UNIVERSITÉ DE STRASBOURG

ÉCOLE DOCTORALE AUGUSTIN COURNOT [ED221]

UR7308 HuManis, EM

THÈSE soutenue le 6 décembre 2022

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Pour obtenir le grade de Docteur de l'université de Strasbourg

Utilizing Blockchain to Enhance the Governance of Business Networks and Generation of Inter-Firm Competitive Advantage

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Remerciements

Firstly, I would like to give my great thanks to my supervisors Professor Jessie Pallud and Dr. Laura Georg Schaffner for their advice and guidance over the course of this doctoral journey.

I would like to thank Professor Sven-Volker Rehm for his suggestions and ideas.

I would like to thank Professor Jean-Philippe Bootz and Professor Samuel Fosso Wamba for their participation in my thesis committee.

I would like to thank Professor Sebastien Point for his leadership of the HuManis Lab.

I would like to thank the entire EM Strasbourg and École Doctorale Augustin Cournot for their assistance in all matters.

Finally, I would like to thank Professor Saïd Assar, Professor Yves Barlette, and Professor Samuel Fosso Wamba for agreeing to be my jury.

This thesis is dedicated to the memory of my father, Hans Phillip Petersen.

Abstract

This paper-based thesis first integrates blockchain into current theory on the governance of inter-organizational exchanges within business networks, and second develops a blockchain governance structure framework and model comprised of administrative, platform, and application level mechanisms which can perform the functions of transaction coordination and safeguarding and which can thus substitute for the traditional contractual and relational mechanisms of governance. Third, this thesis tests the blockchain governance structure against empirical observation of the we.trade network for trade finance. Participant buyers, sellers, and their banks place their trust in the we.trade blockchain network itself, replacing the need for the traditional mechanisms of governance. This thesis finds to be true the hypotheses that present on such a network is a blockchain governance structure whose administrative, infrastructure, and application levels deliver the required processing and safeguarding of transactions. It is noted that additional case studies of blockchain driven networks, and/or quantitative analysis of survey responses from the participants of such networks, is needed for further verification of the developed framework and model.

This thesis finds that smart contracts are most significant amongst the blockchain delivered governance mechanisms for both researchers and practitioners alike. Smart contracts, in addition to automating transaction dataset processing as found on we.trade, further can automate the monitoring and enforcement of the governance ruleset itself.

This thesis concludes that the emergence of blockchain technology now provides the means by which automation of the specification, validation, and enforcement of private ordering between exchange participants can be achieved, and proposes that this should stimulate a reevaluation of existing theory and practice of inter-organizational governance.

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But remember, please, the Law by which we live,

We are not built to comprehend a lie,

We can neither love nor pity nor forgive.

If you make a slip in handling us you die!

The Secret of the Machines
Rudyard Kipling
1911

Résumé de la thèse en français

Cette thèse sur papiers intègre d'abord la blockchain dans la théorie actuelle de la gouvernance des échanges inter-organisationnels au sein des réseaux d'entreprises, et développe ensuite un cadre et un modèle de structure de gouvernance de la blockchain comprenant des mécanismes administratifs, de plateforme et d'application qui peuvent remplir les fonctions de coordination et de protection des transactions et qui peuvent ainsi se substituer aux mécanismes traditionnels de gouvernance contractuelle et relationnelle. Enfin, cette thèse teste la structure de gouvernance de la blockchain à l'aide d'une observation empirique du réseau we.trade pour le financement du commerce. Les acheteurs et vendeurs participants, ainsi que leurs banques, font confiance au réseau blockchain, remplaçant ainsi le besoin de mécanismes traditionnels de gouvernance.

Cette thèse confirme les hypothèses selon lesquelles, sur un tel réseau, se trouve une structure de gouvernance blockchain dont les niveaux administratifs, d'infrastructure et d'application assurent le traitement et la protection des transactions. Il est à noter que des études de cas supplémentaires de réseaux basés sur la blockchain et/ou une analyse quantitative des réponses aux enquêtes des participants de ces réseaux sont nécessaires pour une vérification plus approfondie du cadre et du modèle développés.

Cette thèse révèle que les contrats intelligents (en anglais : smart contracts) sont les plus importants parmi les mécanismes de gouvernance fournis par la blockchain, tant pour les chercheurs que pour les professionnels. Les contrats intelligents, en plus d'automatiser le traitement des données de transaction que l'on trouve sur we.trade, peuvent en outre automatiser la surveillance et l'application de l'ensemble de règles de gouvernance.

Cette thèse conclut que l'émergence de la technologie blockchain fournit désormais les moyens par lesquels l'automatisation de la spécification, de la validation et de l'application des arrangements privés entre les participants à l'échange peut être réalisée, et suggère que cela devrait stimuler une réévaluation de la théorie et de la pratique existantes de gouvernance inter-organisationnelle.

I. Objectifs

L'objectif de cette thèse est de répondre à la question de recherche suivante :

> L'utilisation de blockchain peut-elle améliorer la gouvernance des réseaux d'entreprises et la génération d'avantages concurrentiels inter-entreprises ?

En abordant cette question, cette thèse cherche à apporter plusieurs contributions de valeur au domaine :

1. Combler les lacunes de la recherche sur la blockchain et placer la blockchain dans le contexte des disciplines connexes
2. Construire un cadre et un modèle identifiant les mécanismes par lesquels la blockchain peut assurer la gouvernance au sein des réseaux d'entreprises, et ainsi fournir un substitut aux méthodes contractuelles et sociales traditionnelles
3. Tester empiriquement ce cadre de gouvernance fourni par la blockchain par rapport à un cas réel
4. Identifier les effets potentiels des éléments de ce cadre sur la génération d'avantages concurrentiels

Étant donné qu'il existe peu de théories développées relatives à la blockchain, en particulier dans un contexte commercial (Lohmer, Petzok, & Lasch, 2021; van Pelt, Jansen, Baars, & Overbeek, 2021), des tests empiriques des travaux conceptuels relatifs à la blockchain sont absolument nécessaires.

II. Démarche

Cette thèse porte sur la construction d'un cadre et d'un modèle de gouvernance des transactions au sein des réseaux d'entreprises, ainsi que sur l'utilisation de la méthode d'étude de cas pour le test déductif de ces concepts théoriques. L'approche de l'étude de cas a été adoptée dans ce domaine de la blockchain selon les lignes directrices de Yin (2014), afin de pallier le manque de données quantitatives disponibles et de recueillir des preuves du monde réel dans un contexte trop contemporain pour permettre la collecte de données d'enquête. L'étude de cas ne représente pas un échantillon et ne peut pas être utilisée pour extrapoler des probabilités, mais permet plutôt la généralisation analytique de propositions théoriques (Yin, 2014) et l'éclairage de caractéristiques pouvant s'appliquer à un ensemble de cas (Gerring, 2007).

Cette thèse utilise une approche qui, bien que positiviste à la base dans la mesure où une réalité objective est jugée à la fois possible et souhaitable (Iacono, Brown, & Holtham, 2011), inclut également une considération post-positiviste des facteurs socio-techniques à l'œuvre dans le contexte spécifique du seul cas examiné (Chukwudi, Zhang, & Gable, 2019).

De nombreux tests théoriques via la méthode d'étude de cas ont été menés dans une perspective positiviste, dans laquelle des propositions testables sont formulées, des cas sont sélectionnés pour s'aligner sur le domaine théorique, des données pertinentes sont collectées et des modèles observables sont mis en correspondance avec les constructions théoriques pour produire un état « présent » ou « absent » (Chukwudi et al., 2019), et ainsi permettre le développement de ce qui peut représenter une plateforme prédictive (Orlikowski & Baroudi, 1991).

Cependant, étant donné qu'une étude de cas est une enquête sur un phénomène passé et/ou actuel, dérivée de multiples sources, y compris des entretiens directs et des observations, ainsi que des archives publiques et privées, le contexte spécifique dans lequel chaque artefact est collecté et vérifié est extrêmement pertinent (Leonard-Barton, 1990). Comme l'a noté Eisenhardt (1989), dans une étude de cas, le chercheur doit se concentrer sur la compréhension de la dynamique présente dans ce cadre unique. De plus, les frontières entre les phénomènes et le contexte ne sont pas toujours apparentes (Heim, Han, & Ghobadian, 2018).

Ainsi, la prise en compte spécifique du contexte de la perspective post-positiviste peut enrichir les informations disponibles à partir du cas et renforcer la nature prédictive souhaitée du cadre et du modèle à l'étude dans cette thèse.

Cette thèse est basée sur une étude de cas unique. Bien que l'utilisation d'un cas unique puisse impliquer le risque d'une mauvaise appréciation de l'importance relative d'événements et de données individuelles, elle offre la possibilité d'une analyse plus approfondie, ce qui peut étayer davantage la mise à l'épreuve des concepts théoriques et la prédiction de résultats futurs (Voss, Tsikriktsis, & Frohlich, 2002).

Le cas « we.trade » a été délibérément choisi pour cette thèse (c'est-à-dire de manière non aléatoire), car selon Gerring (2007), il peut être considéré comme un cas relativement central pour la théorie examinée. On sait que sur l'instance we.trade, les effets proposés de la gouvernance fournie par la blockchain sont présents : - à savoir, que les contrats écrits, la confiance et les structures sociales ne sont pas nécessaires pour le traitement efficace des transactions entre les parties.

Les hypothèses testées dans le cas we.trade sont présentées sous la forme de conditions nécessaires déterministes (Dul & Hak, 2007) afin de soutenir l'approche de cas unique. Si la cause déclarée d'une hypothèse particulière n'est pas présente dans le cas we.trade, alors cette hypothèse est rejetée. Si à la fois une cause théorique et son effet s'avèrent présents dans le cas we.trade, bien que cela ne soit pas suffisant pour prouver la causalité, cela démontrera que l'hypothèse particulière n'est pas réfutée, et cela peut donc fournir un support pour une étude plus approfondie du cadre.

Les articles qui composent ce processus sont les suivants.

1. Article Conceptuel :- Automatisation de la Gouvernance : La Blockchain comme Mécanisme de Gouvernance des Réseaux d'Entreprises

Ce premier article conceptuel visait à identifier les lacunes de la littérature sur la blockchain et à placer la blockchain dans le contexte de la littérature existante sur les disciplines liées à la gouvernance des réseaux d'entreprises.

Cet article a ensuite porté son attention sur la construction d'un cadre identifiant les mécanismes par lesquels la blockchain peut assurer la gouvernance au sein des réseaux d'entreprises, et ce faisant, peut fournir un substitut aux méthodes contractuelles et sociales traditionnelles.

Le contenu de cet article, bien qu'il ne soit pas présenté dans son intégralité dans cette thèse, a alimenté la section Introduction de cette thèse.

2. Article Conceptuel :- Automatisation de la gouvernance - La blockchain en tant que fournisseur de gouvernance pour les réseaux d'entreprises

Cet article conceptuel a développé le placement de la blockchain dans le contexte de la littérature existante sur les disciplines liées à la gouvernance des réseaux d'entreprises, y compris l'économie des coûts de transaction, les structures sociales et la théorie des réseaux.

Cet article a ensuite développé un cadre et un modèle identifiant les mécanismes par lesquels la blockchain peut assurer la gouvernance au sein des réseaux d'entreprises et, ce faisant, peut fournir un substitut aux méthodes contractuelles et sociales traditionnelles.

3. Article qualitatif :- La blockchain en tant que fournisseur de gouvernance en action :– le cas we.trade

Cette étude de cas a été conçue pour répondre à la première partie de la question de recherche de cette thèse, à savoir : l'utilisation de la blockchain peut-elle améliorer la gouvernance des réseaux d'entreprises ?

Cette étude de cas a opérationnalisé en hypothèses testables les propositions du cadre et du modèle de l’article conceptuel, puis a cherché à les vérifier empiriquement par rapport au réseau we.trade basé sur la blockchain.

4. Article Qualitatif :- Transformer le Financement du Commerce via la Blockchain : La Plateforme we.trade

Cette étude de cas a été conçue pour répondre à la deuxième partie de la question de recherche de cette thèse, à savoir : l'utilisation de la blockchain peut-elle améliorer la génération d'avantages concurrentiels inter-entreprises ?

Cette étude de cas a examiné les méthodes par lesquelles la gouvernance fournie par la blockchain soutient la création d'un avantage concurrentiel dans les échanges inter-entreprises au sein d'un réseau d'entreprises.

