be more aggressive in defining and claiming intellectual property rights.

China's automotive manufacturing typically requires a complex supplier value chain to achieve outsourcing product development. A representative example of active involvement by the Chinese government in structuring the supply networks can be shown in the formation of the "Shanghai Santana Community" (SSC) under the auspices of the Shanghai municipal government. The Community is composed of 176 members including Shanghai Volkswagen and its key parts suppliers, auto sales companies and relevant service stations, universities and research institutes. SSC played a crucial role in the global purchase, vehicle sales and maintenance service and scientific research and developed the regional supplier network.

Now SSC has 206 members. The community improves the communication between SAIC-VW and its suppliers, fulfills good performance in the production localization, production update and fitting market demands. Similarly, in order to strengthen the collaboration and build the strategic partnership with its suppliers, Shanghai General Motors Co. Ltd. (SGM) and SAIC also established a "Joint Development Center" (JDC), which is composed of 40 automotive suppliers. The difference between SSC and JDC is that JDC is a kind of supply division which belongs to SGM, which allows suppliers to participate in some major projects in SGM, such as enhancing quality, and improving productivity, new technology development. Suppliers can access the database of technological services and consult related training and education information from SGM. Also they could join the SGM's programme of overseas visiting and international exchange.

The semiconductor industry is the core of the information technology industry. As China is the top mobile communication market and home appliance market in the world, the semiconductor industry should seize the first chance in these areas, creating its own technology, developing its own products and setting its own standards. The Chinese government views semiconductors as a strategic industry and has offered extensive support to companies involved in chips design and manufacturing. Now, China's chip industry, which is in the early stage of development, lacks inter-dynamics among industry chains as well as competitive brands and companies. More importantly, Chinese designers are hindered by chip manufacturing capabilities that lag about two generations behind the rest of the world. Hence, the Chinese government attempts to develop chips of its own intellectual property rights since it wants to stand out as a giant in the world of the semi-conductor industry. The Chinese government proposes a number of different actions to support the semi-conductor industry including bank loans subsidized by public authorities, government investments, tax reductions, and the founding of design centers. As a result, most of the semiconductor development in China involving domestic companies has centered on the foundry business, the Chinese Academy of Sciences (SAC) and the Ministry of Information Industry established a "Godson Chip Industrialization Alliance" (GCIA) in 2000. The alliance aims at industrialization of the "Dragon/Godson Chip" technology and first subsumes seven domestic enterprises and research institutes, such as ICT, Haier Group, Great Wall Computer Software and Systems Inc., Ltd. (Great Wall Software), China Soft Network Technology Co. Ltd., Redflag Software Co. Ltd., Shuguang Co. as well as BLX IC Design Co. Ltd. Its primary goal is to develop and promote the recently introduced *"Dragon CPU"*. With the products

covering the whole industrial chain, from CPU to mainboard, server to network computer and micro-computer, and from router to switch, the "Dragon Chip" CPU will be widely applied to network terminal products including communications and digital home appliances.

Information and communications technologies (ICTs) are likely to have a large impact on China's markets, services, earnings opportunities, educational possibilities, government administration and provision of social services. The Chinese government believes that the country must control certain core technologies in the telecommunication development. In 2002, the "TD-SCDMA Industry Alliance" (TDIA), a social organization, was formed voluntarily by enterprises and government-sponsored institutions. The members of the alliance include several telecom equipment providers, such as Datang Mobile Communications Equipment Co Ltd (Datang Mobile), ZTE Corporation, Huawei Technologies and China Putian. The purposes of the Alliance are: to integrate and coordinate the industry resources; to improve research and development (R&D) and production of the mobile communication enterprises within the Alliance; to promote the rapid and healthy development of the TD-SCDMA telecommunication industry; and to realize the popularization and industrial application of TD-SCDMA in China telecommunication markets. Recently, in February 2006, the Chinese government declared TD-SCDMA a national 3G standard and expressed its desire to promote the widespread deployment of the technology. The move is a crucial step towards the commercialization of TD-SCDMA and also sends a strong signal that the Chinese government is about to issue 3G licenses.

5.3.2. Research methods and data collection

Data analyzed in this chapter are based on interviews, archival research, and observations at 4 industrial technology alliances (Eisenhardt, 1989; Yin, 1989; Brown & Eisenhardt, 1997). The primary data source was 12 semi-structured interviews with individual respondents, 4 of which were taped (confidentiality concerns prevented me from taping all interviews). In addition, I attended alliances management meetings, project group meetings, presentations by consultants, seminas and workshops. I also had access to secondary sources from Chinese technology alliances such as internal newsletters, alliance reports, and regulation documents. I did two to three follow-up interviews with informants through telephone interviews and had them review case descriptions and add details. I then reviewed the case stories again to identify similarities and differences across cases. For each emerging

insight I revisited the original field notes, interview notes/tapes to further refine my understanding of events. A summary of the methods applied appears in Table 5.3.

Table 5.3. Methods and Data Collection

Cases	Case A. SSC *Shanghai Santana Community*	Case B. JDC *GM Shanghai Joint Development Center*	Case C. GCIA *Godson Chips industry Alliance*	Case D. TDIA *TD-SCDMA Industrial Alliance*
Interviews	1 general secretary 1 manager 1 assistant	1 purchasing manager 1 production manger	1 director 1 chief scientist 1 researcher	1 director 1 manager assistant 2 project managers
Length of interviews	1-2 hours	1-2 hours	1-3 hours	1-3 hours
Date of interviews	July 2004 - Sept.2004	July 2004 - Sept.2004	Dec.2005- Jan.2006	Dec. 2005- Jan. 2006
Number of Interviews	3	2	3	4

In this study, I selected cases in multiple industries (automotive, computer, and telecommunication) so that a theoretical framework could be developed that would apply across industries. I selected these high-tech industries because they face different platform strategies and are at the forefront of knowledge creation for innovation in Chinese transition economy. For implementing new product development strategies, in automotive industry, SSC and JDC adopt a supplier value chain strategy; the computer industry, GCIA uses modularization in product development, and telecommunication industry, TDIA carries out both product architecture and social cognitive platform strategies. I use three levels of analysis. A combined macro- and micro- level analysis: formation of alliance, bridging practice, motivation and governance. I analyze the main configurations of knowledge creation processes and the matchmaking and mediating mechanisms in technology alliances across these three levels. Based on these three levels, I have also identified three primary interacted factors that influence knowledge production processes in technology alliance. These three factors are: identity building, process network, and social cognitive modular platforms. These three factors provide a focus for my investigation. For Chinese technology alliances, collective preference formation is becoming a more complex problem as the technical,

industrial, and government regulatory communities become more differentiated as a result of economic changes and new government-industry relationships (Suttmeier, 2004). Thus, in this study, I employ qualitative research methods to uncover the details of the interaction among these factors. At the level of alliance formation, the units of analysis are partners of alliances, such as government, private enterprises, publicly owned firms, research institutions, and universities. The focus of analysis is the role of brokers and boundary spanners across organizational boundary to build linkages between different actors and bring them together to form alliances. Identity building is discussed at this level. At the level of bridging practice, the unit of analysis is the interdisciplinary groups or knowing communities initiated by alliances. The focus of analysis is matchmaking dynamics between different groups and communities and creation knowledge for innovation within alliances. The process network and knowledge modularization are emphasized at this level. At the level of motivation and governance, the unit of analysis is the individuals among interdisciplinary groups or communities. The focus of analysis is the quality of communication and density of interaction at individual to collective knowledge constructs. Motivation mechanisms and the process of trust are also highlighted at this level. In cross-case analysis, I link these three levels to describe the positions of brokers and boundary spanners within technology alliances. The results of the case study of Chinese auto industry also showed that the role of brokers and boundary spanners in evaluation and building links between communities/groups is important to knowledge creation processes.

5.4. Analysis and Results

In these case studies, my research extends previous work by examining how brokerage and boundary spanning are linked to new knowledge creation in Chinese technology alliances. My multiple case studies approach involves detailed interviewing innomediaries and observing their matchmaking and mediating practice. Therefore, I have conducted initial interviews with at least one manager/director of each industrial technology alliance. In addition, I have achieved a large study of second hand resources such as archival records, alliance charts, meeting minutes that helped me to understand the relative interaction and communication patterns among members of an alliance. Table 5.4. summarizes the practical effect of my hypotheses that I develop on the basis of the cross-level analysis.

Table 5.4. A Cross-Level Analysis of the Socio-Cognitive Modular Platforms

Configurations	Role of	Hypothesizes	Practical effect			
			SSC	JDC	GCIA	TDIA
Alliance formation	Firm, Institution, University, Center	H1. Brokerage and boundary spanning are the main forces to bind knowing communities and interdisciplinary groups together.	Positive *Support by government control by committee*	Negative *Control by of firm, part of division*	Positive *Strong in boundary spanning*	Positive *Strong in brokerage, less in boundary spanning*
Bridging practices	Community Group	H2. Brokers can draw upon process network to bring with innovative ideas.	Positive *Suppliers Community*	Negative *Strong hierarchy*	Positive *Academic community-based*	Positive *Academic community-based*
		H3. Boundary spanners help to create an inter-communal process network.	Positive *Supply chain network*	Negative *Contracting relation*	Positive *Research – industry network*	Positive *Research – industry network*
		H4. Brokers and boundary spanners can bridge the normative practice between academic/commercial communities and interdisciplinary groups across organizational boundaries.	Positive *Joint R&D within community, build standard system*	Negative *Learning training, R&D project share risk*	Positive *Bridge gap and across technical boundary, translate routines*	Positive *Gather and distributed information common lab/platform R&D*
Motivation and governance	Individual, Broker, Boundary spanner, Mentor, Engineer, Designer, Researcher, consultant	H5. Trust developed through predictive and normative models will increase the likelihood that a broker will achieve mediation.	Negative *Strong self-interest, less moderator*	Negative *Strong self-interest, leadership*	Positive *Common interest Lead by goal, long-term*	Positive *Reciprocity Lead by goal, short- term*
		H6. Boundary spanners gain reputations through repeated interaction to resolve technical and organizational boundary conflicts.	Positive *Non-profit, indirect interaction platform*	Positive *Team, project, experts, training*	Positive *Recruit technical experience frequent interaction*	Positive *Standard own IPR strong R&D capability*
		H7. The quality of communication and the repetitiveness of interaction are important index of evaluation and selection in knowledge creation processes.	Negative *Poor user profiles and interface management*	Positive *IT platform mediation, information database*	Positive *IT platform mediation, strong motivation, ethics*	Positive *IT platform mediation, forum, online community, external relation*
		H8. Recognitions of the number of structural ties and relational ties, the strength of cognitive distances and relational closeness are the main knowledge governance mechanisms.	Negative *Annual meeting, share information, less interaction*	Negative *Team rules, strong regulation, full control system*	Positive *Match and balance the ties and frequency interaction, community norm*	Positive *Match technology interfaces, social cognitive platforms*

My hypotheses about the framework of brokerage and spanning for knowledge creation are being tested on the collaboration and coordination among members of knowing communities, interdisciplinary groups within Chinese technology alliances. Cross-sectional studies across industries are very useful to understand the relevance of mediated innovation mechanisms in different industry and market contexts. The findings from 4 Chinese technology alliances coupled with the findings from knowledge creation processes in the Chinese automotive industries described earlier, give us strong reasons to expect that social cognitive modular platforms are positively associated with formative and moderative knowledge processes, particularly, matchmaking and mediating are the key mechanisms for knowledge governance.