III. Précurseurs

En considérant que l'unité de base de l'activité économique est la transaction, la gouvernance peut être définie comme les « règles de travail » nécessaires pour assurer l'ordre lors du traitement des transactions (Commons, 1932: 13). Traditionnellement, ces règles peuvent être appliquées formellement dans des contrats écrits selon l'approche de gouvernance contractuelle de l'économie des coûts de transaction (Williamson, 1975, 1985, 1993), ou de manière informelle grâce à l'utilisation de la confiance ou des pressions des structures sociales connues collectivement sous le nom de gouvernance relationnelle (Arrow, 1974; Granovetter, 1985; Jones, Hesterly, & Borgatti, 1997; Poppo & Zenger, 2002).

Dans le cadre d'un réseau d'entreprises tel qu'une chaîne d'approvisionnement qui se compose d'organisations indépendantes mais interdépendantes (Carter, Rogers, & Choi, 2015), l'efficacité des échanges inter-organisationnels est essentielle, et ceux-ci peuvent être mis à profit pour générer un avantage concurrentiel pour l'organisation concernée (Dyer & Singh, 1998). La gouvernance des droits et du comportement des membres du réseau nécessite des règles et des processus spécifiques, comme suggéré par Buchanan (1965) sur les clubs et par Ostrom (1990) sur les ressources communes, et comme décrit dans la théorie des réseaux (Klijn & Koppenjan, 2006; Provan & Kenis, 2007).

Pour beaucoup, la blockchain peut être synonyme de Bitcoin (Nakamoto, 2008), la première soi-disant « crypto-monnaie » qui a d'abord été créée pour permettre aux transactions de pair à pair d'être effectuées sans intermédiaires, et qui a depuis fait sensation dans les domaines culturels et financiers. Pendant ce temps, le réseau et la base de données décentralisés sous-jacents à Bitcoin ont été généralisés dans les technologies des registres distribués (en anglais, « Distributed Ledger Technology ») telles que la blockchain. Dans la blockchain, les nouveaux enregistrements sont regroupés en blocs et ajoutés à une chaîne de données liée qui peut être considérée comme pratiquement immuable, car toute tentative de falsification d'un enregistrement rendra invalides les maillons suivants de la chaîne, ce qui entraînera la détection (Catalini & Gans, 2016; Dhar & Stein, 2017).

Alors que Bitcoin est libre d'accès et de droits de traitement, les exigences de sécurité dans la plupart des cas d'utilisation commerciale signifient que la majorité des blockchains commerciales à ce jour sont autorisées (Deloitte, 2020), dans lesquelles un groupe ou un consortium de contrôle désigne une autorité pour contrôler quelles entités peuvent rejoindre, soumettre et valider des transactions sur la blockchain. Un exemple souvent cité est le réseau Tradelens qui a été créé par la compagnie maritime Maersk et IBM pour faciliter le transport maritime (IBM, 2021). La direction nommée par Maersk contrôle l'adhésion au réseau (avec des plans annoncés pour la formation d'un "groupe consultatif de clients" composé de membres), et se désigne, ainsi que plusieurs des plus grands participants, comme des nœuds « d'ancrage de confiance » responsables de la validation et de la sécurité des transactions soumises au réseau (Tradelens, 2022).

Alors que la blockchain était initialement considérée comme une innovation purement informatique, elle est désormais considérée comme englobant une sphère d'influence beaucoup plus large (Davidson, De Filippi, & Potts, 2016). La littérature récente sur l'utilisation de la blockchain pour les applications commerciales a théorisé que la blockchain peut représenter une " nouvelle technologie institutionnelle qui rend possible de nouveaux types de contrats et d'organisations " (MacDonald et al., 2016). L'un des principaux fondements de ces perspectives sont les programmes de « contrats intelligents » ("Smart

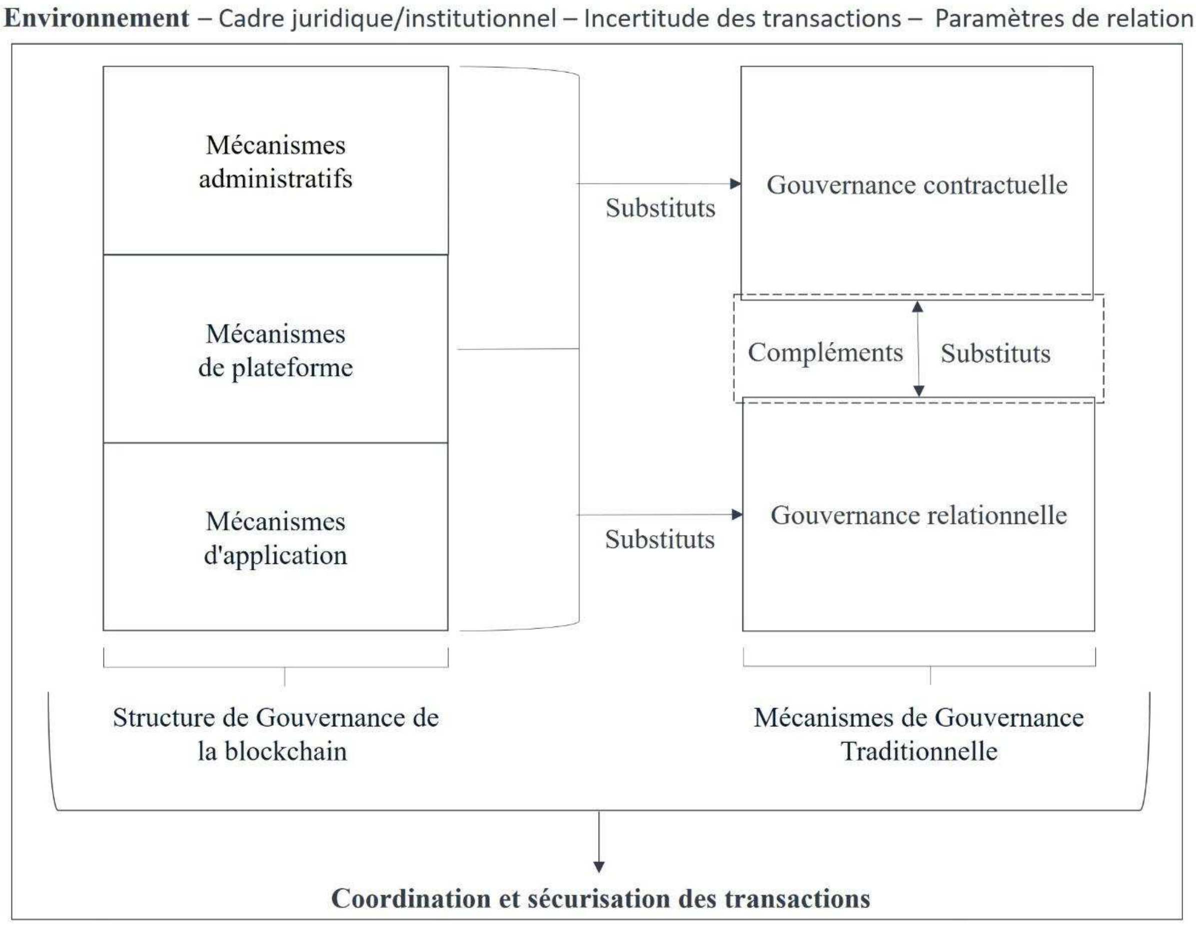
Contracts Alliance", 2016) qui peuvent fonctionner de manière autonome sur un réseau blockchain, et qui constituent la base grâce à laquelle ces réseaux "font respecter les accords et réalisent une coopération et une coordination qui se distinguent à la fois de la gouvernance contractuelle et relationnelle traditionnelle et des autres solutions informatiques" (Lumineau et al., 2021).

IV. Cadre et modèle

Le cadre et le modèle décrits dans cette thèse suggèrent que la blockchain puisse permettre la mise en place des mécanismes nécessaires à la gouvernance des membres du réseau et de leurs transactions, et ce faisant, fournir un substitut aux approches traditionnelles. Cette structure de gouvernance fournie par la blockchain est composée de trois niveaux conceptuels distincts:–

1. Les mécanismes administratifs doivent fournir un ensemble de règles acceptables et impartiales régissant le réseau et le comportement des membres.
2. Les mécanismes de plateforme doivent garantir que l'infrastructure de la blockchain est techniquement sûre et gouvernée de manière fiable.
3. Les mécanismes d'application doivent utiliser des contrats intelligents pour traiter automatiquement les transactions, tout en régissant le respect des paramètres commerciaux convenus entre les parties.

Graphique 1 décrit ce cadre.



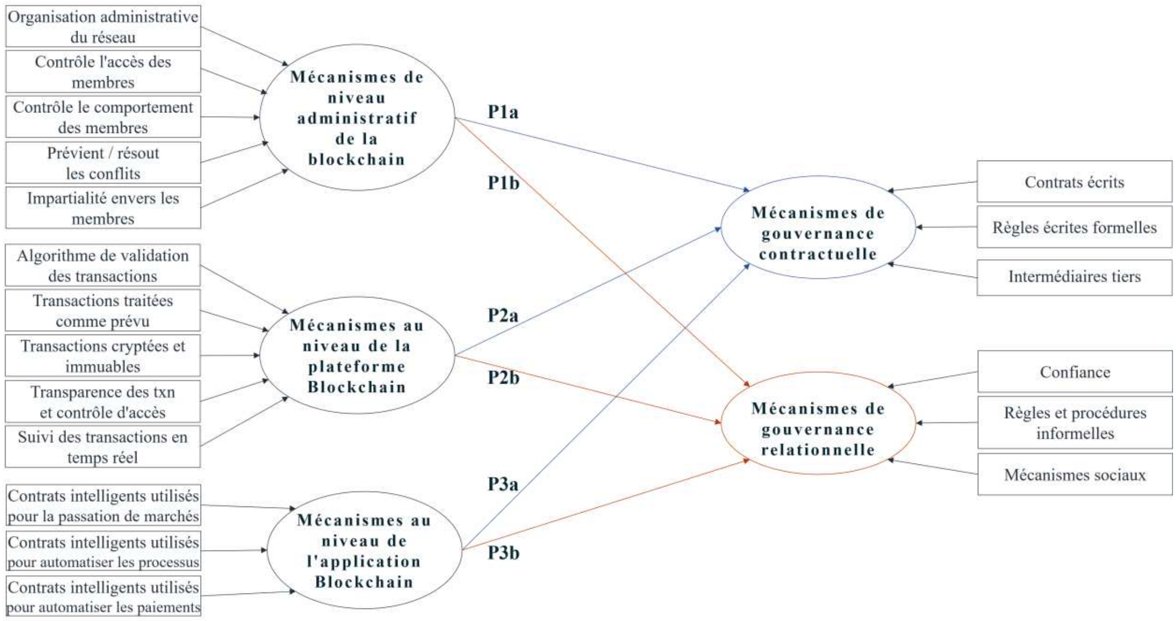
Graphique 1 - Cadre conceptuel de la gouvernance assurée par la blockchain

Les mécanismes administratifs comprennent des contrôles « en chaîne » (automatisés) et « hors chaîne » (manuels) de la participation au réseau. Dans une blockchain avec autorisation, l'entité ou le groupe d'entités (c'est-à-dire le consortium) propriétaire du réseau désigne normalement une "organisation administrative du réseau" ou NAO (Provan & Kenis, 2007, p. 6) pour exploiter la blockchain. La NAO précisera les processus d'intégration des membres, la réglementation de l'accès et du comportement des membres, ainsi que le départ des membres, et contrôlera l'étendue des droits de décision accordés aux membres. Ce faisant, la NAO révélera le niveau d'impartialité présent dans son traitement des membres. Cette thèse suggère que plus les mécanismes administratifs sont efficaces, moins la gouvernance contractuelle et relationnelle sera utilisée par les participants du réseau.

Les mécanismes de la plateforme concernent l'infrastructure technologique de la blockchain, en particulier le moteur de validation ou de consensus qui garantit que les transactions sont traitées comme les membres l'attendent, la protection des données via le cryptage et l'immuabilité de la blockchain, la transparence de l'accès pour les utilisateurs appropriés et la surveillance contre les malversations. Cette thèse suggère que plus les mécanismes de la plateforme sont efficaces, moins la gouvernance contractuelle et relationnelle sera utilisée par les participants du réseau.

Les mécanismes d'application utilisent principalement des constructions de contrats intelligents pour automatiser le traitement et la protection des transactions, et pour faire respecter les règles des transactions et de la blockchain. Cette thèse suggère que plus les mécanismes d'application sont efficaces, moins la gouvernance contractuelle et relationnelle sera utilisée par les participants du réseau.

Ces relations de causalité sont présentées dans le modèle du Graphique 2.



Graphique 2 - Modèle de gouvernance fournie par la blockchain et ses effets de substitution

Les propositions de ce cadre et de ce modèle sont reformulées sous forme d'hypothèses pour l'examen de l'étude de cas. Ces hypothèses sont présentées sous la forme de conditions nécessaires déterministes (Dul & Hak, 2007) afin de pouvoir les tester via une seule instance du domaine étudié, c'est-à-dire dans le cadre de cette seule étude de cas.

Hypothèse 1 (niveau administratif) : Il doit exister un ensemble de règles acceptables et impartiales régissant le comportement du réseau et des membres, afin que ces derniers emploient la gouvernance blockchain comme substitut à la gouvernance contractuelle et relationnelle.

Hypothèse 2 (niveau de la plateforme) : Il doit y avoir une infrastructure technologique de confiance, afin que les membres emploient la gouvernance blockchain comme substitut à la gouvernance contractuelle et relationnelle.

Hypothèse 3 (niveau de l'application) : Il doit y avoir des contrats intelligents pour automatiser le traitement des transactions et le respect des règles, afin que les membres emploient la gouvernance blockchain comme substitut à la gouvernance contractuelle et relationnelle.

V. Résultats

Cette thèse a trouvé un appui dans l'étude de cas empirique we.trade pour les hypothèses examinées.

Cette thèse a étudié le cas du réseau de financement du commerce we.trade à travers le prisme de la structure de gouvernance fournie par la blockchain. Lancé en janvier 2019, we.trade a été créé pour permettre aux acheteurs et aux vendeurs membres d'effectuer des transactions numériques sur un réseau compatible avec la blockchain, en leur offrant également la possibilité d'utiliser des produits financiers intégrés proposés par ses banques membres.

Comme présenté dans le Tableau 1, cet article constate que les hypothèses présentées sont soutenues par l'observation du réseau blockchain we.trade.

Gouvernance Fournie par la Blockchain	
Hypothèses	Soutenues par l'étude de cas we.trade
1 (niveau administratif) : Il doit exister un ensemble de règles acceptables et impartiales régissant le comportement du réseau et des membres, afin que ces derniers emploient la gouvernance blockchain comme substitut à la gouvernance contractuelle et relationnelle.	Oui
2 (niveau de la plateforme) : Il doit y avoir une infrastructure technologique de confiance, afin que les membres emploient la gouvernance blockchain comme substitut à la gouvernance contractuelle et relationnelle.	Oui
3 (niveau de l'application) : Il doit y avoir des contrats intelligents pour automatiser le traitement des transactions et le respect des règles, afin que les membres emploient la gouvernance blockchain comme substitut à la gouvernance contractuelle et relationnelle.	Oui

Tableau 1 - Hypothèses de gouvernance fournies par la blockchain et l'étude de cas we.trade

Cette thèse conclut donc qu'une **structure de gouvernance blockchain** sera composée de multiples niveaux qui se renforcent mutuellement, chacun d'entre eux nécessitant la présence et l'efficacité de mécanismes spécifiques, et qui, de concert, peuvent permettre à la gouvernance délivrée par la blockchain de fonctionner comme un substitut aux formes traditionnelles de gouvernance contractuelle et relationnelle. Plus précisément:

1. **Au niveau administratif**, une combinaison cohérente de mécanismes « en chaîne » et « hors chaîne » doit définir et gérer l'accès et le comportement des membres, et fournir des procédures pour prévenir et résoudre les conflits entre les membres et avec le réseau. Le réseau doit être géré avec impartialité et être perçu comme tel par les participants du réseau. Dans le cas de we.trade, un consortium représentatif de parties prenantes a été formé, et cette autorité était responsable de l'élaboration d'un règlement pour prescrire le processus de traitement des transactions au sein du réseau.

Le Tableau 2 compare les mécanismes de niveau administratif décrits dans le modèle conceptuel aux phénomènes observés dans le cas we.trade.

Mécanismes de niveau administratif de la gouvernance blockchain		
Mécanismes du modèle conceptuel	Présents dans we.trade	
Organisation administrative du réseau	Oui	• L'entité « Joint Venture » (entreprise commune) we.trade est établie pour gérer les opérations sous la direction du consortium

Contrôle l'accès des membres	Oui	• Les banques et les négociants doivent être inscrits et s'engager à respecter le règlement • Les banques effectuent des procédures de connaissance des clients, dites KYC (« Know Your Customer ») sur les membres pour vérifier l'identité, la bonne foi et la conformité.
Contrôle le comportement des membres	Oui	• Le règlement permet de retirer l'inscription en cas de non-respect des critères du règlement.
Prévient / résout les conflits	Oui	• Le règlement décrit les procédures de résolution des conflits
Impartialité envers les membres	Oui	• Le règlement prescrit l'égalité des droits des membres • La composition du conseil d'administration et la propriété de l'entreprise commune we.trade empêchent la domination d'un actionnaire en particulier.

Tableau 2 - Présence de mécanismes de niveau administratif de la gouvernance de la blockchain dans we.trade

2. **Au niveau de la plateforme**, les participants du réseau doivent faire confiance à l'infrastructure technologique pour fournir un écosystème sécurisé – mais transparent, pour les parties appropriées – pour le traitement des transactions. Dans le cas de we.trade, le réseau était organisé en canaux reliant les acheteurs et les vendeurs, ainsi que leurs banques, et sa validité était contrôlée en permanence.

Le Tableau 3 compare les mécanismes au niveau de la plateforme décrits dans le modèle conceptuel aux phénomènes observés dans we.trade.

Mécanismes au niveau de la plateforme de gouvernance de la blockchain		
Mécanismes du modèle conceptuel	Présents dans we.trade	
Suivi des transactions en temps réel	Oui	• Via la plateforme blockchain d'IBM utilisant Hyperledger Fabric
Transparence des transactions et contrôle d'accès	Oui	• Via la plateforme blockchain d'IBM, l'architecture du "canal" Hyperledger Fabric et la couche de l'interface utilisateur Web
Transactions cryptées et immuables	Oui	• Via la plateforme blockchain d'IBM utilisant Hyperledger Fabric
Transactions traitées comme prévu	Oui	• Aucun rapport contraire n'a été trouvé

Algorithme de validation des transactions	Oui	• Un « système de confiance » des nœuds désignés est utilisé pour la validation, sur ce réseau autorisé

Tableau 3 – Présence de mécanismes au niveau de la plateforme de gouvernance de la blockchain dans we.trade

3. **Au niveau de l'application**, les contrats intelligents doivent automatiser le traitement des transactions et le respect des règles du réseau. Les contrats intelligents surveillent les événements de transaction spécifiés et, lorsqu'ils rencontrent un tel événement, automatisent l'exécution prescrite des actions correspondantes. Dans le cas de we.trade, tous les détails de la transaction acheteur-vendeur sont encodés dans les ensembles de données des contrats intelligents, avec les dispositions pertinentes du règlement. Ces éléments constituent la base du traitement automatique ultérieur des transactions et de l'application automatisée des conditions générales convenues au sein du réseau we.trade. Par conséquent, les contrats écrits ne sont pas requis pour la gouvernance des transactions au sein de we.trade.

Le Tableau 4 compare les mécanismes au niveau de l’application décrits dans le modèle conceptuel aux phénomènes observés dans we.trade.

Mécanismes au niveau de l'application de la gouvernance de la blockchain		
Mécanismes du modèle conceptuel	Présents dans we.trade	
Contrats intelligents utilisés pour la passation de contrats	Oui	• Après avoir conclu l’accord client initial avec leur banque pour codifier l'acceptation du règlement we.trade, les acheteurs et les vendeurs peuvent ensuite spécifier et faire traiter leurs transactions entièrement via les contrats intelligents we.trade, sans avoir besoin de contrats écrits traditionnels.
Contrats intelligents utilisés pour automatiser les processus	Oui	• Les contrats intelligents recherchent les événements susceptibles de déclencher une condition spécifique. • Lorsqu'il rencontre un tel événement, le contrat intelligent s'exécute automatiquement. • Le processus se poursuit ensuite vers l'événement suivant.

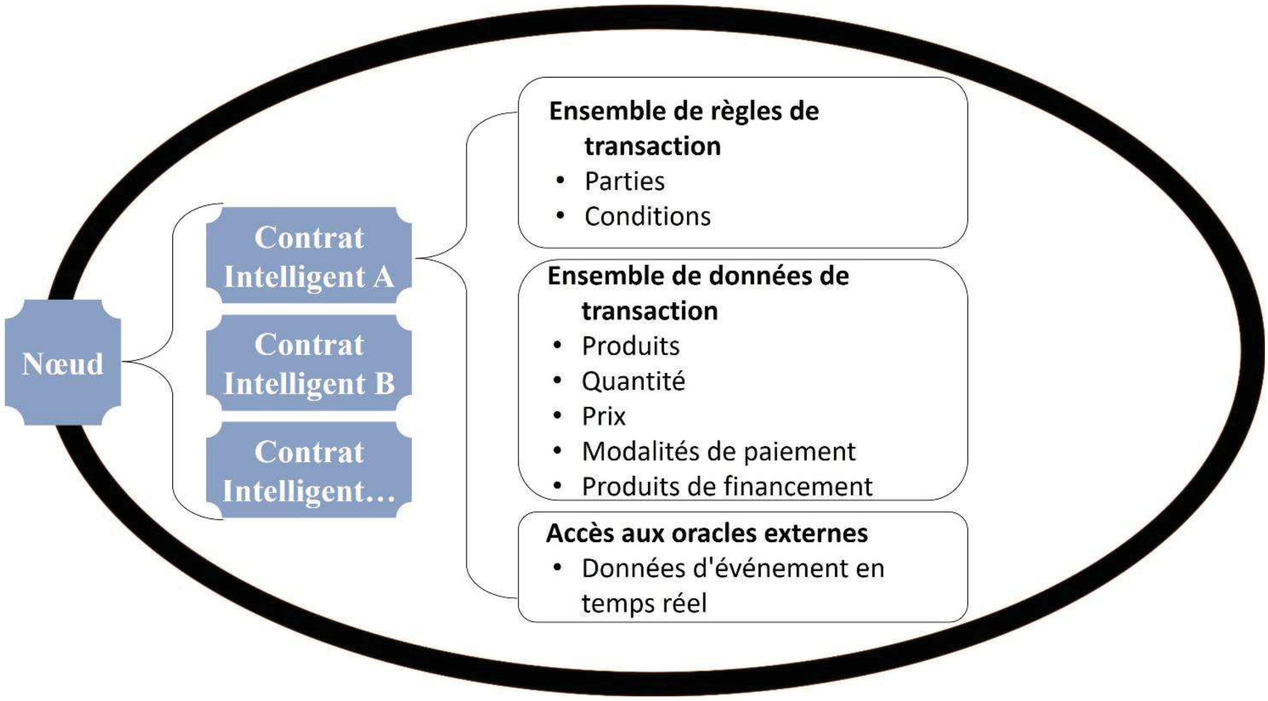
Mécanismes au niveau de l'application de la gouvernance de la blockchain		
Contrats intelligents utilisés pour automatiser les paiements	En partie	• Le paiement peut être effectué automatiquement via un contrat intelligent, mais généralement la banque soumet le paiement selon son processus habituel. • Même si le paiement n'est pas entièrement automatisé, la banque effectue le processus de paiement conformément à la notification qu'elle reçoit du contrat intelligent. Il n'existe aucune méthode par laquelle l'acheteur pourrait arrêter ou retarder le paiement. Le paiement de la transaction est donc exécuté selon les conditions de règlement convenues.

Tableau 4 - Présence de mécanismes de gouvernance de la blockchain au niveau de l'application dans we.trade

Les contrats intelligents représentent le composant le plus révolutionnaire de la structure de gouvernance de la blockchain, et la mesure dans laquelle les contrats intelligents peuvent automatiser le processus d'accord, d'exécution, de règlement et de protection des transactions sera le plus grand déterminant de la valeur que la structure de gouvernance de la blockchain peut fournir à ses participants.

Ensemble, ces composants permettent aux contrats intelligents d'automatiser le traitement et l'exécution de la transaction.

Les composants logiques d'un contrat intelligent sur we.trade sont présentés dans la Graphique 3. Chaque banque possède un nœud sur la blockchain, et chacun de ces nœuds possède un ensemble de contrats intelligents. Chaque transaction entre un acheteur et un vendeur impliquera un ou plusieurs contrats intelligents comprenant l'ensemble des règles de transaction (dérivées du règlement), l'ensemble des données de transaction et l'accès aux données d'événements en temps réel nécessaires (telles que les notifications de contrôles de qualité, de dédouanements ou de livraisons). En combinaison, ces composants permettent aux contrats intelligents d'automatiser le traitement et l'exécution de la transaction.