5.4.1. The formation of Chinese technology alliances

For the theoretical explanations of the formation of alliances, Kogut (1988) emphasized three main motivations which are broadly applicable to Chinese technology alliances: 1) transaction costs resulting from small numbers bargaining, 2) strategic behavior that leads firms to try to enhance their competitive positioning, and 3) a search for organizational knowledge that emerges when one or both partners want to acquire some critical knowledge from the other or one partner wants to maintain its capability while seeking another firm's knowledge.

Taking the case of TDIA for example, TD-SCDMA[16] was originally developed by Datang Group to meet the Chinese telecommunication market requirement. TD-SCDMA, CDMA 2000, and WCDMA are currently the three 3G standards to be deployed in China. The TD-SCDMA standard, which has never been commercially used, lags behind the other two standards in terms of maturity. Therefore, the main aim of TDIA is to integrate and coordinate the industry resource, promote the rapid development of TD-SCDMA industry and realize the application of TD-SCDMA to the Chinese telecommunication market. The alliance focuses on technology and resource sharing and supplement between partners for their mutual benefits. TDIA advises the government to adopt important industry policies in favor of TD-SCDMA development, especially, alliance members operate the uniform Intellectual Property (IP) Rights policies, share the technology and market information with each other, frequently

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[16] TD-SCDMA is the Chinese contribution to the ITU's IMT-2000 specification for third generation (3G) wireless mobile services.

communicate with each other, in order to improve the collective competitiveness of the telecommunication enterprises within the Alliance.

Gulati (1998) proposes that the choice of governance structure is partly driven by the degree of uncertainty among potential alliance partners. In new Chinese technology alliances where partner firms have had little shared collaborative experience, and some have even never worked before, at this point, a more formal governance mechanism serves to mitigate initial concerns of risk and binds partners together within alliances (Fischer, *et al.,* 2002). Furthermore, one of the fundamental problems technology alliances face, especially those alliances involving multiple partners, is the inherent tension between cooperation and competition among partners (Hamel, 1991; Larsson, Bengtsson, Henriksson, & Sparks, 1998; Roehl & Truitt, 1987; Yoshino & Rangan, 1995). Cooperation among competitors within technology alliances becomes a coopetition[17] dilemma. Here, coopetition is an interactive relational process. Actors involved in coopetition are involved in a relationship with two logics of interaction: on the one hand it consists of hostility due to conflicting self-interests and on the other hand it consists of friendliness due to common interests. These two logics of interaction are in conflict with each other and must be separated in a proper way to make a coopetitive relationship possible (Bengsson & Kock, 2000).

In the Chinese technology alliances, the coopetition dilemma manifests itself in the sense that parts of an alliance face a conflict between maximizing their own self-interest, and maximizing the interests of the alliance as a whole. For example, the respondents of TDIA show that the Chinese academy is not the first organizer. In fact, the motion is starting from Great wall software Co. Ltd. They want to develop business-to-business technology in order to reach fast market development. In this way, they propose to build a business network with the Chinese academy of sciences and the Haier group. For the Haier group, they bargain for a large share of domestic electronic market through the value chain of alliance.

In a similar manner, the birth of GCIA (Godson Chip Industry Alliance) is considered to face the high market competition and risk in the beginning phase. On the one hand, there was "no chip" in China's server trade, and foreign chip technologies hold almost all market

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[17] Coopetition is "where two competitors both compete and cooperate with each other; complexity is due to the fundamentally different and contradictory logics of interaction that competition and cooperation are built on." Bengsson & Kock (2000).

shares. On the other hand, the design of computer CPU was a project piled up with money. For instance, the Intel Co., a worldly chip elder put in billions of US dollars each year for design and development, and used some 15 years to develop from 486 to Pentium II. Meanwhile, GCIA said that they had already reached at the same level of Pentium III this year. Could it be as quick as that? The respondents of GDIA stated that the Dragon Chip is defined as a type of embedded CPU, and it is intended for applications such as e-government, industry-specific equipment, financial services, automation control, communications, handheld devices and home information appliances. It remains to be seen whether the Dragon CPU and its backers can overcome the domination of foreign MPUs, namely those of Intel Corp. and Advanced Micro Devices Inc. The Dragon Chip also faces some technical challenges. Furthermore, many Chinese chipmakers have already partnered with foreign chipmakers. However, it has an advantage in that it is supported by the Chinese government, and China intends to use internally produced chips in areas such as national defense and military equipment related to national security. Another advantage in that GCIA partners are more familiar with regional diversity and local tastes and have often tailored their products accordingly. To foreign firms, Chinese are an entirely new set of customers. In this sense, Chinese firms also often have an easier time getting their products to customers. Concerning dragon chip's development, the technical breakthrough is merely the first step, and the crucial point is to build an integrated industrial chain. The Chinese government and related enterprises invest 3.7 million USD to support GCIA to build a high-tech industrial value chain. The Chinese government helps alliance partners to build confidence and promote cooperation.

Therefore, evidence shows that the conflict between self-interest and common interest described above, in fact, is the key characteristic of the formation of Chinese technology alliances at the beginning stage. However, how can partners manage such a dilemma and achieve sustainable cooperation in alliances? In my view, to understand the coopetition relationships that develop through interactive processes, a social cognitive platform perspective can be fruitful. Competitors can be involved in a social cognitive platform to learn from each other and foster knowledge creation and sharing for innovation. Another effective way to build identity within the alliance is to make all partners aware of inter alliance competition (Bornstein, 1992; Tajfel & Turner, 1979) so as to create the feeling that all partners within the alliance share a common fate. For example, the interview data indicates that SSC (Shanghai Santana Community) holds regular community meetings among members

of the community. During the meeting, they analyze the policy and the influence on the Chinese auto market. They share experience and discuss the latest R&D development between members of the community. In addition, members of the community help each other to contact overseas industries for advanced training and acquiring the relevant expertise. They work closely with universities, research institutes for joint research in new product development. The expert team of the community helps members to check errors of product quality, standards, and market operations and resolve the conflict quickly across organizational boundaries. It is shown that through joint work, they build a community identity and create a sense of cohesion that binds them together.

Conversely, JDC (GM shanghai Joint Development Center) failed to develop such a social cognitive platform to enhance a joint development capability. They build the supplier network and use computer-mediated communications. Suppliers can access the database of technological services and consult related information and resource to develop their own capability. But they miss the important opportunity to learn from and with each other. They have a weak organizing structure for collaboration, and most joint projects and activities belong to the GM's purchasing department.

The case study of TDIA (TD-SCDMA Industry Alliance) shows that they have more effective governance infrastructures than the other three alliances. They implement a community-based platform strategy to enhance collaboration and coordination among members of the alliance. The organizational structure of TDIA consists of the general assembly, the council and the secretariat, under which there are four working groups: the TD-SCDMA IPR management group, the industry projects management group, the administration group and the communication group. These groups of people act as a kind of innomediaries which bridge links between members of the alliance across boundaries. Also they build external relationships with academic or commercial communities and foreign enterprises. They regularly hold alliance meetings among members of alliance, and introduce experts to help the enterprises across technology boundaries. During the meeting, they discuss working plan, rule of patent announcement, current and potential problems and solutions of the alliance. In this case, they are committed to building common goals of the alliance. We should realize that goals emerge from the interaction, they are not prior to it. The collaborative work of the alliance requires *continuous negotiation* between innomediaries and members of the alliance. In addition, they select new members of the alliance and include advice on how to

work with external enterprises and communities during the meeting. As the director of the TD-SCDMA Industry Alliance said: *"The participation of the foreign firms marks the internationalization of our alliance."* Currently, the alliance is maintaining contact with 10 foreign telecom equipment providers, including Siemens and Nokia.

Additionally, they established the TD-SCDMA Forum including China Mobile, China Telecom, China Unicom, Datang, Huawei, Motorola, Nortel and Siemens. The Forum is a kind of open community, promotes the global uptake of TD-SCDMA technology. This community-based platform has become a communication bridge among government and enterprises, as well as research and academic communities. They regularly hold technical communication seminars as well as various international summits. Simultaneously, they help to build a worldwide process network and industry value chain, and to accelerate cooperation among members of the community.

The above evidence shows that a separate monitoring or surveillance system may be needed to create universal hostages within the alliance (Zeng & Chen, 2003). To improve cooperation and coordination among partners of the technology alliance, also requires extra monitoring and coordinating. Innomediaries play a key role in building identity and binding different actors together.

5.4.2. Bridging practice between knowing communities/groups

Diversity brings more perspectives and ideas to groups and it is a source of innovation and creativity (Wiersema & Bantel, 1992). Distributed group is a typical joint organizing structure in Chinese technology alliances. Normally, such distributed group interacts through interdependent tasks and is guided by common goal, with links strengthened by communication technology (Lipnack & Stamps, 1997). To integrate and synthesize knowledge, the groups must be ready to engage together in contributing knowledge and learning from others. Distributed group needs to monitor its joint knowledge and add strategies to increase that knowledge (Brandon & Hollingshead, 1999; Wegner, 1987).

In order to accelerate the R&D process the alliance assigns several expert groups to different tasks, which are called modular product design (Sanchez & Mahoney, 1996). This enables concurrent engineering. Since the individual experts of such groups might be

geographically dispersed, the distributed groups have to apply a virtual communication approach. At a formative stage, Innomediaries help these distributed groups by bringing in consultants/experts or adding group members to fulfill group needs. These boundary spanners are typically composed of consultants/experts who are highly knowledgeable and proficient in their own work and its practices. The main tasks for these experts are bridging technical boundaries, problem solving, shared cognition, and co-construction of meaning within and between communities/groups. They are skilled at recognition, the ability to search one's current level of understanding and defining when it is not adequate. Specifically, it is about the tacit understanding of how to examine a problem, what knowledge to bring to bear on joint R&D activities. In this sense, they deal with the issues of "when" and "where" new knowledge is emerging. Such a recognition includes knowing what is important to the project, where the new problem is and how to generate new ideas. For example, the case of TDIA (TD-SCDMA Industry Alliance) indicated that distributed groups can join work together in an *open scientific lab* which builds a common platform for members of the alliance. Through this common platform/lab, groups may work well together with defined roles, boundaries and coordinated schedules for gathering information on what the group/community requires. They also determine the responsibilities, project scope and intended outcomes. While these well-defined *"dictionary"* produced a collaboration of some sorts, the coordinated activity reduces conflict between groups (Blankevoot, 1986). They set *temporal* boundaries, such as when the project will end. Since groups gather the first and only such combination, developing a group/community identity is important for being able to understand and communicate the purpose of the mission (McGrath, 1984).

On top of that, TDIA implements knowing communities based social cognitive platforms to facilitate knowledge creation in a way that complements the new product architecture platforms. Innomediaries build strong inter-communal process networks with outside industry and academic institutions. TDIA often collaborate with academic research centers for joint new product development, such as Beijing Telecom University, Beijing University, and Tsinghua University, etc. At this point, innomediaries help alliances to accumulate knowledge assets; at the same time, innomediaries guide and control knowledge creation, sharing, and application across firms boundaries. Normally, innomediaries design work plan and schedule and let scientists work independently. But, some time, innomediaries also spend time and effort to interact and communicate with those scientists, monitoring and assessing the community/group's overall knowledge. In this case, innomediaries play a key

role in the knowledge governance, brokers concentrate on recognizing, evaluating and integrating groups/community's knowledge to support joint R&D activities. Practically, innomediaries bridge the linkages between organizations and academics communities, build the process network and form the long-term firm-community relationships.

Goals act as boundaries, orienting, but also constraining, activities. However, when these groups return to their mother companies, common mission goals need to be adjusted and refined in order to fit the project to the timeframe and workforce available during the distributed work activity. At this stage, innomediaries need to spend time and effort to learn and communicate with distributed groups, discover interdependencies, and actively work to synthesize knowledge and resolve conflicts toward mutual goals. In the meantime, innomediaries continue to monitor the boundaries between distributed groups, including differences in methods and approaches, and in the technology boundaries maintained between the groups. In learning together, group members create a collective or *community memory* (Orr, 1996) that defines them, creating both a boundary and a definition of who and what they are. They gain a sense of the identity of the group, e.g., what makes someone belong, and what the group represents.

Correspondingly, in the case of SSC (Shanghai Santana Community), the online platform/virtual communities promote knowledge exchange and sharing between different distributed groups and brings them together. These are highly interactive "virtual clusters" that involve a considerable transfer of virtual information over considerable distance. They act as virtual knowing communities, enrolling knowledge workers at their sites to join relational interactions with other distributed groups. Technological developments reduce the significance of face-to-face interaction between distributed groups. In most cases, however, the virtual communication between groups is enhanced by physical meetings. It should be noted that the regular face-to-face meetings are important to facilitate the trust building process, which is supposed to increase the willingness of virtual group members to share their data and information as well as to articulate their tacit knowledge. The main challenge of SSC's collaborate work is finding the right partners at the right time and communicating with others in order to work together. In this case, innomediaries play more an important role in matchmaking process. They select groups' profiles and help members of the community to discover the relationships with each other. In this way, they raise the awareness of the

community identity, and build an inter-communal network to find potential partners for direct interaction.

Taking another example, the TD-SCDMA Forum, in order to achieve the goal of technology promotion, they established 3 working groups: a technology promotion group, an industrialization group and a marketing promotion group. These groups implement monographic studies, hold seminars and symposia on TDIA, enhance the communication and the contact among partners of the alliance. At present, members of the TD-SCDMA forum have reached 420, covering 30 countries and regions worldwide including a telecom standardization organization, worldwide telecom operators, equipment manufacturers, content providers, chip manufacturers, etc. those groups as boundary spanners help the alliance to build such a large process network for technology promotion and innovation development. For example, the recent established joint lab between Alcatel Shanghai Bell and Datang Mobile is aiming to test the interoperability between GSM and TD-SCDMA applications. The lab hosts a complete TD-SCDMA system testing with operations in Datang Mobile's Bejing headquarters and Alcatel Shanghai Bell's facilities. This builds on a TD-SCDMA solution jointly developed by the two companies. Brokers of the Forum played an important role in building a partnership between *Datang Mobile* and *Alcatel Shanghai Bell* on TD-SCDMA development.

The above evidence confirms that all groups have worked to achieve common goasl and to build group identity. They need to create and determine schedules and processes, especially to build new collaborative relations. In addition, innomediaries help to build a process network that supports specialization and a dynamics of learning and exploration, and offers the benefit of both specialization and variety generation (Kogut, 2000).

The alliance brokers act as moderators between distributed groups and communities to support decision-making processes if necessary. The brokers also help to construct shared meaning or common ground defined as how people should behave (Ouchi, 1980; Tsoukas, 1996) It includes who has access to what knowledge, how the quality of the knowledge is evaluated and which attributes of the knowledge should be captured for later use (Davenport & Prusak, 1998; Majchrzak *et al.,* 2000). Hereby, groups establish cooperative norms for interpersonal communication and interaction to support their joint work. The cooperative norms determine the rules, regulations, and technical standards for the smooth operation of

the alliance's distributed units. Innomediaries and project leaders have to determine what and when each expert group has to deliver their results. Along with work comes the process of setting technology boundaries and work process *trajectories*, mapping out future boundaries. As they progress, they adjust and refine the scope of their work to fit the mission requirements. In this sense, identity building, interfaces monitoring, experience recruiting, and community/group norms translating lead to the construction of group routines.

5.4.3. Knowledge governance, motivation and trust in knowing communities

Knowing communities are embedded in the Chinese technology alliances and are composed of loosely affiliated individuals with common interests and a shared community identity. Within the knowing communities, individuals gain new knowledge collectively, through joint discussion, bringing in experts to consult with technology and organizational boundaries, attending conferences together.

Normally, those innomediaries/ community members have dual roles, they participate in communities on part-time basis, and they still belong to their enterprises and keep working routinely. Individuals can be knowledge brokers as well. They might visit other labs to bring expertise to other groups/communities. For example, groups of experts of ICT (Institute of Computing Technology) at Menlan group, before they joined the project, did background research for the Menglan group to gain knowledge in new common areas, and organize related training courses with local engineers to achieve a common understanding (Argote, Gruenfeld and Naquin, 2001). As an initial mission and part of the value chain of the alliance, the Haire and Menglan group established a joint venture to design and produce products by using "Dragon Chip II" in Jiangsu province. Haire and Menglan are good at manufacturing and operational level, but lack research and design capabilities. Therefore, a group of experts of ICT works with local designers and engineers and provides innovation-related ideas and assistance. They help designers and engineers generate new ideas and cover the gap of technology boundaries, arrange resources and evaluate knowledge. In my view, this group of people acts as a knowing community, likely to be especially important at early stage of an innovation.

To integrate knowledge across technological boundaries, experts must spend time and effort to build shared meaning/common understandings with local engineers. Active

communication and frequent interaction are essential strategies for achieving this common ground (Cook & Brown, 1999; Engestrom, 1999). However, they face the communication problem with the local designers and engineers. As the chief architect of Godson chip project said, *"During joint work, the most challenge thing is to control rhythm in teaching and communication with local engineers, should be just enough and not too much... We usually identify that group of members who would benefit from joining a particular stream of communication and then use their leadership to bring them into the discussion."* They use their privileged position to interpret individual concerns and to organize discussion among the members of the group.

Group level frequency of interaction is determined by the density of the communication networks. Communication density describes the overall level of interaction reported by the members of the group. The higher the density, the more communication occurs within the group (Hinds & Kiesler, 2002). Innomediaries should help to create common communication codes, and manage the communication on group/community knowledge creation processes. An individual's choice of code depends on a trade-off between compatibility with the individual's personal environment and the codes and the environments of those with whom the individual wishes to communicate (Wernerfelt, 2003). The difficulty of matchmaking is about how different types of innomediaries can provide knowledge that supports different stages of a firm's innovation processes and how different contexts play a role in determining the optimal scope of the knowledge creation processes. At this point, informal communication is necessary, trust, norm, motivation also can enhance the knowledge creation capabilities.

Granovetter (1985) suggests that social ties or embeddedness can promote trust between actors and impact economic performance. Uzzi (1996) further develops these ideas by demonstrating that a mixture of embedded and arm's length ties increases survival rates among firms in the New York apparel industry. In Chinese society, the types of guanxi bases themselves signal *relational closeness* to guanxi outsiders. Guanxi is the Chinese term that means "connections," "relations", or "relationships." (Saxenian, 2003; Chen, Chen and Xin, 2004). The minimum requirement for two individuals to have guanxi is that they are acquainted with each other from past interactions, similar to weak ties in the Western network literature (Bian, 1997; Burt, 1992; Granovetter, 1973). Because Chinese technology alliances represent a particular type of social tie, examining the overall network of ties within which a

firm is embedded is likely to shed light on the effectiveness of knowledge creation and sharing within alliances.

The interview of one of the directors of TDIA indicates that the birth of TD-SCDMA needed a number of apparently extraneous kinds of knowledge. SCDMA was originally developed by Beijing Xinwei Telecom Technology, a joint venture set up between Datang Group and US-based Cwill. The interview of the chief innovator of SCDMA indicated that *"At the very beginning, two Chinese oversea students came to my office and we discussed about development of a new technology for Chinese telecommunication standard market"* *"We had intensive discussion about the technology boundaries, such as most of countries adopt FDD technology, while we would develop TDD based technology, and develop new subcomponents such as AI antenna and CDMA technology"*. Once they had defined the boundaries, two students went back to the US and they set up work groups on both sides and developed this new technology standard jointly through an internet communication platform. After one year, they finished the conceptual design, and they got a chance to talk to senior government officers to seek external support for their project. At that time, they named the new technology "SCDMA". In order to encourage Chinese telecommunication industries to adopt this new technology standard, they established a joint venture to facilitate the research and development of SCDMA. Later, they got government support and built the TD-SCDMA industry alliance.

Evidence shows that *guanxi* as a kind of relational network is useful to make exchanges and accomplish tasks (Guthrie, 1998). Different guanxi bases signal different degrees of relational closeness. For instance, the close friend is seen as high in relational closeness. In addition, Gulati (1999) highlights the important role that a social network of prior ties can play in affecting trust among partners. Not only can networks provide for strong cognitive and emotional bases for trust, but they also may serve as important mechanisms for deterrence-based trust where the anticipated utility of a tie with a given partner motivates good behavior (Powell, 1990). Motivation provides a means for representing and reasoning about individuals' overall objectives, while trust offers a mechanism for modeling and reasoning about the reliability, honesty, veracity and so forth (Griffiths & Luck, 2003). As we discussed in Chapter 3. motivation can be linked to a set of underlying goals, from the accomplishment of which individuals derive a certain level of utility (Deci, 1976); to sum up, there are three kinds of motivations: 1) extrinsic motivation is driven by a reward system and

incentive mechanisms (Brief *et al.,* 1977); 2) hedonic intrinsic motivation is driven by the goal of being engaged in enjoyable activities (Lindenberg, 2001); and 3) normative intrinsic motivation is driven by the goal of engaging in behavior that is compliant with norms and values (Allen & Meyer, 1990; Kreps, 1997). The three kinds of motivations reflect the fundamental difference between individual behavior in groups or communities. Motivations can be thought of, as an individual's high level desires, guiding all aspects of his/her behavior. Furthermore, motivations direct one's reasoning and action at both individual and collective level. Foss (2005) also considers motivation and cognition as important mechanisms in knowledge governance. An individual responds to change in his/her own beliefs, resulting from *predictive perception*, by generating goals according to his/her motivations and beliefs. At this stage, extrinsic motivation or hedonic intrinsic motivation might play a role to guide individual or group behavior.

The empirical data of the Godson group show that reward structures need to accommodate with employees' career development. The director of Institute of Computing Technology proposed three principles about how to motivate researchers during Godson project: "*reputation, care, and reward system*". First, he established a research funding for young scientists, and changed the employees' treatments, such as living conditions and medical insurance. Further, he reformed the administrative structure of ICT, established a shared infrastructure in order to allow researchers or employees to own their share of funding. Exchange favors/gifts is actually one of the best ways to build up strong guanxi (the Chinese term for relations or connections), in this case, extrinsic motivation determines whether researchers want to cooperate, intention determines whether they can cooperate and trust determines the predictive risk of cooperating. Individual researchers will agree to cooperate if there is no conflict of intentions, and the goal for which cooperation is requested is of motivational value (Griffiths & Luck, 2003). In this sense, Chinese norms of reciprocity embedded in "huibao[18]" and institutionalized in guanxi help reduce risk. "Huibao" builds up process-based trust, which is rooted in the reciprocity of social interactions (Creed & Miles, 1996; Zucker, 1986). Process-based trust is embedded in specific social relations, and "huibao" provides a mechanism embodying these crucial requirements of trust of this sort among Chinese people.

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[18] An indigenous Chinese concept called "huibao", which translates as the norm of reciprocity in English or gift exchange, is highly an appreciated basis of morality in China.