Graphique 3 - Les composants des contrats intelligents we.trade

Un contrat intelligent surveille les notifications d'une condition de règlement spécifique. Lors de la détection d'un tel événement, le traitement approprié de la transaction est déclenché et exécuté automatiquement, garantissant que les fonctions convenues entre l'acheteur et le vendeur, ainsi qu'entre leurs banques, sont exécutées. Ainsi le contrat intelligent automatise le traitement des clauses contractuelles des contrats écrits traditionnels.

Par exemple, l'interface d'un fournisseur de services logistiques qui confirme le mouvement des marchandises déclenche une condition de règlement de la livraison qui, à son tour, lance le processus de paiement approprié. Les événements qui peuvent être convenus entre l'acheteur et le vendeur pour déclencher les processus de paiement comprennent l'accord initial de la transaction, l'envoi de la facture par le vendeur ou son acceptation par l'acheteur, et la confirmation de l'expédition des marchandises par le vendeur ou la confirmation de la livraison des marchandises par l'acheteur. L'acheteur et le vendeur, ainsi que leurs banques, conviendront ensemble lors de l'élaboration de la transaction si le paiement doit être entièrement automatisé ou si la banque continuera de contrôler le processus de paiement.

Comme indiqué dans l'étude de cas we.trade, les mécanismes administratifs, de la plateforme et de l'application doivent être suffisamment efficaces dans le traitement et la protection des transactions afin de permettre aux participants du réseau d'accorder leur confiance à la structure de gouvernance de la blockchain, plutôt que de s'appuyer sur les méthodes contractuelles et relationnelles traditionnelles.

VI. Etude de la Question de Recherche

À partir des conclusions tirées dans la section précédente, on peut répondre par l'affirmative à la question de recherche de cette thèse - à savoir, l'utilisation de la blockchain peut-elle améliorer la gouvernance des réseaux d'entreprises et la génération d'avantages concurrentiels inter-entreprises ?

Comme théorisé dans l'article 1 de cette thèse, et comme démontré dans l'article 2 de cette thèse, l'utilisation d'une structure de gouvernance blockchain de mécanismes au niveau administratif, de la plateforme et de l'application peut effectivement améliorer la gouvernance d'un réseau d'entreprises : - en automatisant la performance des rôles de gouvernance nécessaires que sont la coordination, la protection contre l'incertitude environnementale, la rationalité limitée et les comportements opportunistes, et la surveillance, la résolution des conflits et l'application de sanctions. La preuve de cette amélioration est que la structure de gouvernance de la blockchain, comme le montre le cas we.trade, peut se substituer pleinement aux méthodes traditionnelles de gouvernance contractuelle et relationnelle dans le traitement et la protection des transactions d'achat/vente.

De plus, comme démontré dans l'article 3 de cette thèse, en plus des gains d'efficacité générés par la substitution des formes traditionnelles de gouvernance comme décrit dans la première partie de la question de recherche, l'utilisation d'une structure de gouvernance blockchain peut permettre de générer des sources supplémentaires d'avantage concurrentiel. En particulier, l'introduction d'une application automatisée dans le processus de transaction d'achat/vente par le biais de contrats intelligents peut accroître les liquidités et optimiser le flux de trésorerie, tout en réduisant les risques et les coûts de gestion des risques, et peut ainsi rendre possible des flux commerciaux entièrement nouveaux pour les participants du réseau.

VII. Contributions à la théorie

Cette thèse a cherché à apporter plusieurs contributions théoriques pour étendre les connaissances existantes. Comme l'avènement de la blockchain est relativement récent, cette thèse se présente comme une grande opportunité de recenser les connaissances existantes, d'identifier les lacunes dans la compréhension théorique actuelle, de combler ces lacunes par le développement de nouvelles constructions théoriques et de tenter de vérifier ces constructions de manière empirique.

Premièrement, cette thèse aborde les lacunes importantes dans la recherche existante sur la blockchain dans un contexte commercial (Lohmer et al., 2021), en cherchant à placer la blockchain dans la sphère des disciplines avec lesquelles elle se croise - y compris l'économie, les études d'organisation, le droit, la stratégie, le marketing et la gestion des opérations (Roehrich et al., 2020) ainsi que les systèmes d'information - dans le but de soutenir le développement d'une théorie qui peut synthétiser les constructions multidisciplinaires connexes.

Deuxièmement, cette théorie construit un cadre et un modèle identifiant les mécanismes au niveau de l'administration, de la plateforme et de l'application par lesquels une structure activée par la blockchain peut automatiser les fonctions de gouvernance au sein d'un réseau d'entreprises pour coordonner le traitement des transactions et se prémunir contre les problèmes d'échange. Ce faisant, cette thèse identifie la blockchain comme un antécédent significatif et un facteur causal déterminant l'étendue du besoin des méthodes contractuelles et relationnelles traditionnelles de gouvernance au sein d'un réseau d'entreprises piloté par la blockchain. En outre, cette thèse postule que les éléments d'une structure de gouvernance fournie par la blockchain peuvent eux-mêmes se substituer à ces mécanismes contractuels et relationnels. En développant cette structure, cette thèse peut être considérée comme dirigeant la littérature de la gouvernance inter-organisationnelle vers la nouvelle frontière des accords autonomes et de l'application automatisée.

Troisièmement, cette thèse a contribué aux connaissances existantes en vérifiant empiriquement la structure de gouvernance fournie par la blockchain qu'elle a développée. La plupart des analyses des effets de la blockchain étant encore de nature spéculative et manquant de preuves empiriques (Wang et al., 2019), cette thèse a cherché à faire avancer l'étude de la blockchain avec une validation systématique de son cadre et de son modèle. Compte tenu de la relative nouveauté du domaine de la blockchain, cette thèse n'a pas été en mesure d'effectuer une mesure quantitative de ses constructions théoriques et, à cette fin, a plutôt examiné l'étude de cas réelle du réseau de financement du commerce we.trade piloté par la blockchain.

Cette thèse a testé des hypothèses présentées sous la forme de conditions nécessaires déterministes afin de soutenir l'approche de cas unique adoptée, telle que prescrite par Dul and Hak (2007). Les causes et les effets théoriques se sont avérés être présents dans le cas we.trade, les hypothèses énoncées n'ont donc pas été réfutées. Bien que cela ne soit pas suffisant pour prouver la causalité, cela fournit un soutien pour une étude plus approfondie de ces concepts, comme il est discuté dans la section suivante.

En outre, cette thèse a identifié les effets potentiels des éléments de ce cadre et de ce modèle sur la génération d'un avantage concurrentiel dans le cadre de we.trade, cherchant à nouveau à ajouter un poids empirique à la nature largement spéculative des recherches existantes sur les implications de la technologie blockchain dans le contexte commercial.

VIII. Contributions à la pratique

Les hypothèses testées présentées dans cette thèse apportent des informations exploitables aux professionnels.

La compréhension, à partir de cette thèse, des mécanismes identifiés au niveau de l'administration, de la plateforme et de l'application, nécessaires pour que les participants placent leur confiance (Hosmer, 1995) dans la capacité d'une structure de gouvernance de la blockchain à coordonner et à protéger les transactions, peut permettre aux professionnels de planifier et d'exploiter plus efficacement les réseaux commerciaux autorisés de la blockchain. Puis, via la gouvernance fournie par la blockchain, elle peut permettre aux professionnels de surmonter les problèmes de gouvernance qui peuvent traditionnellement résulter des méthodes traditionnelles de gouvernance. Comme décrit dans cette thèse, les contrats formels nécessitent des ressources importantes pour être créés, surveillés et appliqués (Joskow, 1985; Schwartz, 2004; Zou et al., 2019), et sont pourtant toujours inévitablement incomplets (Burkert et al., 2012; Grossman & Hart, 1986; Williamson, 1996), tandis que les méthodes informelles telles que la confiance et les structures sociales sont peut-être encore plus difficiles à utiliser (Larson, 1992).

Comprendre à partir de cette thèse la capacité de la blockchain à systématiser les rôles de la gouvernance dans le contexte du traitement des transactions peut fournir aux professionnels un moyen d'optimiser les échanges inter-organisationnels et ainsi générer un avantage concurrentiel supplémentaire (Dyer & Singh, 1998), en particulier dans des domaines tels que la gestion de la chaîne d'approvisionnement internationale qui contient des variations importantes au niveau de l'environnement et de l'entreprise (Ganne, 2018; Chambre de commerce internationale, 2020) qui compliquent encore davantage le fonctionnement efficace des mécanismes de gouvernance traditionnels des contrats écrits et des structures sociales (Van Der Valk et al., 2020).

Pour illustrer la valeur de ces connaissances, la pandémie de COVID-19 et la guerre en Ukraine ont montré que les processus commerciaux inter-organisationnels peuvent être sensibles à une rupture soudaine et traumatisante, et que les approches traditionnelles de la gouvernance au sein des réseaux d'entreprises peuvent être moins adaptables dans ces circonstances. Les professionnels peuvent désormais reconnaître la valeur de l'utilisation de la gouvernance fournie par la blockchain pour atténuer ces vulnérabilités dans le cycle de vie du commerce : - de la recherche, la sélection et la vérification des partenaires, au traitement, au suivi et à la protection des transactions.

Cette thèse a mis en évidence pour les professionnels le potentiel d'amélioration des capacités des contrats intelligents au-delà même de l'exécution et de l'application automatisées des paramètres de transaction, vers l'encodage des règles du cadre de gouvernance lui-même. Pour que les contrats intelligents puissent englober des fonctions de gouvernance telles que l'inscription, la surveillance et la résolution des conflits, ils pourraient représenter le fonctionnement d'un écosystème entièrement autogéré.

Les professionnels ont été conseillés dans cette thèse qu'afin de répondre aux préoccupations observées des participants du réseau blockchain, interrogés sur l'iniquité des règles de gouvernance (Deloitte, 2020), ils devraient chercher à donner la priorité à l'extension des contrats intelligents pour systématiser l'impartialité dans les opérations et dans la résolution des conflits. Les professionnels ont également été conseillés dans cette thèse de se concentrer sur l'intégrité et l'acceptation par les participants des flux d'oracles externes qui fournissent les informations utilisées par les contrats intelligents comme déclencheurs d'événements : - comme dans l'exemple des informations de qualité et de livraison qui sont introduites dans we.trade.

Enfin, l'importance croissante des contrats intelligents en tant que substituts des contrats écrits et des structures sociales obligera les professionnels à améliorer l'utilisabilité et l'auditabilité de ces programmes. Actuellement, les contrats intelligents ne peuvent pas être créés à partir de contrats écrits et ne sont pas facilement compréhensibles pour les non-techniciens. Comme l'a montré l'étude we.trade, les utilisateurs peuvent être "effrayés" par les contrats intelligents, et la convergence des lexiques des contrats écrits et intelligents améliorerait l'acceptation et l'utilisation des contrats intelligents.

IX. Limites et recherches futures

La principale limite de cette thèse est son utilisation de la méthodologie d'étude de cas unique. Bien que ce cas ait satisfait aux quatre tests permettant d'établir la qualité d'une recherche par étude de cas, tels que décrits par Yin (2014), compte tenu de l'accès et des ressources nécessaires, tester les hypothèses théoriques sur plusieurs cas aurait fourni un plus grand degré de validation, et aurait pu identifier des idées supplémentaires.

Les recherches futures sur des questions de recherche telles que celle de cette thèse pourraient appliquer l'approche de l'étude de cas à plusieurs blockchains d'entreprises autorisées. Étant donné la nouveauté de la blockchain et la relative rareté de ces réseaux en activité, il se peut que les réseaux supplémentaires ne soient pas exactement comparables à we.trade en termes d'approche. Alors que we.trade se concentre sur le commerce à compte ouvert et que la majorité de ses participants sont des petites et moyennes entreprises, d'autres réseaux basés sur la blockchain qui existent dans le secteur du financement du commerce traitent d'autres domaines tels que le financement des entreprises (Marco Polo) ou les lettres de crédit (Contour and Komgo), et sont donc moins impliqués dans la gouvernance du traitement des transactions. Des hypothèses supplémentaires peuvent être nécessaires pour traiter ces différences entre les centres d'intérêt du réseau.

Au fur et à mesure de la maturité des réseaux basés sur la blockchain et de la croissance du nombre de participants actifs, il sera peut-être possible d'utiliser des études quantitatives pour analyser les réponses aux enquêtes de ces participants. Le nombre minimum requis de réponses n'a pas pu être atteint dans cette thèse malgré l'utilisation de multiples approches différentes.