Another important factor is the initial R&D investment of the Godson project. According to the director's explanation, the first challenge is to manage distributed resources and motivate depressed researchers. The director decided to invest 1.24 million USD in R&D development of Godson chips. This amount of investment equals half a year of operational costs of ICT (Institute of Computing Technology), although the Godson project is facing many unknown market risks and barriers, but ICT researchers know that they are in the same boat and should collaborate together. In this sense, they build "we" identity, share the common goal to "develop Chinese chips", and are bound together by confidence "Chinese can made their own chips". They started from high-level motivations, strong confidence, clear goals, and robust research and design capabilities. After five months, they developed the first conceptual chip and passed the testing. Then they focused on product development, they finished the whole R&D development within ten months. This is an amazing research and development speed. As the chief scientist of the Godson chip project said, *"we can develop Godson chip within ten months, just because we adopt very effective technology boundaries."*

At the beginning phase of the project, they defined the boundaries as *"high quality, universal, and refined"*. They changed technology boundaries in later processes. They redefined objectives into two specific goals, *"compatible"* and adopted *"RISC architecture"*. They implemented an incremental approach to develop new products, step by step to check errors, and discovered the problems. In the design processes, the chief scientist played the role of an integrator. The chief scientist realized that a moderate frequency of interaction and quality of communication is very important in research processes. The chief scientist gave an example: one time, they were informed that the director of CAS (Chinese Academy of Science) would visit and review their work processes within two days. Then they decided to change the work schedule and to finish work within two days. However, the chief scientist considered the drawback effect on researcher's motivation, in case they could not finish the work. Thus, the chief scientist just organized several key experts to test and refine the product; they worked together very intensively, and finished the work in time. As the chief scientist said, *"The innovative idea comes from recombination and problem solving, it also depends on your previous experience, it is kind of accumulative processes, but, some time, the new solution or ideas can come radically, and it is hard to know when new knowledge is emerging."* Motivation and trust are the important factors to keep a project going and stable. The Godson project group holds group meetings once a week, and the chief scientist encourages researchers to exchange opinions about the work processes; *"operational routines*

are the foundations of our work processes, however, motivate people becomes more important." They define group identity, common norms, and share common understanding. At the same time, they build trusting relationship among the members of the group.

Evidence shows that Chinese cannot directly generate trust from their confidence on strange other. Confidence encourages Chinese to embrace more social relations, but trust must be built on actual interaction experience in dyad relations. As suggested by repeated games, a Chinese researcher selects a particular intention to pursue and acts toward its achievement, and he uses motivational value as guiding measure. Once a group builds common norms, and the interaction among the group attends to reciprocity, they are building normative trust within the group. It is to be noted that normative intrinsic motivation, and hedonic intrinsic motivation are the main forces to accelerate knowledge creation at the individual-collective constructs. As one of researchers of the Godson chip project said, *"Our project management style is just like 'feeding sheep', we rely on individual self-determined and competence-enhancing behavior"*. But, how an individual researcher comes with such an intrinsic motivation, according to the interview data, to collective work processes, researchers respect group leaders' foresight and beliefs, intelligence and passion, experiences and capabilities, more importantly, they share a common goal that is to "develop Chinese CPU on their own".

We should be aware of the importance of a *motivation fluctuation*. In dynamic environments, fluctuations in the importance of motivations can lead to failures to establish cooperation that would actually benefit the individuals (Griffiths & Luck, 2003). In this sense, a moderate on mediating effect is taking place. Brokers and boundary spanners not only foster knowledge creation processes by optimizing the frequency of interaction and quality of communication, but they are also concerned about the moderate effect on the robustness and flexibility benefits that motivations afford. As individuals interact they can infer trust values based on their experience and over time improve their models of trustworthiness. Trust is a useful notion for binding a group together and providing additional justification for individual rational program. In addition, repeated interaction helps members of an alliance to build a long-term relationship; partners are more likely to have opportunities to *reciprocate* other partners' behavior (Zeng & Chen, 2003). Lastly, a longer time horizon may provide more opportunities to develop trust among partners of Chinese technology alliances.

In summary, as an exploratory study, I have just completed the very early stage of my research to analyze the role of brokers and boundary spanners at the micro level. My empirical research of Chinese technology alliances suggests that innomediaries help to develop shared meaning or common understanding to meet at the group/community interfaces connecting with each group/community or specialized participants in order to achieve effective knowledge creation and mobilization in the new product development processes.

Three general findings emerged from this process.

First, using different matchmaking contexts at different levels can provide opportunities to improve the efficiency and the quality of communication and interaction between members of an alliance as well as overall knowledge production.

Second, for the optimum communication and interaction difficulties, matchmaking plays a role in determining the optimal scope of knowing processes for recognition, selection and evaluation of knowledge.

Third, I also found a mediating effect of the normative context of knowledge on relational moderation. I argue that it is possible that relational moderation and cognitive optimum scope may have independent and interactive effects on the processes of knowledge creation. Trust is a useful notion for binding a group together and providing additional justification for an individual rational program.

Thus, brokers and boundary spanners not only foster knowledge creation processes by optimizing the frequency of interaction and quality of communication, but they also have a moderating effect on the robustness and flexibility benefits that motivations afford.

5.5. Discussion and Conclusions

This chapter represents an attempt to integrate and synthesize research examining the role of brokers and boundary spanners that affect knowledge creation processes in the context of Chinese technology alliances and to explicitly highlight a few links to broader areas of inquiry concerning motivation effect and trusting relationship. A deeper understanding of how

important brokering and boundary spanning at varying levels of analysis affect how they optimize the scope of knowing processes and moderate motivation and trust and the capability of knowledge creation might allow future research in this area to more fully specify models of knowledge creation in individual, communities/groups, alliances. In addition, by explaining links to related fields of study, future work may be more grounded in and also inform broader theories and literatures. The remaining discussion in this chapter presents specific questions and topics for consideration in future empirical analyses in this area.

5.5.1. Theoretical implications

My conceptual framework of brokerage and boundary spanning for knowledge creation contributes to a better understanding of the process of matchmaking and mediating between cognitive distance and relational closeness by showing how different actors can play specialized roles in the knowledge creation processes. Specifically I think that it contributes to a better understanding of the processes of rational selection and evaluation, and the firm-community relationship.

First, my research contributes to the literature on new product development which has adopted platform strategies and has mainly centered on modularization. By implementing a product platform strategy, firms can reduce overall production costs and times, while meeting diverse customer demands (Weck, Sub & Chang, 2003; Urich & Eppinger, 1999; Kogut & Kim, 1996). A platform strategy to product development is essentially a factor in design and manufacturing and market development. Modularity is increasingly proposed as an approach to product innovation, deeply changing the trade-off between costs and diversity (Sanchz & Mahoney, 1996; Baldwin & Clark, 1997, 2000; Galunic & Eisenhardt, 2001; Langlois, 1999). By showing that a new product is generated through modularized platforms with an open interface the focus has been primarily on open innovation (Gawer & Cusumano, 2002; Chesbrough, 2003). Notwithstanding the fundamental role of product platforms, I highlight the fact that *community-based social cognitive modular platforms* support open innovation and product development at the group/community level. The social cognitive platforms support situated learning within and between modularized communities. Independent knowledge brokers and boundary spanners play a key role by enabling combination and reconfiguration of knowledge and technical experience to support innovation within social cognitive platforms. Importantly, social cognitive platforms focus on how generative

mechanisms drive the process of knowledge creation at the knowing communities settings. The notion of community-based socio-cognitive platforms can be seen as an alternative platform strategy for innovation development between division of labor and division of knowledge (Amin & Cohendet, 2004).

Second, my model highlights the fundamental role of brokerage and boundary spanning to overcome the gaps in creation and sharing of knowledge and to bridge links between individual or group/community collective knowledge construction and across technological boundaries (Sawhney *et al.*, 2003; Wolpert, 2002; Fleming & Waguespack, 2006; Burt, 1992, 2004; Allen, 1997; Tushman, 1977). The processes of brokering and boundary spanning between product platforms and social cognitive platforms constitute a fundamental aspect of the quality of communication and interaction amongst disclosing standard interfaces and modularized communities interfaces, and bind knowing communities and interdisciplinary groups together. My analysis of matchmaking mechanisms shows how bridging links between individual to collective constructs, building shared choice and selection criteria. Furthermore, innomediaries help to create inter-communal process networks that allow the participants of networks to facilitate the knowledge generation, because these networks create access to knowledge (Powell *et al.,* 1996).

Third, inter-communal process networks are associated with trust, and strong ties of network produce and are governed by relational trust and norms of mutual gain and reciprocity, which grow through interaction (Granovetter, 1985; Uzzi, 1996; Krackhardt, 1992; Powell, 1990). Shared meaning is a prerequisite for trust to emerge. Also matchmaking needs relational trust to expand the scope of common understanding. Importantly, innomediaries need to build long-term, trust-based relationships with the participants in the knowledge process network. I show that social cognitive trust is closely related to the community's activity, and based on processes of interaction as a kind of rational program trigged by *motivation* and *self-interest* through predictive and normative models. I consider that strong and weak relational ties are embedded in relational networks that are specific features of social cognitive trust. Another important feature is social cognitive trust based on reciprocity, which can be seen as the key engine to develop trust in social cognitive platforms. Ultimately, an innomediaries position in relational network is related to predictive and normative models of trust, towards other individuals in the network.

5.5.2. Managerial implications

The concept of community-based social cognitive platforms is extremely useful for firms that need to develop new products with commercial or academic communities. In Chinese technology alliance, next to diverse knowledge and different technology boundaries, distributed members of alliance cannot benefit from the creativity, diversity and agility of each other, and members of alliances present several structural holes that limit the scope of their interaction and relations (Burt, 2004). These holes get wider when referring to the process of joint development. Therefore, the indirect connections, such as brokerage and boundary spanning are useful for knowledge creation and sharing within technology alliances. Brokers and boundary spanners can bring new ideas, span technical boundaries and create links and interaction between members of alliances across space and time (Fleming & Waguespack, 2006; Burt, 2004). In doing this, they provide a fundamental service for knowledge generation and mobilization within technology alliances.

Furthermore, brokers and boundary spanners gather and integrate knowledge and bridge the technology gap between members of alliances and organize academic or commercial communities to participate in specific joint research/development projects on the basis of common interests. They use knowing communities/social cognitive platforms to facilitate knowledge creation in a way that complements the new product architecture platforms. At this point, they help alliances to accumulate knowledge assets; at the same time, they guide and control knowledge creation, sharing, and application across firms boundaries. In this sense, they play a key role in the knowledge governance, brokers concentrate on aggregating and disseminating knowledge to support innovation, practically, in building the linkage from individual to collective knowledge in joint development activities.

5.5.3. Limitations and future research

I find at least three limitations in this cross-level study.

First, considering the nascent nature of the brokerage and boundary spanning phenomenon, I am aware that the hypotheses that I developed will need to be refined by operationalizing the definitions of the constructs, and by developing measures for each construct. Further empirical research is needed to test and validate the hypotheses that I have

developed in this chapter. At a broader level, I will use the methods of the social network analysis (Owen-Smith & Powell, 2004) and the document analysis (Fiol, 1994) to understand the dynamics of interaction and communication. To do this, I measure ties strength by the frequency of interaction between individual, groups/ communities and their level of resource commitment to the relationship.

Second, the similarity between brokers and boundary spanners requires a further study. Brokers can span boundaries, but not all boundary spanners broker. In fact, I think that a broker may turn into a boundary spanner, and perform dual roles in joint research development activities. For example, the case of Menglan- GCIA shows that a group of experts of ICT went to Menglan to bridge the technology boundaries, in the meanwhile, they helped local engineers to arrange the resources and evaluate the technological knowledge. In this sense, they are brokers and boundary spanners. In the case of TDIA, because these companies are good at research and development capabilities and most of them in the same industrial regime, the brokers need to develop strong competencies and moderate commercial and academic communities to facilitate knowledge creation among these companies. They also help to build public scientific research lab as the common platform for joint R&D development. However, in the other two cases, the positions of brokers and boundary spanners are not so clear; future research must explore this area further.