Les recherches futures pourraient utilement se concentrer sur l'utilisation des contrats intelligents dans la gouvernance bien au-delà du domaine du traitement des transactions qui est le sujet de cette thèse. Les informations sur les règles et le respect des règles de gouvernance peuvent être encodées au sein d'une grande variété d'applications et d'industries et à travers les réseaux (Reijers et al., 2018).

X. Conclusion

Cette thèse conclut que l'émergence de la technologie blockchain fournit désormais les moyens par lesquels l'automatisation de la spécification, de la validation et de l'application de la commande privée entre les participants à l'échange peut être réalisée, et suggère que cela devrait stimuler une réévaluation de la théorie et de la pratique existantes de la gouvernance inter-organisationnelle.

Cette étude de cas a montré que les commerçants et les banques qui participent à we.trade font confiance à la gouvernance activée par la blockchain fournie via le réseau, plutôt qu'aux méthodes contractuelles et relationnelles traditionnelles.

Au premier rang des mécanismes de gouvernance de la blockchain figurent les contrats intelligents. Ceux-ci exécutent l'ensemble de données de la transaction conformément à l'ensemble des règles appliquées et lorsqu'ils rencontrent les critères d'évènement externe spécifiés. La mesure dans laquelle le code de contrat intelligent peut être généré à partir d'un accord de gouvernance, et la mesure dans laquelle il peut surveiller et appliquer de manière autonome l'ensemble des règles de gouvernance en plus de traiter l'ensemble des données de la transaction, seront des déterminants majeurs de l'importance du futur rôle que la blockchain jouera pour faciliter les relations inter-organisationnelles.

Part A. This Thesis

I. Research Question and Target Contribution

This purpose of this thesis is to answer the following research question:

> Can the utilization of Blockchain Enhance the Governance of Business Networks and the Generation of Inter-Firm Competitive Advantage?

In addressing this question, this thesis seeks to deliver several contributions of value to the field:

1. To address the gaps in the research on blockchain, and to place blockchain within the context of the related disciplines
2. To construct a framework and model identifying the mechanisms by which blockchain can deliver governance within business networks, and by so doing can provide a substitute to traditional contractual and social methods
3. To test this framework of blockchain delivered governance empirically against a real-world case
4. To identify the potential effects of the elements of this framework upon the generation of competitive advantage

II. The Process by which this Thesis was Developed

The process by which this thesis will address the specified research question, and deliver the specified contributions, is presented in Figure 1 and in the sections below.

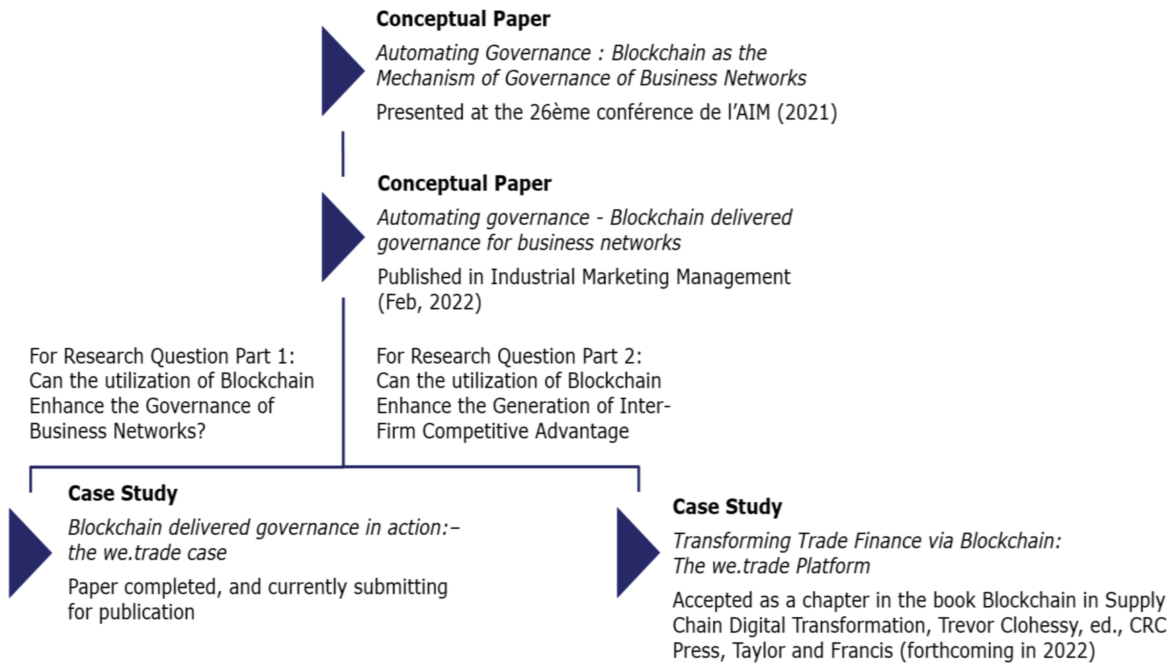


Figure 1 – Thesis Process

1. Conceptual Paper :- Automating Governance : Blockchain as the Mechanism of Governance of Business Networks

This initial conceptual paper was aimed at identifying the gaps in the literature on blockchain, and on placing blockchain within the context of the existing literature on the disciplines related to the governance of business networks.

This paper then placed its attention on the construction of a framework identifying the mechanisms by which blockchain can deliver governance within business networks, and by so doing can provide a substitute to traditional contractual and social methods.

The contents of this paper, while not presented in full within this thesis, informed the Introduction section of this thesis.

2. Conceptual Paper :- Automating governance - Blockchain delivered governance for business networks

This full conceptual paper expanded upon the placement of blockchain within the context of the existing literature on the disciplines related to the governance of business networks, including transaction cost economics, social structures, and network theory.

This paper then developed a framework and model identifying the mechanisms by which blockchain can deliver governance within business networks, and by so doing can provide a substitute to traditional contractual and social methods.

This paper is presented in full in this thesis in Part C. The Three Studies, Chapter 1. Automating Governance: Blockchain Delivered Governance for Business Networks.

3. Qualitative Paper :- Blockchain delivered governance in action:– the we.trade case

This case study was designed to address the first part of the research question of this thesis, namely: Can the utilization of Blockchain Enhance the Governance of Business Networks?

This case study operationalized into testable hypotheses the propositions of the framework and model of the conceptual paper, and then sought to verify these empirically against the we.trade blockchain based network.

This paper is presented in full in this thesis in Part C. The Three Studies, Chapter 2. Blockchain Delivered Governance in Action:- The we.trade Case.

4. Qualitative Paper :- Transforming Trade Finance via Blockchain: The we.trade Platform

This case study was designed to address the second part of the research question of this thesis, namely: Can the utilization of Blockchain Enhance the Generation of Inter-Firm Competitive Advantage ?

This case study investigated the methods by which blockchain delivered governance support the creation of competitive advantage in the inter-firm exchanges within a business network.

This paper is presented in full in this thesis in Part C. The Three Studies, Chapter 3. Transforming Trade Finance via Blockchain:- The we.trade Platform.

III. Publications resulting from this Thesis

The publications produced during the course of this thesis are described below in Table 1:

Publication List		
Automating governance - Blockchain delivered governance for business networks		
	Author	David Petersen
	Publisher	Industrial Marketing Management
	Type	Journal (CNRS Category 2)
	Status	Published February, 2022 https://doi.org/10.1016/j.indmarman.2022.01.017
	See Section	Part C. The Three Studies, Chapter 1.
Blockchain delivered governance in action:– the we.trade case		
	Author	David Petersen
	Publisher	In Progress
	Type	Journal
	Status	Submitting for Publication
	See Section	Part C. The Three Studies, Chapter 2.
Transforming Trade Finance via Blockchain: The we.trade Platform		
	Author	David Petersen
	Publisher	CRC Press, Taylor and Francis
	Type	Book Chapter *in* Blockchain in Supply Chain Digital Transformation, Trevor Clohessy, ed.
	Status	Accepted for Publication (forthcoming in 2022/3)
	See Section	Part C. The Three Studies, Chapter 3.

Table 1 – Publications Relating to this Thesis

Part B. Introduction

I. Blockchain and the Governance of Business Networks in Context

1. Background

Nakamoto (2008, p. 1) arrived unheralded to unveil Bitcoin with the rallying cry: "what is needed is an electronic payment system based on cryptographic proof instead of trust, allowing any two willing parties to transact directly with each other without the need for a trusted third party." In the relatively short time since this proclamation, Bitcoin has been generalized into the domain of blockchain, offering benefits from enhanced security, immutability, and transparency, efficiency and cost reduction, and decentralization and disintermediation (Fosso Wamba et al., 2020). The scope of potential use cases of blockchain has rapidly expanded from financial services to supply chain (CB Insights 2019; World Economic Forum 2016; IBM 2016; Smart Contracts Alliance 2016), from health/medical to wearable devices (De Moya & Pallud, 2020), and many others (Allen et al., 2020), often facilitated by the implementation of 'smart contracts' to automate the performance of processes across blockchains.

The European Commission announced in 2018 that "Blockchain is a great opportunity for Europe and Member States to rethink their information systems, to promote user trust and the protection of personal data, to help create new business opportunities and to establish new areas of leadership, benefiting citizens, public services and companies", and accordingly launched the EU Blockchain Observatory and Forum in February 2018, with the stated goal to invest some € 300 million in blockchain projects through its Horizon 2020 programme (European Commission 2018).

However, the majority of research has to date focused on Bitcoin and cryptocurrency technology (Fosso Wamba et al., 2020; Yli-Huumo et al., 2016), there is a scarcity of research on blockchain business applications (Risius & Spohrer, 2017) and business-oriented functionality such as smart contracts (Alharby & Moorsel, 2017), and there has been relatively little research into the implications of blockchain for the structure of the organization (Beck et al., 2017; Constantinides et al., 2018).

This thesis was conceived in response to calls such as that of Risius and Spohrer (2017) for further research into the impact of blockchain on the governance of inter-organizational networks. Specifically, this thesis will focus on the domain which Lumineau, Wang, and Schilke (2021, p. 26) describe as explicit transactions, such as the trade exchange of buying and selling.

This thesis begins by placing blockchain in the context of a mechanism of governance, contrasted with the traditional perspectives of contractual governance (as proposed by the field of transaction cost economics), relational governance (trust and social structures described by economic sociology), network-based governance (following on from network theory). In particular, this thesis will examine the elements which make blockchain what Davidson, De Filippi, and Potts (2018) describe as an institutional innovation, representing an entirely new governance technology.

This thesis then seeks to make a contribution by developing and empirically testing a conceptual framework and model of automated governance by blockchain:- which can be defined as the automatic protection of the rights of entities during transaction processing on a blockchain network. It is posited that the extent to which the blockchain can assure participants of its ability to protect these rights will be the extent to which the blockchain can substitute for alternate mechanisms of governance. Throughout this process, the implications for further avenues of research, and for application by practitioners, are described.

2. An Introduction to Blockchain

2.1. Overview

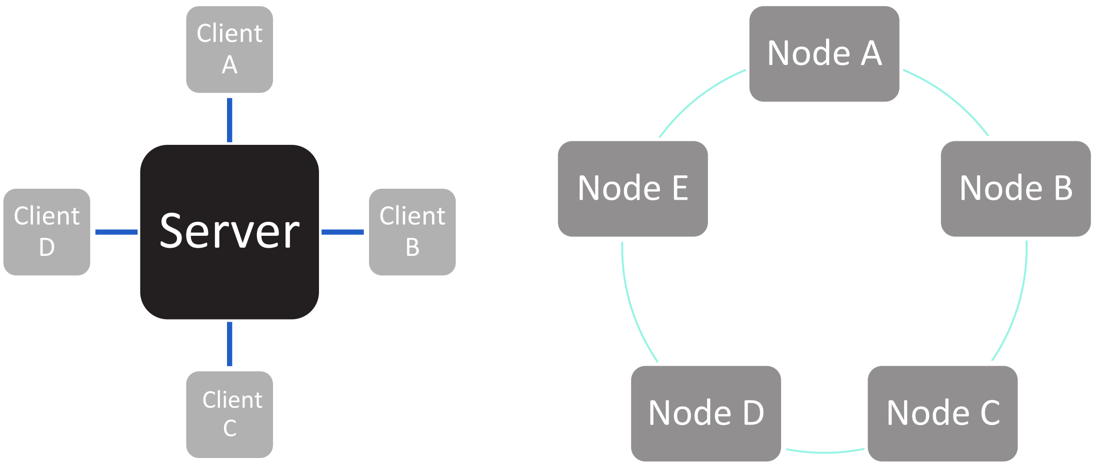
Nakamoto (2008) drew together concepts of cryptography, digital cash, hashing, and peer-to-peer computing to create the Bitcoin model and subsequently the bitcoin.org software framework. While Nakamoto (2008) did not use the terms 'distributed ledger technology' or 'blockchain', subsequently these have been used to generalize the Bitcoin design into platforms in which transactions can be performed by multiple nodes across a decentralized database and network, with data immutable and retained historically (Dhar & Stein, 2017; Haddad & Hornuf, 2016). Blockchain can be regarded as a specific type of distributed ledger technology in which transaction data is grouped into chronologically sequenced blocks, the validity of the transactions is controlled by the "hash" totals of the blocks, and the blocks are appended to a decentralized ledger.