Third, it would be important to understand how different types of innomediaries can provide knowledge that supports different stages of firm's innovation processes and how different contexts play a role in determining the optimal scope of the knowledge creation processes. My practice-based knowledge spiral is a kind of knowing processes trajectory that innomediaries and project leader can use to search, analyze and determine what, when and where knowledge is emerging and mapping out the optimum scope of knowing processes and mediating the moderate strength of motivation and trust to support knowledge creation processes. However, the correlations of each factor and effect on the performance are still not clear. Further qualitative analyses, such as by using the comparative method, may contribute to better understanding the dynamics of the practice-based knowledge creation spiral.

Chapter 6.

Summary and Conclusions

- The key Findings of the Study
- Theoretical and Managerial Contributions
- Limitations of this Study
- Directions of Future Research

This research aimed to provide a new theoretical ground for knowledge creation in organizations and communities. The argument I make in this thesis is a theoretical one, and our understanding of knowledge creation can only be advanced to a certain point through theorizing. To narrow the scope of my research is critical. Based upon the results of an empirical study, I summarize the main hypotheses that led my studies as follows: Recognitions of the optimum scope of knowing processes and mediation of moderate effect on motivation and trust are the main knowledge governance mechanisms within the community-based socio-cognitive modular platforms.

H1. The quality of communication and the repetitiveness of interaction are an important index of evaluation and selection in knowledge creation processes.

H2. Recognitions of the number of structural ties and relational ties, the strength of cognitive distances and relational closeness are the main knowledge governance mechanisms.

This Chapter provides an in-depth discussion of how the emergent data and model provided insight into the one overarching question of my study, namely: *"How might we re-define and better understand the processes of knowledge creation?"* and three sub research questions: *"What are the generative mechanisms through which new knowledge is created?"*, *"How does inter-subjectivity or interaction take place and what is involved in it?"* and *"How does a human agency moderate knowledge creation processes?"*

To answer the questions, I first integrate three bodies of literature that seemed most relevant for knowledge creation: the conceptual knowledge, the organizational knowledge creation theory, and the communities of knowing. Then I re-reviewed the literature on social capital, social cognitive theory and the Chinese view of human capital in order to explore more precisely research questions related to a micro-foundation of knowledge. The second round of literature reviews led to the final conceptual framework, a conceptual process model of knowledge creation. In order to gain an in-depth knowledge and understanding of knowledge creation processes, I took a grounded theory case study approach to develop a practice-based knowledge spiral in an effort to present inner dynamics and transformation of knowledge creation processes in organizations and communities.

I organize this chapter as follows. First, I present the summary of my key findings. Next I discuss the implications and contributions of this study, followed by the discussion of the limitations of the study and future directions of this research.

6.1. The key Findings of the Study

The empirical study involves two phases with two sets of results, which are organized by three levels of analysis: individuals, communities/groups, and organizations. In the first phase, the comparative case studies in Chinese automotive industries provide us with an empirically grounded theory and a set of propositions about knowledge creation processes and practice-based knowledge spiral. In the second phase, the main propositions are tested using cross-sectional studies across Chinese technology alliances. The cross-level case study exemplifies knowledge creation as a dynamic evolutionary process in which knowledge gets created in a practice-based knowledge spiral and field evidence strongly suggests some key elements of cognition and recognition mechanisms for strategy making in the knowledge governance.

6.1.1. Knowledge creation at the individual level

At the individual level, I find that individuals first acquire knowledge through analogical mapping. Analogy, in its most general sense, is the ability to think about relation patterns. As Douglas Hofstadte (2001) argues, analogy lies at the core of human cognition. Gick and Holyoak (1983) provided evidence that analogy can provide the seed for forming new relational categories, by abstracting the relational correspondences between examples into a diagram for a class of problems. In my study, I find that individuals interact with others to test and confirm their own perceptions and this process starts with the recognition by the individual or groups that the experiences of others may be helpful in building a collective construct and generating new knowledge. Specifically, individuals try to identify what they already know in their mental models and interpret those images or metaphors through observation. When individuals are engaged in real conversation and observation, their perception shifts from their own mental model to the action. In this transformation level, individuals' belief and judgments/ interpretations are termed boundary or mental categories. It is these categories that allow coordination action. At the adaptation level, individuals are

connected to their knowledge source/experience and interpretations are disseminated across individuals. I also find that individual construction, are mostly based on values, motivators and other psychosocial attributes. The personal background seems also to be relevant as a determinant of knowledge creation processes. At the collective level, individual self-fulfilling, self-interest and motivation shape interaction and construct meanings among group members.

This finding suggests that human cognition based on mental models that construct in interaction is also influenced by one's physical and social environment. Cognitive diversity yields opportunities for individuals to acquire new knowledge; individuals manage the optimal number and strength of exchange relations in order to optimize knowledge creation. This finding also suggests that the individual responds to changes in his/her beliefs, resulting from predictive perception, by generating goals according to his/her motivations and beliefs. Motivations can be thought as individual's high level desires, guiding all aspects of his/her behavior (Griffiths & Luck, 2003). As individuals interact with others, they can infer trust values based on their experience and over time improve their models of trustworthiness. Trust offers a mechanism for individual analogy reasoning about the reliability, honesty, veracity and so forth.

6.1.2. Knowledge creation at the communities/groups level

At the communities and groups level, I find that members of communities or groups may contain both tacit and explicit elements, and these may be brought into contacts through various interaction processes of which some require overlapping activities and close interaction. Boundary objects can be utilized to help develop and improve effective communication and interaction between members of communities. High frequency of interaction can push communities members towards mutual beliefs and thereby build the community identification and common norm generated by the community as a whole. Furthermore, the use of computers and information technologies as media to create and sustain collaborative networks in knowledge creation also appears as a significant factor in collaboration at the individual and collective levels. At the communities' level, an important part of the role of brokers leads to the emergence of community structure and boundary spanners in linking firms and communities. The between group/community brokers can help generate new ideas and evaluate the knowledge in the practice across organizational boundaries. Boundary spanners also help to create an inter-communal process network

between communities/groups. Through the direct face-to-face interaction and the indirect inter-communal process network, brokers collect good ideas/advices and transmit them to the pool of evaluation system, which includes staff of expertise and experience who select and interpret these ideas/advices. The knowledge creation process includes those who have access to what knowledge, how the quality of the knowledge is evaluated and what attributes of the knowledge should be captured for later use. Boundary spanners are also strongly linked to their colleagues and have extensive links outside their divisions. I also find that high levels of communities/groups interaction may decrease the capability of knowledge creation since members of communities/groups do no longer make full use of their cognitive ability to explore something new. Brokers can help to reduce cognitive distance and achieve a sufficient quality of communication and frequency of interaction, in the way to build common understanding and achieve a common goal. This finding suggests that brokers and boundary spanners play valuable roles in knowledge creation. They match the optimal scope of knowing processes for recognition, selection and evaluation of knowledge. They also play an important role in bridging practice from individual level to collective level.

I also find that motivations and past experiences are the most important factor in knowledge creation processes among groups/communities. Motivation determines whether members of communities/groups want to cooperate in joint activities. Trust is a useful notion for binding a group/community together and providing additional justification for individual rational selection program into action. However, fluctuation in the importance of motivations can lead to failures to establish cooperation. This finding suggests that brokers and boundary spanners can match the size of communities/groups to facilitate knowledge creation processes and at the same time consider the moderate effect on the robustness and flexibility benefits that motivations afford. This finding also suggests that it is possible that relational moderate and cognitive optimum scope may have independent and interaction effect on the processes of knowledge creation.

6.1.3. Knowledge creation at the organizational level

Novelty, however, remains a challenge. At the organizational level I find that local Chinese firms can catch up with the emerging technologies through learning, cultural incentives, and organizational opportunities. The Chinese firms adopt reverse engineering or imitation and in-house R&D to develop their organizational capabilities. In addition,

dispersion of the value chain of the Chinese industry helps SMEs or entrepreneurs to develop product technology through technology integration. The newly founded local firms can draw advanced experience from foreign counterparts, so as to improve themselves by upgrading their technologies. Normally the newly founded local firms have limited product design capabilities and start their product design by imitating existing products and have a lower cost in developing a product. The Chinese entrepreneurs learn new knowledge from the experience of similar industries, and choose to invest step by step in the new product development. I also find that local entrepreneurs are very flexible to involve internal and external resources to integrate a decentralized innovation process. The local entrepreneurs use new technology development tools to help with product development and product upgrading, and the result is that the development cycle is shortened sharply. This finding suggests that the larger the number of other industries the entrepreneurs have experienced, the greater the chance that the entrepreneurs will be familiar with an industry that matches the target well along the strategy making in innovation development. Also, deep experience and understanding of industry and market of the entrepreneurs can steadily improve their performances (Gavetti, Levinthal and Rivkini, 2005). This finding also suggests that local entrepreneurs use analogical mapping to search other similar industry settings, drawn from direct or vicarious experience, guide their new product development processes.

At the alliance level, I find that one of the fundamental problems technology alliances face is the inherent tension between cooperation and competition among partners. In the Chinese technology alliances, the coopetition dilemma manifests itself in the sense that parts of an alliance face a conflict between maximizing their own self-interest, and maximizing the interests of the alliances as a whole. I also find that an alliance requires extra monitoring and coordinating mechanisms to improve cooperation and coordination among partners of the alliance. Within the monitoring system, competitors can be involved in some kind of social cognitive concepts and processes with coopetitive relationships simultaneously and learn from each other and foster knowledge creation and sharing for innovation. Another effective way to build identity within the alliance is to make all partners aware of inter alliance competition so as to create the feeling that all partners within the alliance share a common fate. The alliance members share experience and discuss the latest R&D development between the networked communities. By monitoring the system, boundary spanners help members to check errors of product quality, standards, and market operations and resolve the conflict quickly across organizational boundaries. This finding suggests that through joint work, members of

alliances build identity and share common understanding, and create a sense of cohesion that binds them together. I also find that a group of people in the monitoring system acts as a kind of innomediary to bridge links between members of alliance across boundaries. Also, the innomediaries build external relationships between members of an alliance and academic or commercial communities and foreign enterprises. The innomediaries introduce experts to help enterprise across technology boundaries. The innomediaries also help members of an alliance to define schedules, rules and resolve the potential problems of alliances. This finding suggests that the innomediaries can help build the common goals of an alliance and play a key role in building identity and binding different actors together.

6.2. Theoretical and Managerial Contributions

This study is of interest from both a theoretical and practical perspective. Overall, the thesis expands and integrates three bodies of literatures to provide a holistic view of the theory of knowledge creation. Beyond contributing theoretically, this study makes a practical contribution to the management field, offering some key recommendations on strategies and practices to develop the processes of knowledge creation.

6.2.1. Contributions to theory

Reconciliation of knowledge creation theory

Based on the analysis of the epistemology literature, we can see that there is a strong debate on knowledge creation: one side argues that knowledge is generated by individuals and that knowledge resides in the individual's mind; the opposite view of knowledge is created through collective learning processes and knowledge resides in practice. Each epistemic position is defined by critiques of the others. More important, epistemology literature does not give a clear answer to the question of where knowledge comes from and how people can learn from their experience. It is still not clear how we can define the knowledge or whether we cannot define knowledge. In short, we do not know the origins of knowledge.

The organizational knowledge creation literature suggests that the generative dance between knowledge and knowing is an important phenomenon to examine the new knowledge

creation processes; however, we do not know how this interaction takes place and what is involved in it. Yet, we probably know that routine is created through interaction between knowledge and knowing, but it's not clear how routines are developed.

The communities of knowing literature suggests that building intersubjectivity is the key to support knowing communities for organizational innovation, we need to design the new loose infrastructure in order to enhance the commutation and interaction with knowing communities. However, the structural and epistemic components of communities of knowing raise the question about the mechanics of their interaction that remains relatively unaddressed to so far (Thompson, 2005). Furthermore, interaction between knowledge and knowing or action is important to explain the knowledge dynamics. However, here is a question about the dynamics of such interaction that enables new knowledge to emerge. In this sense, we need to identify where our action comes from and what the origins of knowledge are.

<u>I. The conceptual process model of knowledge creation</u>

From the second round literature review three main conclusions are clear. First, the emergence of norms influences the micro-macro linkages; second, there is evidence that psychosocial attributes exert a strong influence on the willingness of individuals to engage in knowledge creation, which are critical for a micro-foundation formation; and third, that other personal and contextual factors may also influence the knowledge creation processes (*i.e. Wu-Xing* succession).

My research is based upon a number of research streams that together suggest an alignment of knowledge and knowing for new knowledge generation. For my purposes, I took the view that knowledge is a process situated in practice by providing an explanation of how firms interact with its knowing/knowledge communities to create knowledge. The research literature illustrates that knowledge is a process and knowing is an aspect of action and it is about interaction that enables new knowledge creation.

The study of the psychosocial attributes of individuals and the analysis of collective property is the main strategies employed in this research. I aim to understand the factors that influence the knowledge creation processes at individual and collective level by extracting information about some dimensions of micro-macro links, social capital, human nature and

the continuum logic of knowing processes. In order to do this, I used three main conceptual tools: social capital theory, socio-cognitive theory, and co-creativity theory. By analyzing the relevant literatures on social theory of action/social capital, social cognitive theory and Chinese philosophy of knowledge, I have sought to present more precisely the final conceptual framework. There are many factors affecting the processes of knowledge building within organizations/communities. I have identified, from the above literature, five primary factors that interact, acting both as independent and dependent variables, to influence knowledge construction processes. These five factors, which provide a focus for my investigation, are, identity, interface, norm, routine, and trust.

I develop a process model of knowledge creation based on Chinese epistemology, specifically, using *Wu-Xing* continuum logic to demonstrate the knowing processes. I argue that in the analysis of knowledge processes we can rely on an alignment of knowledge and knowing to explore the dynamics of knowledge creation. In my view, a further insight into the concept of generative dance (Cook & Brown, 1999) is offered by the notions of formative and moderative contexts. In the formative context, there are three configurations: standardization, transformation and adaptation; to a moderative context, correspond also three configurations: identification, translation, and reconciliation. These six configurations presented there do not represent all forms of knowledge generation, but they represent six major configurations that I am using as a starting point for examining knowledge creation processes. In these representations, I go beyond previous work on knowledge creation by integrating into my conceptualization the role of the loose social cognitive platforms and of the formative and moderative contexts in knowledge processes.

II. The dynamic model of practice-based knowledge spiral

Human rationality may be limited, but intendedly rational action surely remains possible (March & Simon, 1958). For March and Simon, routine is essentially a mode of coordination between agents. Some routines triggered by specific learning processes such as trial and errors are exploitative, some routines triggered by specific learning mechanisms such as searching are explorative, but in fact it is very static in a sense that we do not know the dynamic of the story. For instance, we do not know how to create and modify a routine which is given a cognitive representation and where the starting point is for a process of experiential

learning. In addition, translation of routines should not be limited by the boundaries of firms, instead of social temporal routines that are embedded in the socio-cognitive platforms.

One process for cognitive change is analogy reasoning. As Gentner *et al.* (2001) point out, *"The structure-mapping approach to analogy and metaphor was a turning point in cognitive science. It shifted focus from the rule-based generation of structures to the topology of mental models, the efficiency of partial matches, and the projection from one domain to another of conceptual and perceptual organization."* In this sense, analogy appears to be a more considered process. Analogies tend to be extended over time: an analogy can be returned to again and again to elaborate future inferences from it (Keane & Costello, 2001). Findings suggest that analogy lies at the core of managerial cognition. Cognition can be especially powerful when coupled with local search. But how cognition influences subsequent processes of experiential learning (Giovanni & Levinthal, 2000). Understanding this linkage is important not only for addressing the general question of how cognitive representations affects choice processes but also for exploring the consequences of cognitive change on the transformation of tacit knowledge that has built up through generative dance between knowledge and knowing. More importantly, in the knowing processes, there is no need to distinguish between exploration and exploitation, the practice reveals knowledge and we cannot say in advance if this knowledge will be more of an explorative form that added to the current exploitation of accumulated knowledge. In practice, Lundvall (2005) for instance speaks of "experimental learning" which consists in doing both exploitation and exploration at the same time (exploration on line while exploiting).

In contrast with Nonaka and Takeuchi's (1995) knowledge creation spiral, the model has a rather strange status vis-à-vis these problems: As I discussed in Chapter 5. Nonaka and Takeuchi left one question unanswered: What is the force that drives the knowledge spiral itself? What the model demonstrates is really to define the conditions (not really the process) for a company to be creative (the mastering of the four elementary modes of knowledge conversion: clearly socialization and internalization have an exploitative dimension, while combination and externalization have a rather explorative aim). If these conditions are satisfied then a spiral may emerge. But this has nothing to do with any practice process. This does mean that other creative mechanisms could not work, etc.

To begin to address the above gap, also based on my empirical findings, my model of the balancing exploration and exploitation with the knowledge spiral should be redefined. The finding suggests that motivations and past experiences are the most important factors in knowledge creation processes among groups/communities. Motivation determines whether members of communities/groups want to cooperate in joint activities. This finding also suggests that it is possible that the relational moderate and cognitive optimum scope may have an independent and interactive effect on the processes of knowledge creation. I next formalize this argument in an agent-based dynamic model of knowledge creation spiral that struggles to find the coherence between motivation and knowledge creation. Figure 6.1. presents the dynamic model of knowledge creation spiral.

Figure 6.1. The Dynamic Model of Practice-Based Knowledge Spiral
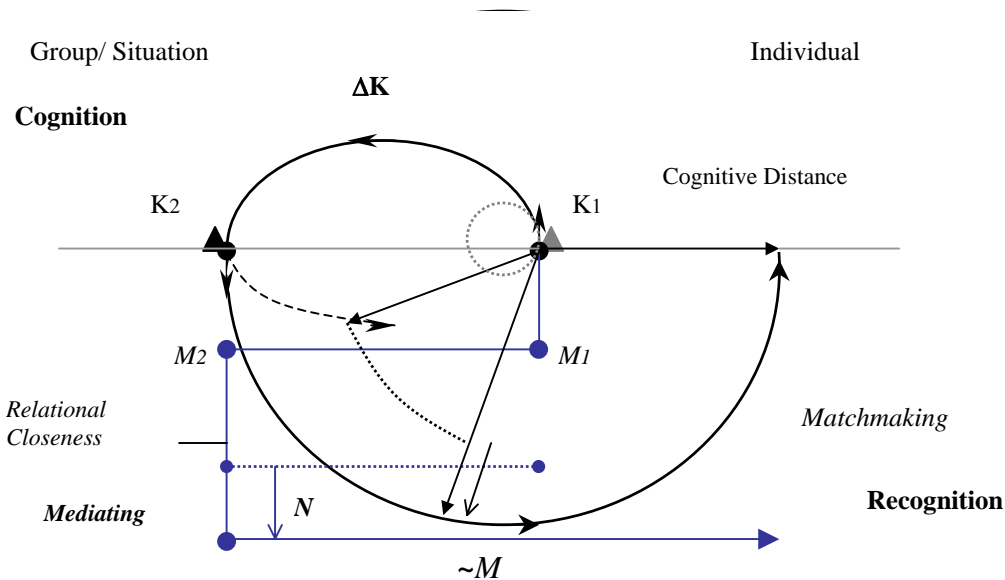
First, I explain where my new model comes from. I also adopt the analogical mapping processes. I try to find the similarity with the Physicists' notion of springs in order to solve the correlation problem between motivation effects on knowledge creation within knowledge creation spiral. Physicists seem to pay a lot of attention to springs and they recognize that springs are useful models for other phenomena. Part of the reason that a spring makes a good model for other phenomenon is that it is simple. The force law for a spiral looks like this:

$$\mathbf{F} = - k\mathbf{x}$$

Where F is the force exerted by a spring, x is the displacement of the end of the spring from its equilibrium position, and k is what is called the spring constant. The spring constant is a measure of the "stiffness" or "strength" of a spring. By measuring and potting the spring force, F, against the stretching of the spring, X, one should get a straight-line graph with slope K. This is Hooke's law.

According to this similarity, combined with the conceptual model of knowledge creation processes, I develop a new dynamic model of knowledge creation spiral:

$$\sim M = \Delta K \, N$$

Where $\sim M$ is motivation, ΔK is the capability of leveraging existing knowledge, absorptive capacity, added data, paradigm shift, best practices and creative value. N, is for the mapping optimum scope of formative context of knowledge processes and the mediating moderate effects of moderative context of knowledge processes.

As suggested in Figure 6.1. where K is the structural knowledge creation processes, and M is the relation aspect of knowledge creation processes. In cognition, the knowledge creation process is linked between K_1 to K_2. The starting point of cognition is triggered by M_1. In recognition, K_2 to K_n is triggered by M_2 and engages to create routines. Selection and recognition are structured by the frequency of interaction and density of communication between these cognitive changes. In my view, Cognitive distance and relational closeness are the key indicators to measure the degree of interaction and communication within the practice–based knowledge spiral. We further argue that a high degree of repetition of interactions between knowing communities contributes to stimulating the processes of knowledge creation; also frequent quantitative interactions between communities can lower the cognitive distance between communities but do not guarantee in the long term the existence of shared meaning and codes between heterogeneous units (Cohendet, 2005). Knowledge creation in the practice-based spiral is constructed with shared common understanding and codes/language that allow interaction and communication between agents. As a result, the specific combination of the repetitiveness of interaction and the quality of communication could lead to four distinct matchmaking contexts which fit the bridging practice and generate knowledge within knowledge creation spiral.

K_1 to K_2 is dedicated to the exploration of knowledge, while the second phase from K_2 to K_n involves the reutilized knowledge creation processes. As Table 5.2. suggested, each matchmaking context contains two sets of measures: the *numbers* of structural ties/relational ties, and the *strength* of the cognitive distance and the relational closeness. We propose that the interplay between cognition and recognition also moves along a knowledge spiral, in this case given by the configuration of ties in the network. The cognitive distance is sparse in the exploration phase and dense in the recognition phase, corresponding to weak ties during exploration and strong ties during cognition. The relational closeness is dense in the cognition/cognitive representation phase and sparse in the recognition phase, corresponding to strong relational ties during cognition and weak relational ties during recognition. We argue that the knowledge creation processes are fostered by these matching and mediating mechanisms. Discovering the effective matching and mediating position is a difficult endeavor. Our hope is that the rigorous analysis of these matchmaking contexts will help bridge practices between rational, positional perspectives on knowledge creation processes, strategy making in knowledge governance.

6.2.2. Managerial contributions

An implication from this study is that managers should be explicit about the importance of practice-based knowledge creation spiral/social cognitive platforms strategy. To orchestrate productive knowledge creation among individuals, communities, organizations, managers could encourage and reward knowledge creation behavior. More broadly, managers could foster a spiral that promotes seeking out and sharing important task specific experiences among communities and groups in the organization.