2.2. Key Elements of a Blockchain Network

2.2.1. Decentralization

Traditionally, data is managed in a centralized database, with a hub-and-spoke structure to connect its various clients, as shown in Figure 2 part i.

In a distributed ledger or blockchain however, each node on the network can store its own copy of the programs and data that relates to it, as shown in Figure 2 part ii. Here, the true state of this ledger is determined by an algorithm which must achieve consensus over what are the agreed valid transactions.



i. Centralized Structure

ii. Decentralized Structure

Figure 2 – Centralized vs. Decentralized Network Structure

2.2.2. Permissioned vs Permissionless Blockchains

It must be noted that the degree of decentralization of blockchain networks varies greatly between permissionless (that is, public), and permissioned (private) blockchains as are typically used in a business context (Deloitte, 2020; Rauchs et al., 2019).

The differences between these two structures are summarized in Table 2 below.

	Permissionless Blockchain	Permissioned Blockchain
Approach	Open system	Closed ecosystem
Level of Decentralization	Completely decentralized	Centralized management entity, decentralized data and program technology
Governance Mechanism	The blockchain technology ("On-chain")	Centralized management entity ("Off-chain"), and the blockchain technology ("On-chain")
Access Rights	Open to all, anonymously	Gatekeeping by centralized management entity to allow specific trading partners
Transaction Validation	Open to all, the actual node used is determined by incentives	Performed by nominated nodes
Illustrative Validation Algorithm	Proof of Work	Byzantine Fault Tolerance

	Permissionless Blockchain	**Permissioned Blockchain**
Examples	Bitcoin Ethereum	Tradelens IBM Food Trust

Table 2 – Permissionless versus Permissioned Blockchain Network Structure

2.2.3. Cryptographic Hashing

The core of blockchain technology could be said to be its use of a cryptographic hashing algorithm to validate and record the submitted transactions, and to ensure the subsequent security and immutability of those transactions.

The essence of such hashing was expressed concisely by van Flymen (2019): "Given a chicken nugget, it's hard to recreate the chicken". It is practically infeasible to decompose a hashed code to its source. For example, the text "A few sandwiches short of a picnic" could be generated into the hash e2762516d0decb18525bb635d3d19abf. However, a change of even one character in the source, e.g. to "A few **S**andwiches short of a picnic", would result in a totally different hash of b699281518b9edefe072e0ef9ae44a being generated by the algorithm (van Flymen, 2019).

A valid chain of hashed transactions is demonstrated below in Figure 3:

- Block #5 contains five transactions, the initial miner (or, creator), and four subsequent transactions
- These transactions are combined with the 'Previous Hash', the 'Timestamp', and 'Junk' (or an arbitrary factor) to create the new 'Hash' for Block #5
- This process is repeated for the three transactions in Block #6, and the four transactions in Block #7

It must be noted that the 'Hash' that validates the transactions within Block #7 also contains the validation of all previous blocks (that is, the chain of values of 'Previous Hash').

Block #5

Transactions		
From	To	Amount
-	Miner	฿ 12.50
Justin	Dan	฿ 15.12
Dan	Federico	฿ 75.51
Pierre	Nick	฿ 31.51
Dan	Satoshi	฿ 99.00
Metadata		
Previous Hash	2e6e504eaf47df8e4c7c9d7109073a2e	
Timestamp	2019-05-05 17:46	
Junk	ABC123456	
Hash	0533e9e05340d8feeff7f997c3f1e7ed	

Block #6

Transactions		
From	To	Amount
-	Miner	฿ 12.50
Josh	Dan	฿ 31.40
Brian	Martine	฿ 10.00
Metadata		
Previous Hash	0533e9e05340d8feeff7f997c3f1e7ed	
Timestamp	2019-05-05 17:46	
Junk	012ABC1234123456789fa212	
Hash	0798c7e2b7344f597f23c45332f84bdf	

Block #7

Transactions		
From	To	Amount
-	Miner	฿ 12.50
Miles	Dan	฿ 21.26
Lina	Casey	฿ 17.82
Alice	Bob	฿ 82.13
Metadata		
Previous Hash	0798c7e2b7344f597f23c45332f84bdf	
Timestamp	2019-05-05 17:46	
Junk	ABC1234abda	
Hash	05f6f67253df4d03f0537456e4d23ea9	

Figure 3 – A Valid Chain of Hashed Transactions.   Source: van Flymen (2019).

In contrast, an invalidated chain of hashed transactions is demonstrated in Figure 4:

- A subsequent change to the 'Dan' transaction in Block #5 produces a different 'Hash' in Block #5, thus invalidating the block
- Additionally, the altered Block #5 hash causes the cumulative hashes for Blocks #6 and #7 to be recalculated and to thus become invalid

Block #5

Transactions		
From	To	Amount
-	Miner	฿ 12.50
Justin	Dan	฿ 15.12
Dan	Federico	฿ 75.51
Pierre	Nick	฿ 31.51
Dan	Satoshi	฿ 99.01
Metadata		
Previous Hash	2e6e504eaf47df8e4c7c9d7109073a2e	
Timestamp	2019-05-05 17:46	
Junk	ABC123456	
Hash	2f8a7b5b97351fb9a74491941145d2b5	

Block #6

Transactions		
From	To	Amount
-	Miner	฿ 12.50
Josh	Dan	฿ 31.40
Brian	Martine	฿ 10.00
Metadata		
Previous Hash	2f8a7b5b97351fb9a74491941145d2b5	
Timestamp	2019-05-05 17:46	
Junk	012ABC1234123456789fa212	
Hash	db3abd3833f500222ca3c2c286ffc41c	

Block #7

Transactions		
From	To	Amount
-	Miner	฿ 12.50
Miles	Dan	฿ 21.26
Lina	Casey	฿ 17.82
Alice	Bob	฿ 82.13
Metadata		
Previous Hash	db3abd3833f500222ca3c2c286ffc41c	
Timestamp	2019-05-05 17:46	
Junk	ABC1234abda	
Hash	3eac7b920862530e99f94752a59df9e3	

Figure 4 – An Invalidated Chain of Hashed Transactions.   Source: van Flymen (2019).

Thus if a malicious party was to attempt to fraudulently create, modify, or delete a transaction within a posted block, that party would have to re-calculate all the subsequent hashes and convince the blockchain network to validate and accept these new blocks in opposition to a properly validated chain of blocks (that could be extensive depending on the elapsed time as recorded in the timestamps), which would be virtually impossible.

2.3. Smart Contracts

The ‘smart contracts’ concept was developed by Szabo (1994) in the mid-1990’s as an extension of digital-cash constructs, and defined as “a set of promises, specified in digital form, including protocols within which the parties perform on these promises” (Szabo, 1996, p. 1). This has since inspired the creation of programmed, self-executing, rule-based smart contracts as a key element of blockchain functionality across multiple blockchain platforms, including Ethereum, Hyperledger, and others (Buterin, 2014; Smart Contracts Alliance, 2016).

Blockchain smart contracts can execute transactions automatically, upon the satisfaction of measurable terms and conditions agreed between the parties, as in the example of the transfer of a payment from a buyer to a seller upon the submission of a verified proof of delivery criteria. The scope of the smart contract could represent either all or a part of the contract between the parties, and it could replace a written contract or it could be referenced by the written contract for certain elements of the agreement between the parties. There is not yet a consensus in the literature as to the boundaries of smart contracts (Van Der Valk et al., 2020), yet they are gaining increasing acceptance as a valid form of legal agreement (European Commission, 2020).

Collections of smart contracts can be combined in a decentralized application, or 'dapp'. Dapps can be built directly on a blockchain, or onto a dapp framework which represents another layer built on top of the blockchain. External, off-blockchain data sources known as 'oracles' can feed information into a smart contract, widening the scope of possible functions to be performed by smart contracts.

3. Context

An extremely wide range of definitions exists for the concept of governance (Jones et al., 1997). Within the context of business networks, governance mechanisms can be seen as those "interfirm management structures" (Achrol & Gundlach, 1999, p. 107) that promote effective coordination in the processing of transactions between network participants.

This section will compare the alternate frameworks which have been described in the literature for understanding the mechanisms by which governance is employed within business networks. A synopsis of the major works involved is provided in Part G. section I.

3.1. Contractual and Relational Governance

Traditional perspectives on governance have typically focused on the use of a combination of contract and relational (or social) levers.

Contractual Governance. Combining institutional economics and organizational theory, and building on the definition of the transaction as the basic unit of economic analysis (Commons, 1932) and of the alternate structures of firm and market (Coase, 1937), Williamson (1975) developed the concept of Transaction Cost Economics (TCE) and stressed the importance of contract in transaction processing. Contracts were considered necessary because of environmental uncertainty, asymmetric information and bounded rationality (Simon, 1947), and due to the risk of exchange hazards primarily opportunistic behavior (Williamson, 1975, 1985, 1993b). Contracts would specify foreseeable responsibilities, and would define processes for addressing unforeseeable contingencies.

With this lens, the role of governance is seen to be the organizing of transactions (Williamson & Ouchi, 1981), and the governance structure is seen to be "the institutional framework within which the integrity of a transaction, or related set of transactions, is decided" (Williamson, 1996, p. 397).

Relational Governance. Granovetter (1985) brought the discipline of sociology to institutional economics and identified the strength of social structural influences on market behavior. In particular, Granovetter described the concept of embeddedness, which stresses "the role of concrete personal relations and structures (or 'networks') of such relations in generating trust and discouraging malfeasance" (Granovetter, 1985, p. 490). Relational governance thus is based largely upon trust, which can be defined as the perceived likelihood of an exchange partner acting in violation of an agreement, either implicit or explicit (Madhok, 1995).

Theorists have long recognized the importance of trust in enabling (Arrow, 1974; Macaulay, 1963) and improving the performance of inter-organizational exchanges (Heide & John, 1992; Poppo et al., 2008; Poppo & Zenger, 2002; Zaheer & Zaheer, 2006). Arrow (1974) noted that there would be an element of trust in every transaction.

Managing relationships via informal channels, that is essentially via the presence of trust between the parties, could be regarded as the preferable approach within business networks due to the difficulty of completeness of contracting and the complexity of multiple legal jurisdictions, the lower transaction costs which can be achieved by eliminating the costs of contracting, monitoring, applying and enforcing, adaptation, and re-contracting, and the more sustainable nature of repeated value-added transactions within an environment of trust (Dyer, Singh, and Hesterly 2018). Williamson acknowledges that ceteris paribus, exchanges that involve personal trust will be more resilient and adaptable (Williamson 1985). Dyer and Chu's study into the automobile purchasers and suppliers in the USA, Japan, and Korea (Dyer and Chu 2003, 2011) found that the presence of trust in relationships reduces transaction costs, while at the same time encouraging information sharing and thus creating value in the relationship.

However, there are reasons why the use of a trust-based form of governance approach may not be practical in part or in full:

1. Trust is expensive and time consuming to create (Madhok 1995), and thus may not be feasible in newly-created partnerships, or short-term relationships.
2. Levels of trustworthiness vary between firms - since this will be the result of a mixture of historical factors and social complexities - thus leading to potential mismatches and unpredictable outcomes in dealings between the firms (Tyler 2001).
3. Cross-national and/or cross-cultural partnerships wherein the participants have different attitudes towards trust complicate the creation and use of trust (Zaheer and Zaheer 2006). While Dyer and Chu's study of trustworthiness within the automobile industries of the US, Japan, and Korea included Japanese suppliers based in the US working with US automakers (Dyer and Chu 2011), it did not include firms building trustful relationships across distances and national borders.
4. Trust between companies of various sizes and structures may suffer from the unequal power of the entities, as may be implied from the presence of the bargaining power of buyers, and the bargaining power of suppliers, as two of the five forces which determine competitive advantage in the industry structure view (Porter 1980).
5. Trust based on personal relationships may be limited in terms of duration and scope, and degree of control (Jeffries 2000).