The concept of community-based social cognitive platforms is extremely useful for firms that need to develop new products with commercial or academic communities. Indirect connections, such as brokerage and boundary spanning are useful for the knowledge creation and sharing within alliances. Brokers and boundary spanners can bring new ideas, span technical boundaries and create links and interaction between members of alliances across space and time (Fleming & Waguespack, 2006; Burt, 2004). In doing this, they provide a fundamental service for knowledge generation and mobilization within alliances. In my view, the prominent feature of the community-based socio-cognitive platforms is a set of rules/norms and loosely coupled structures that encourage critical evaluation of existing

knowledge, legitimates coordination and supports judgment in bridging normative practice. In this sense, the community-based socio-cognitive platforms pay special attention to how generative mechanisms drive the process of knowledge creation between communities and multidisciplinary groups. In the context of social cognitive platforms, knowledge brokers and boundary spanners are the potential source of innovation and creativity. They facilitate diverse individuals to pool information and combine ideas voluntarily, which may stimulate problems solving, thereby providing innovative performance. They also create distributed modular infrastructures to leverage resources and knowledge. More importantly, they develop shared meaning or common understanding to meet at the interfaces connecting each module or specialized participants in order to achieve effective mobilization in the innovation process.

The socio-cognitive platforms do bring about knowledge modularization, in which matching and mediating between cognitive distance and relational closeness should be the main social governance mechanisms to synthesize knowledge creation and transformation and facilitate coordination of interdisciplinary groups and communities as they created new knowledge. The notion of cognitive modular platforms emphasizes the fact that knowledge does not reside in the heads of the group members, but rather is situated in a variety of modular units and sense-making devices connecting the group's activities in a coherent whole. The matchmaking infrastructure contributes to how to organize and manage the process networks and seeks to coordinate innovation activities across organizational boundaries.

The effectiveness of matchmaking rests on more than just structural configurations of knowledge processes, in addition to structural embeddedness, relational embeddedness is also important, to consider how process networks affect knowledge creation the quality of communication and interaction are matter. The innomediaries should build long-term, trust-based relationships with the participants in the knowledge network. I consider that *relational ties* are embedded in *relational networks* that are specific features of processes of trust within social cognitive platforms. As a trusting relationship develops in the social cognitive platforms, there is maybe a convergence of cognition, with a mutual understanding and appreciation of competencies and motives, with an emergence of shared social norms, which construct cognitive structures as a basis of trust. Members of platforms engage more in social reciprocity through intensive interaction to develop their trusting relationship. Such social reciprocity can be seen as the key engine to form trust in social cognitive platforms.

Furthermore, brokers and boundary spanners gather and integrate knowledge and bridge the technology gap between members of alliances and organize academic or commercial communities to participate in the specific joint research/development projects on the basis of common interests. They use knowing communities/social cognitive platforms to facilitate knowledge creation in a way that complements the new product architecture platforms. At this point, they help alliances to accumulate knowledge assets; at the same time, they guide and control knowledge creation, sharing, and application across firms boundaries. In this sense, they play a key role in the knowledge governance, brokers concentrate on aggregating and disseminating knowledge to support innovation, practically, in building the linkage from individual to collective knowledge in joint development activities.

6.3. Limitations of this Study

The findings in this thesis also have their limitations.

First, the thesis studied 4 firms in automotive industries and 4 technology alliances from three industries. Accordingly, the findings reflect the knowledge creation processes in these firms and industries. It is necessary to study more firms in more industries in order to increase the understanding of organizational knowledge creation dynamics.

Second, larger samples test my conclusions would be necessary to show that these conclusions are not due to the choice of specific cases. There is a need in the future for quantitative research, and quantitative and qualitative data should be seen as complements rather than substitutes. The nature of this complementarity is an important area of further research.

Third, my limited sample did not permit me to analyze the role of the country. For example, there may be systematic differences between the knowledge creation practices of China, Japan and US.

6.4. Directions of Future Research

This theory-building research leads to many potential research avenues.

First, the research presented here represents a first step in establishing the practice-based knowledge spiral as a construct, but more work is needed before its implications can be fully understood. Importantly, the knowledge spiral has conceptual and empirical relationships with other knowledge creation constructs that are not fully explored here. Especially, the role of brokers and boundary spanners in evaluation knowledge and building links between communities has not yet explored. This could be accomplished by studying a large sample of companies to assess the five proposed key variables and test if they are significant descriptors and differentiators of knowledge spiral.

Second, considering the nascent nature of the brokerage and boundary spanning phenomenon, I am aware that the hypotheses that I developed will need to be refined by operationalizing the definitions of the constructs, and by developing measures for each construct. Further empirical research is needed to test and validate the hypotheses that I have developed in this thesis. At a broader level, I will like to use the methods such as social network analysis (Owen-Smith & Powell, 2004) and document analysis (Fiol, 1994) to understand the dynamics of interaction and communication. To do this, I will measure ties strength by the frequency of interaction between individual, groups/ communities and their level of resource commitment to the relationship.

Third, samples of this dissertation were restricted to the listed companies in order to include major companies in China; it focuses on relatively large and profitable firms. Therefore, the results might differ in small or venture firms. To increase the generalizability of the research results, I should investigate small or venture firms, such as some newly founded firms in the biotechnology industry.

Fourth, the results are limited to Chinese firms. The generalizability from a Chinese setting to other countries may be questionable. Therefore, the results of this study may have to be carefully interpreted. Further empirical research would involve data collection over diverse countries using more qualitative data. It will be possible to conduct analyses in more

optimally rigorous fashion with more proper operationalization of both knowledge creation processes and organizational performance variables in various countries.

Fifth, my practice-based knowledge spiral is a kind of knowing process trajectory that innomediaries and project leader can use to search, analyze and determine what, when and where knowledge is emerging and to map out the optimum scope of knowing processes and mediate the moderate strength of motivation and trust to support knowledge creation processes. However, the correlations of each factor and effect on the performance are still not clear. Further qualitative analyses, for instance, by using the comparative method (Ragin, 1987, 2000), may contribute to better understand the dynamics of practice-based knowledge creation spiral.

As an exploratory study, I have just completed the very early stage of my research. The practice-based knowledge spiral model that is useful to explain the nature of knowledge, the interaction of knowledge and knowing, origin of routines, the generative mechanisms for knowledge creation, in particular, a micro-foundation of knowledge creation. My hope is that this research will have provided a conceptual stepping-stone toward a fuller and more fine-grained model of knowledge creation. This study may be used as a base for further empirical research on knowledge creation processes in organizations and knowing communities.

Chinese Glossary

Confucius

Ti-Yong   -

Wu-Xing

Ti-Yong Heyi

Yin-Yang   -

Ti

Yijing

Zhu Xi

Ti-Yan

Xin

Fengshui

Mencius

Ren

Yi

Li

Zhi

Sheng/Xin   /

Zhi Xing He Yi

Junzi

Shenren

He

Zhongyong

Wang Yang-ming

Sheng-Zhi

Dao

Zhuang zi

Sun Tzu

The Art of War

Guanxi

Huibao

Chang/ *ba* in Japanese

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Appendices

- Key Resources and Results from the Case Studies
- Interview and Questions

I. Key Resources and Results from the Case Studies

Kunpeng Conceptual car - PATAC Shanghai

–Building the concept, integrates traditional Chinese culture into design-fish, Kunpeng.
–Identity transformation, observation, interaction and communication-Zoo, nature.
–Practice and integration, CAD application and resources database citation.

Production lines, work shop of Shanghai VW Factory No.1

ALA.s Conceptual Car - PATAC Shanghai

ALA.s, used digital car design technology, inspiration from Chinese culture-silk, ruyi and began with a digital model in the development process.

Phoenix fuel cell vehicle
Based on GL8 business architecture
of GM
Phoenix fuel cells provided by GM
and integrated by PATAC

Chery QQ Mini car
Chery auto Ltd. China
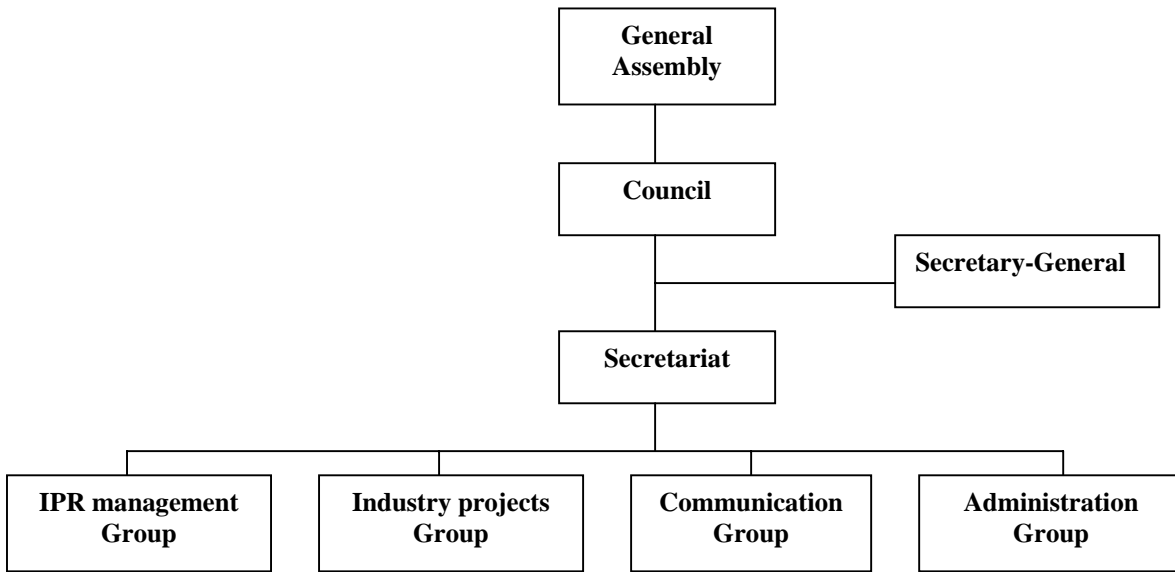

Geely Haoqing car
Geely auto Ltd. China

Fangzhou CPU Chip
"Fangzhou" is the brand name of the
CPU chips developed by China
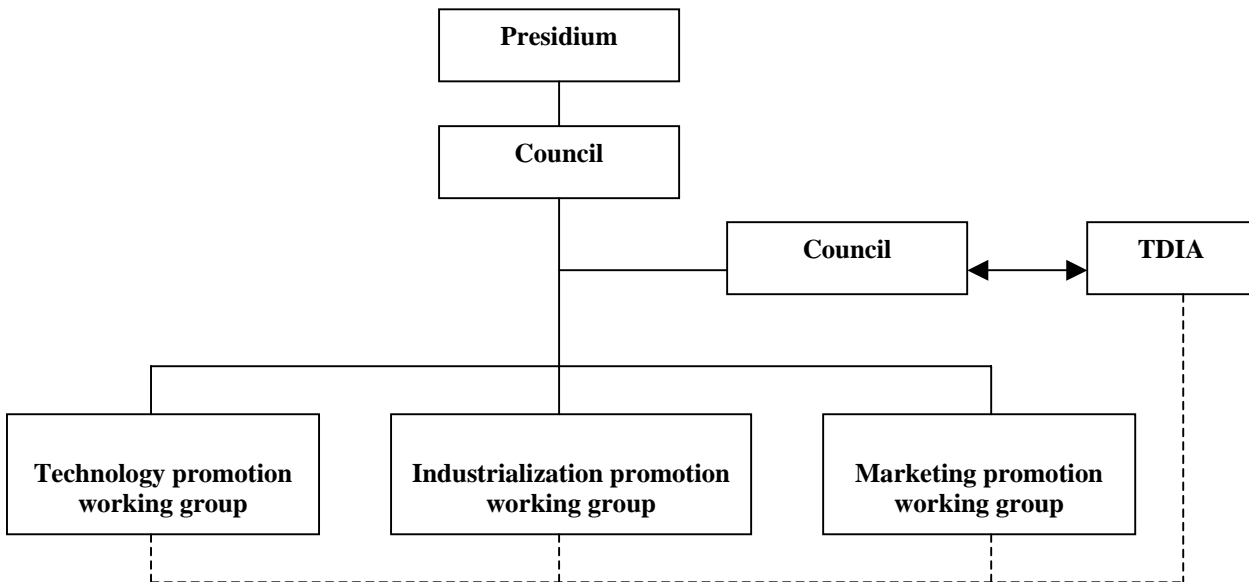Semiconductor Manufacturing
International Corp (SMIC).

Godson Chip, Godson Chip Industry
Alliance
The "dragon chip" is a nickname for
computer chips recently developed in
China as an alternative to US-made Intel
and AMD chips.

Organizational Structure of TD-SCDMA Alliance

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                    ┌─────────────┐
                    │   General   │
                    │  Assembly   │
                    └──────┬──────┘
                           │
                    ┌──────┴──────┐
                    │   Council   │────────────────┐
                    └──────┬──────┘        ┌────────┴─────────┐
                           │               │ Secretary-General │
                    ┌──────┴──────┐        └──────────────────┘
                    │ Secretariat │
                    └──────┬──────┘
        ┌──────────┬───────┴───────┬──────────────┐
┌───────┴──────┐┌──┴──────────┐┌───┴─────────┐┌───┴──────────┐
│IPR management││Industry     ││Communication││Administration│
│   Group      ││projects     ││   Group     ││   Group      │
│              ││Group        ││             ││              │
└──────────────┘└─────────────┘└─────────────┘└──────────────┘
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The organizational structure of TDIA consists of the General Assembly, the Council and the Secretariat, under which there are four Working Groups: the TD-SCDMA IPR Management Group, the Industry Projects Management Group, the Administration Group and the Communication Group.

Organizing Structure of TD-SCDMA Forum

```
              ┌───────────┐
              │ Presidium │
              └─────┬─────┘
              ┌─────┴─────┐
              │  Council  │
              └─────┬─────┘
                    │          ┌─────────┐        ┌──────┐
                    ├──────────│ Council │◄──────►│ TDIA │
                    │          └─────────┘        └──┬───┘
    ┌───────────────┼───────────────┐                │
┌───┴──────────┐┌───┴──────────┐┌───┴──────────┐     │
│Technology    ││Industrializa-││Marketing     │     │
│promotion     ││tion promotion││promotion     │     │
│working group ││working group ││working group │     │
└───────┬──────┘└──────┬───────┘└──────┬───────┘     │
        └──────────────┴───────────────┴─────────────┘
```
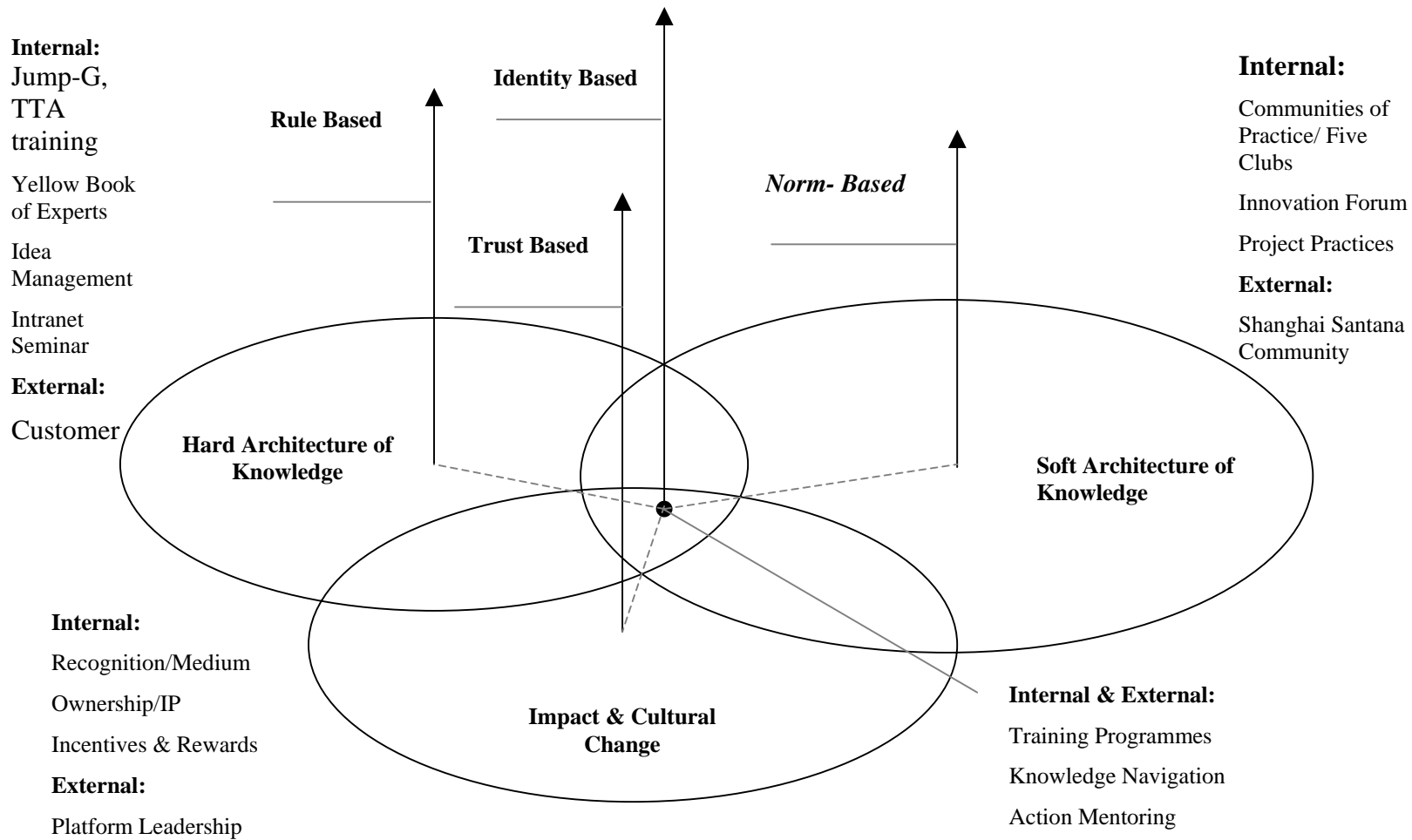
The council is the highest rank of the TD-SCDMA forum hierarchy. The standing institution includes the external liaison department and the Secretariat. In order to cooperate with the tasks of the working groups, the Secretariat will be responsible for the management of the member units of forum.

© Sources from China TD-SCDMA Industry Alliance

Shanghai Santana Community/Knowledge intensive communities vs. Joint development Consortia/GM JDC

Principles	GM Shanghai Joint Development Center (JDC)	VW Shanghai Santana Community (SSC)
1) Diversity	Consortia, a group of companies who are working together for joint development, a division belong to GM Shanghai, control by purchasing Manager, members by selection	Communities, a group of people who share some interest or belong to a common context, members voluntarily work together, control by community committee
2) Boundary	Exchange information among shanghai GM's suppliers, and coordinate by JDC group leader, in building strategic partnership, coordinate by organizational rules	Exchange knowledge between auto companies, suppliers, sales, universities, social institutions, members respect community norms, coordinate by common norms
3) Interaction	Face-to-face interaction, and IT platform mediation, direct and indirect interaction within full control system, JDC leader group and information databases	Face-to-face interaction at community meeting, in direct interaction by modular distributed community platforms, user profiles and interface management
4) Integration	Engage in organizational learning, training, according to JDC's work plan, joint develop R&D projects with a prior agreement, share risk and responsibilities	Joint research and development between community members, engage in member's problem solving and check errors, build standard system among members, organize learning and training, promote excellence
5) Collaboration	First consideration of new project and business, get first hand information and opportunities with GM shanghai under market competition, participate abroad training and professional visiting	Non-profit, autonomous formed in across boundaries development and multi-services activities, share common identity, build trust for creating core competitive synergy towards international market

Internal:

Jump-G,
TTA
training

Yellow Book
of Experts

Idea
Management

Intranet
Seminar

External:

Customer

Rule Based

Identity Based

Norm- Based

Trust Based

**Hard Architecture of
Knowledge**

**Soft Architecture of
Knowledge**

Internal:

Communities of
Practice/ Five
Clubs

Innovation Forum

Project Practices

External:

Shanghai Santana
Community

Internal:

Recognition/Medium

Ownership/IP

Incentives & Rewards

External:

Platform Leadership

**Impact & Cultural
Change**

Internal & External:

Training Programmes

Knowledge Navigation

Action Mentoring

Architecture of Knowledge Management In Shanghai VW

II. Interview and Questions

Begin with form describing research, and confidentiality.

At the group level:

1. Is there brokering or boundary spanning activity across more than two tiers of innovation activity?
2. Is the process management approach loosely coupled instead of hardwired?
3. What networks are already operating in relevant markets or industries?
4. What networks should we target to amplify our own capabilities?
5. What do we need to do to create more knowledge in these networks?
6. What are the reciprocal expectations regarding outputs from the relationship?
7. How clearly are the expectations communicated, and how broadly are they communicated on both sides of the relationship?
8. How willing are these partners to discuss some of their most creative ideas with you?
9. Have you learned from these partners anything that makes you better at what you do?
10. What could be done to strengthen incentive structures on both sides of the relationship to motivate better performance against expectations?

At the individual level:

11. How did your group/community form? Was there a trigger event?
12. Can you please provide a history of who has been involved? Please include who has become involved or is no longer involved over time.
13. Have you been involved during the entire history? How did your role as anchor evolve?
14. What is your project objective? And, what technical boundary makes up your group/community? How has this changed over time?
15. How frequently does your group/community get together? How has this changed over time?
16. What is the goal of your group? How has this changed over time?
17. What is your general group size, such as number of people involved? How has this changed over time?
18. Is there a set of documents/rules that represents the current state of your group/community? How has this changed over time?
19. How frequently would you say experts from your group/community collaborate with people outside the group/community? How has this changed over time?
20. What is the role of the lead in your group/community? How has this changed over time?

La Plateforme Modulaire Socio-Cognitive pour la Création de Connaissance

The Socio-Cognitive Modular Platform for Knowledge Creation

Résumé

Le but principal de cette étude est d'explorer les bases théoriques relatives à la création de connaissances dans une perspective socio-cognitive. La question de recherche centrale de cette étude est: comment redéfinir et mieux comprendre le processus de création de connaissance? Afin de répondre à cette question, nous nous sommes concentrés sur trois objectifs de recherche : (*i*) fournir un modèle en spirale basée sur la pratique et intégrant la création de connaissances dans les organisations et les communautés ; (*ii*) mettre en avant la relation structurale entre création de connaissances et réseau ; et (*iii*) examiner la confiance et les normes à l'origine de l'interaction entre les processus de création de connaissances et les conséquences pour l'organisation de la création de ces connaissances. Comme étude exploratoire, cette dissertation fournit l'évidence valable et le cadre théorique pour des influences contextuelles sur la création de la connaissance.

Mots clés : création de connaissances, modèle en spirale basée sur la pratique, réseau, confiance, normes à l'origine de l'interaction.

Abstract

The main purpose of this study seeks to explore new theoretical ground for knowledge creation in a socio-cognitive learning's perspective. The central question of this study is driven by: How might we re-define and better understand the processes of knowledge creation? In order to answer this question, the study focused on three research objectives: *(i)* to provide an integrated practice-based spiral model of knowledge creation in organizations and communities, *(ii)* to find structural relationships between knowledge generation and process networks and *(iii)* to examine the trust and norms-mediated interaction in the knowledge creation processes and the implications for organizational knowledge governance. As an exploratory study, this dissertation provides valuable evidence and theoretical framework for contextual influences on knowledge creation.

Key Words: Knowledge Creation; Practice-Based Spiral Model; Networks; Trust, Norms-Mediated Interaction

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