6. While trust in general reduces the risk of inappropriate behavior, the 'paradox of trust' allows risk through opportunistic behavior (Granovetter 1985; Dyer and Singh 1998). In today's world where risk-management is an ever-increasing factor in regulatory regimes, what could be seen as an over-reliance on trust may be regarded as an exposure in governance.
7. Dyer and Singh posit that informal mechanisms of trust can prove to be a liability when they lead to complacency and reduced market discipline, and thus cause "relational inertia" (Dyer, Singh, and Hesterly 2018).

Complementary Mechanisms. This view of the contributions of contractual and relational governance contends that multiple governance mechanisms may be employed to target different problems (Gundlach & Cannon, 2010; Heide et al., 2007), that "formal contracts and relational governance function as complements" (Poppo & Zenger, 2002, p. 707), that "relational and contractual mechanisms are indeed complementary forms of exchange governance" (Zheng et al., 2008, p. 43), and that contracts "are compatible with indirect social control and group norms resulting from network embeddedness" (Wuyts & Geyskens, 2005, p. 113). It is noted that some studies find trust and contract to be "both complements and substitutes" (Woolthuis et al., 2005, p. 813).

3.2. Network Structure and Governance

The study of business networks has been greatly influenced by the field of sociology, particularly the embedding of social structures across networks as suggested by Granovetter (1985), and the application of social network analysis to the structure of relationships between entities and to the examination of the role of trust in markets and exchange relationships (Wasserman & Faust, 1994). Networks were seen to be comprised of relational ties which were channels for the flow of resources between interdependent actors or entities (Hoffer Gittell & Weiss, 2004; Wasserman & Faust, 1994).

To Klijn and Koppenjan (2006, p. 144), "networks may be regarded as institutions", and these network institutions are in fact "sets of rules". These rules can be controlled with network composition strategies to define the participants and their access rights, and network interaction strategies to manage the linkages between the participants (Klijn & Koppenjan, 2006).

In the example of a supply chain – "a network consisting of nodes and links" (Carter et al., 2015, p. 90) in which inter-organizational relationship governance mechanisms will affect multiple connected parties (Van Der Valk et al., 2020) – the structure may continue to grow in volume and in complexity with the rapid globalization of trade (International Chamber of Commerce, 2018), enabled by the increased availability and efficiency of international networked communications (Zhu et al., 2006). Empirical support for the network view that "the manner in which a firm reaches its partners and the shape and form of its network influence its performance" has been found in the steel and semiconductor industries (Rowley et al., 2000, p. 370), and in a multitude of other industries and locations (Larson, 1992).

3.3. Network Governance and Competitive Advantage

While the resource-based view of firm competitive advantage (Wernerfelt, 1984) is focused on firm-specific factors, the relational view (Dyer & Singh, 1998) extends this past the boundaries of the firm into the networks within which the firm participates, as interpreted below in Figure 5.

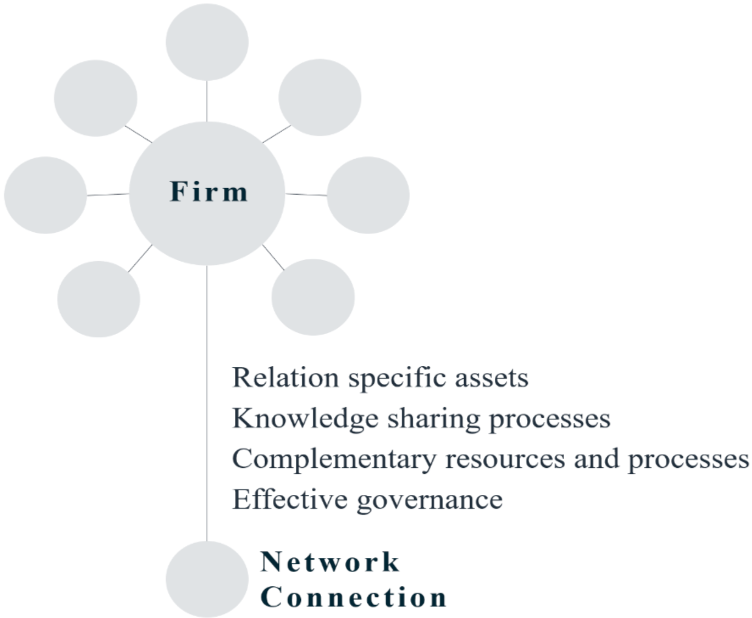


Figure 5 – The Relational View of Relation-Specific Resources and Processes

Authors such as Dyer and Singh (1998) have identified effective governance as being a critical potential source of inter-firm competitive advantage, with the method of governance affecting both the cost side (that is, the management of transaction costs), and the revenue side (providing incentives for trading partners to share in value-creating activities) of business operations.

Dyer and Singh (1998) do not explicitly define the term governance in constructing the relational view, but in their theoretical discussion of market relationships cite Williamson (1985) on transaction costs and governance mechanisms. The challenges of complete contracting, the complexity of multiple legal jurisdictions, the costs of contracting, monitoring, applying and enforcing, adaptation, and re-contracting, and the more sustainable nature of repeated value-added transactions in an environment of trust, may indicate that the use of trust in governance is preferred (Dyer et al., 2018). However, trust-based approaches may be of limited practicability, due to the significant cost, time, and individual and corporate alignment required for their creation and maintenance, and the need for formalization of inter-firm processes for audit and regulatory purposes.

These inputs to, and potential outputs from, governance are presented below in Figure 6.

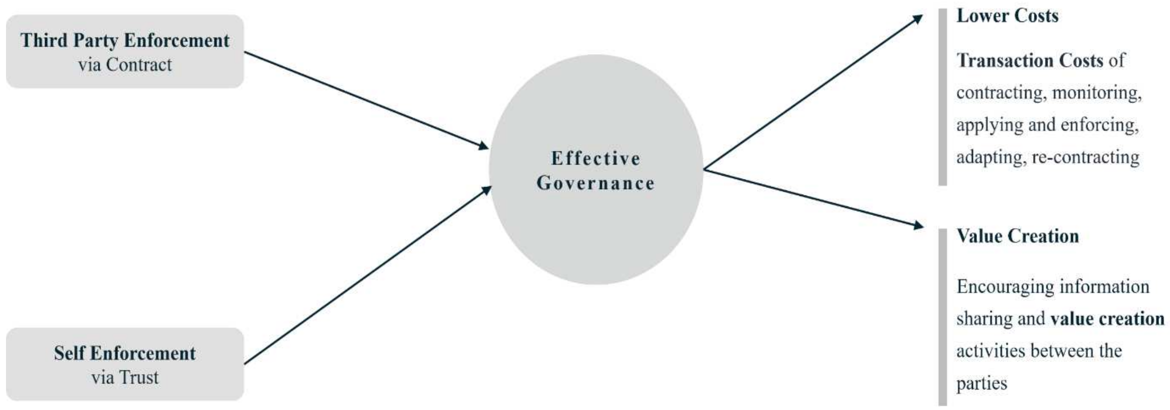


Figure 6 – Sources and Results of Effective Governance

Additionally, the governance mechanisms of business networks must contend with gaps or discontinuities in information flows, time, and/or location. Despite the widespread application of technology in recent years, these gaps have persisted and perhaps even increased in number and in size with the deployment of ever more complex, globalized, and disaggregated business flows.

Small and medium sized enterprises (SMEs) face even greater relative challenges due to their limited management and technical resources. Further variations will exist in key factors such as the adoption of security measures depending upon whether the SME CEO owns or merely operates the SME, and depending upon the network of social influences upon the CEO (Barlette et al., 2017).

The relationships between these factors is presented below in Figure 7.

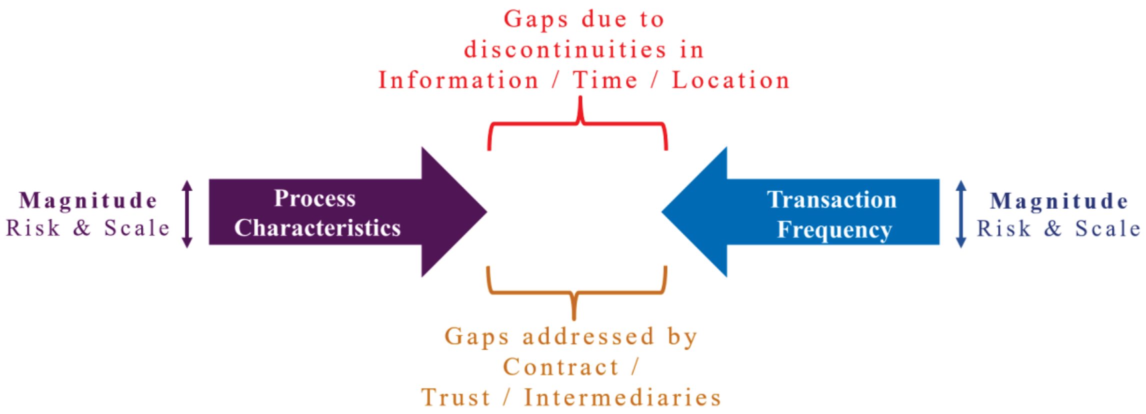


Figure 7 – Governance over Gaps in Information, Time, Location

In Figure 7, the width of these displayed gaps are the result of the relative extent of the process characteristics, and of the transaction frequency. The process characteristics will include factors which influence the nature and complexity of the transaction, such as the industry, the parties involved, the degree of automation in the process, the level of integration between the parties, and the cultures and languages of the parties. The transaction frequency is the volume of recurrence of the transaction, as typically the greater the frequency of the transaction the lesser the perceived risks and uncertainties for the parties.

The magnitude or importance of the gap to the party is determined by the perceived level of risk in the transaction, and the relative scale or significance of the transaction to the party.

3.4. Blockchain and Governance

Blockchain as a Governance Mechanism. The concept of blockchain as a governance technology draws upon an interdisciplinary intersection of the domain of information systems, the mechanisms of contractual governance, relational governance and network theory, and principles of the self-governance of communal resources (Allen & Berg, 2020; Davidson et al., 2016).

Davidson, De Filippi, and Potts (2016) suggest that while blockchain at first appeared to be part of the rise of information systems, blockchain itself represents a revolution in institutions, organization, and governance. MacDonald, Allen, and Potts (2016, pp. 283–284) concur, writing that blockchains are "fundamentally a technology of decentralization", and that they are "best understood as a new institutional technology that makes possible new types of contracts and organizations". Brennan, Subramaniam, and van Staden (2019, p. 1) categorize blockchain as one of the major disruptive technologies leading to a "revolutionary paradigm shift" in thinking about business structures and governance.

Davidson, De Filippi, and Potts (2018, p. 4) expanded on their earlier work to posit that blockchain represented an "institutional innovation", providing a new "governance technology", to enable a "new species of economic coordination". As well as being a "trustless" technology – removing the need for trust between trading partners, either direct or via intermediaries – blockchain and its smart contract construct provide the means for the network to be self-monitoring, self-governing, and self-enforcing, forming a self-contained decentralized autonomous organization or DAO (Davidson et al., 2018, p. 5). A DAO functions in accordance with the governance rules specified in the blockchain itself (Beck et al., 2018).

By providing an alternative organisational mechanism for coordinating economic activity, blockchain technology offers a potential substitute governance mechanism to the use of markets, hierarchies, relational contracting and governments, and thus blockchains are indeed in this sense an institutional innovation (Davidson et al., 2018).

Allen, Berg, Markey-Towler, Novak, and Potts (2020) describe blockchains as digital platforms wherein management is decentralised across the network transactors, validators, and developers, and that it is this distribution of governance structure that makes blockchain an institutional technology.

Lumineau, Wang, and Schilke (2021, p. 26) conclude that for explicit transactions - such as the trade exchange of buying and selling - blockchains would have a "substitutive effect for both contractual and relational governance mechanisms". They posit that blockchain provides an automated framework that offers a "way to enforce agreements and achieve cooperation and coordination that is distinct from both traditional contractual and relational governance as well as from other IT solutions" (Lumineau et al., 2021, p. 1).

Blockchain addressing gaps in inter-firm business processes. By providing network participants with this transparency of transaction processing and history, blockchain can reduce uncertainty and minimize process discontinuities. Since agreements are codified and executed on this visible and immutable platform, there is not the need to rely on partners for trust, nor to assign intermediaries to reinforce trust at these gaps in the process flows (World Economic Forum, 2016). These capabilities of blockchain represent a different approach to security, one in which transparency rather than secrecy can be more efficacious (Grove et al., 2018).

The correction of asymmetries of information between network participants, and the availability of the required information across the network, will reduce opportunities for fraudulent behavior such as multiple requests for financing being based upon the same purchase agreement or invoice. This will also minimize the need for central authorities to act as process intermediaries.

As shown below in Figure 8, blockchain can thus be expected to more effectively address the gaps in information flows, time, and location that the mechanisms of contracts and trust have traditionally filled.

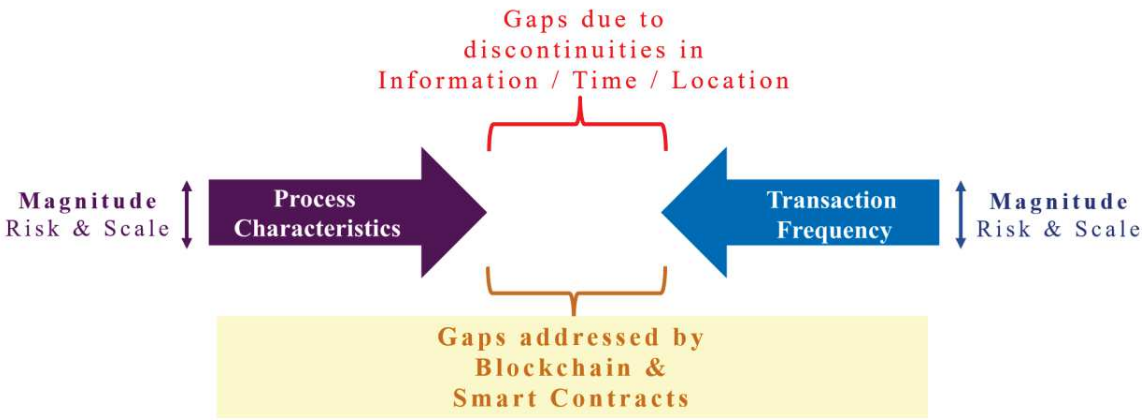


Figure 8 – Blockchain Governance over Gaps in Information, Time, Location

In addition, blockchain may provide repeatable value such as the ability to be replicated to new markets and networks, while being difficult to imitate, thus providing sustainable advantage to network participants.

The mechanisms to be used as levers in managing governance within a blockchain structure and the results of effective governance (lower cost and higher value added) are summarized below in Figure 9.

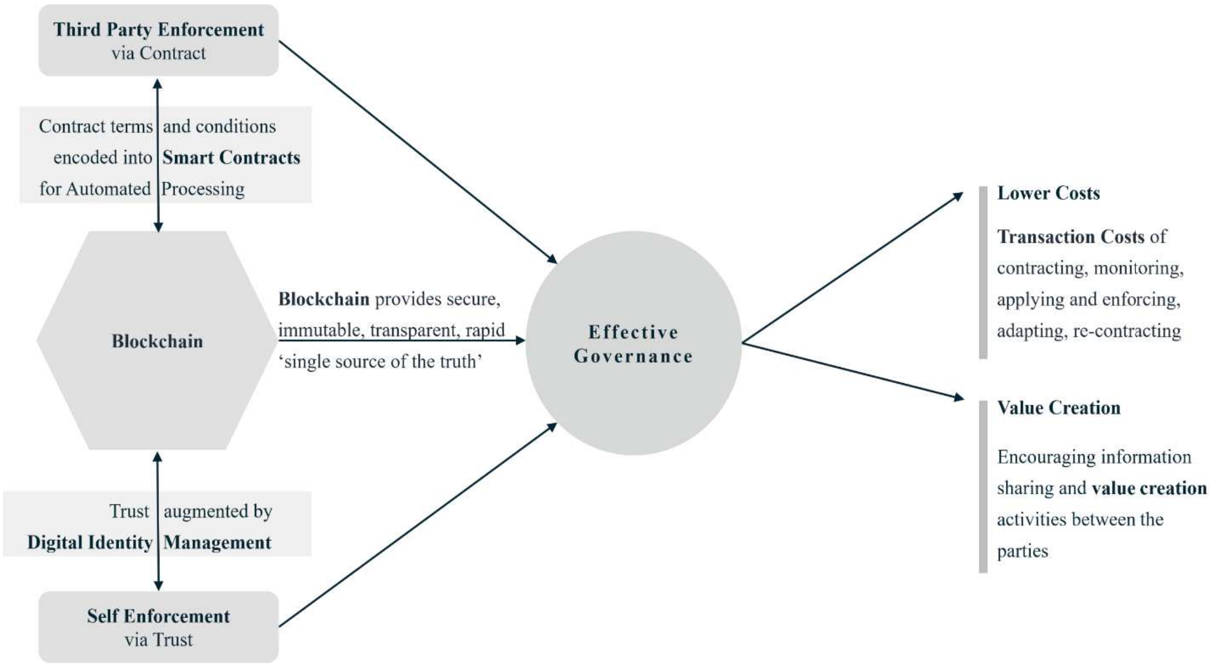


Figure 9 – Sources and Results of Effective Governance with Blockchain

3.4.1. The Case of 'The DAO'

'The DAO' (standing for 'Decentralized Autonomous Organization') was a fund within the Ethereum blockchain platform which, in return for the money it received, issued tokens to confer ownership, and to convey voting rights and participation in the projects in which it would invest (Arrunada & Garicano, 2018). After receiving the equivalent of approximately USD 250 million in the Ethereum cryptocurrency called 'ether' from its investors, it was discovered that a token holder had used a vulnerability in The DAO smart contract code (the 'race to empty' scenario in which an attacker "utilized the 'split' function to exit The DAO while repeatedly calling a function to withdraw funds before the balance could be updated") to drain approximately USD 60 million worth of ether (DuPont, 2018, p. 163). The Ethereum community attempted for several weeks to inhibit the effects of this tactic, and in fact the construction of the ‘split’ function did prevent the perpetrator from exiting The DAO with any of the acquired funds.

With the future of Ethereum itself being questioned, the Ethereum Foundation, with the support of its founder Vitalik Buterin, then implemented an upgrade to the Ethereum software that performed what was in effect a withdrawal transaction which moved all tokens to a new Ethereum blockchain and to their original owners, and which effectively erased The DAO (DuPont, 2018).

This change was fiercely debated within the Ethereum community. While the majority of community members agreed with this approach in order to protect the investors of The DAO, a significant number of members continued to invoke the “code is law” mantra and the belief in the immutability of transactions that had been assumed to be at the heart of The DAO, and of Ethereum, and the concept of blockchain itself (Zachariadis et al., 2019, p. 113). This minority refused to support the new code, and instead continued with a “hard fork” to separate from Ethereum into ‘Ethereum Classic’, a parallel Ethereum platform in which the allegedly malfeasant transactions continued to exist.

While The DAO had been formed with the idea of automating governance via blockchain, DuPont (2018) notes that the resolution of the crisis required private discussions between a network of individuals having existing relationships.

4. Framework

This thesis has defined governance within business networks as "interfirm management structures" to promote effective coordination between network participants (Achrol & Gundlach, 1999, p. 107), and as the "institutional framework within which the integrity of a transaction, or related set of transactions, is decided" (Williamson, 1996, p. 397).

Davidson, De Filippi, and Potts (2018) and Lumineau, Wang, and Schilke (2021) have written that blockchain possesses the capabilities required to perform as a governance mechanism.

To evaluate this position, this section will review how blockchain can feasibly fulfill those major functions which may be required for the governance of a business network, including the protection of participation rights, the coordination of transaction processing, the monitoring of this processing, the control of opportunistic behaviour, and the resolution of conflict.

Protection of Participation Rights. Blockchain can be seen to have the ability to protect the expected participation rights of stakeholders in a business network, that is, it can facilitate the automated implementation of the network composition strategies which will define which entities can participate in the network, and with what access rights (Klijn & Koppenjan, 2006), and the control of boundaries via the inclusion and exclusion of participants (Ostrom, 1990, 2000, 2010).

This highest level of blockchain governance is delivered by the structure and mechanisms of the blockchain itself. Primarily these define the rights of participation in the blockchain, including the right to join the network, to submit transactions, and to validate transactions.

The structure of the blockchain fundamentally relates to its degree of decentralization, while the key mechanism of the blockchain is its method for determining consensus agreement on the validation and acceptance of transactions submitted by nodes on the network. The choice of this consensus mechanism will follow the choice of blockchain structure.

Any entity can participate in a permissionless blockchain such as Bitcoin, in which the network itself automatically defines how entities can join the network, raise transactions, and validate transactions: that is, where is no central controlling body and which participants must trust the operation of the network to regulate and self-enforce performance. In permissionless blockchains, governance can be seen to be performed on-chain (that is, performed on the blockchain itself). A permissionless blockchain would not expel participants, rather its consensus algorithm would simply automatically ignore nodes on the blockchain which submitted data judged to be invalid (for example, due to inconsistent hashing).

On a permissioned blockchain, such as the Tradelens supply chain platform (Tradelens, 2020) for example, a gatekeeper will control which entities can join, transact, and validate, typically reinforced with digital management of identity and off-blockchain contracts. Thus the participants must still rely on the mechanism of formal or relational contracts (for example, via a consortium agreement to which participants are a party) to place trust in the platform owner and gatekeeper. A permissioned blockchain would also automatically ignore invalid data, but its gatekeeper might follow this with action against the submitting participant, depending on terms defined in the off-blockchain contract.

Coordination of Transaction Processing. Blockchain has the capability to perform the required coordination of transactions submitted by its participants, that is, to support the processing of transactions over its network with the management of dependencies and the minimization of exchange problems (Jones et al., 1997; Malone & Crowston, 1994). Again, both permissionless and permissioned blockchains can perform this role of coordination.

On a permissionless blockchain, any entity can submit transactions, and can do so anonymously, without contract or digital identity verification. On a permissioned blockchain, the gatekeeper will control which entity can submit transactions, following on from the controls enforced upon joining the blockchain. Validation of transactions submitted on a permissionless blockchain may be performed by any participant, since any participant has the right to attempt to perform the consensus validation algorithm. On a permissioned blockchain, the validation of transactions may be performed by designated nodes according to the consensus algorithm in use.

Blockchain smart contracts execute transactions automatically, upon the satisfaction of the terms agreed between the parties and programmed on the smart contract. The smart contract can include codified processes, parameterized deal terms (such as dates, prices, and quantities), general terms which can be codified in program form, and references to off-blockchain documents such as a written contract (stored as an encrypted hash to ensure the referred document cannot be changed). The extent to which the components of a written contract can be programmed as a smart contract will depend upon the exact contents of the written contract, the capabilities of the smart contract programming language utilized, and the capabilities of the programmers involved.

As is the case with contractual governance (Grossman & Hart, 1986; Williamson, 1996), uncertainty in the macro environment and bounded rationality will mean that contracting can never be complete on a blockchain's smart contracts, since not all contingencies will be foreseeable and manageable.

However, while contractual governance is static in nature, and has been said to insufficiently consider prior interactions and repeated engagements (Gulati, 1995; Ring & van de Ven, 1992), blockchain smart contracts may offer significant advantages in flexibility via the dynamic reference to external libraries of terms, the use of 'oracle' feeds of external measurement data, and automated updates and renewals.

Monitoring. Through the functionality provided by blockchain for the monitoring of its decentralized operations, by smart contracts for the processing of transactions and for the consideration of external 'oracle' feeds, and by the transparent and immutable nature of the blockchain transactions themselves, blockchain can be seen to satisfy governance requirements for effective monitoring.

In the context of relational governance, the concept of self-enforcing contracts relied on the existence of trust between the parties to incentivize the expected behavior. However, in the blockchain context, self-enforcing smart contracts are automated processes that network participants can and must rely upon to deliver the expected outcomes.

Opportunistic Behavior. The risk of opportunistic behavior, that is, the exchange hazard of possible malfeasance by a party involved in the transaction, is a major focal area of contractual governance (Williamson, 1975, 1985).

Blockchain provides the security, transparency, and immutability of transactions which can address the risk of opportunistic behavior. Blockchain can minimize the risk of opportunistic behavior both ex-ante, since its consensus algorithm of transaction validation will ensure that any invalid transactions submitted will not be processed, and also ex-post, since blockchain transactions are by nature transparent and immutable, and thus any malfeasance would be subsequently detectable.

Conflict Resolution. Commons (1932) and Ostrom (1990, 2000, 2010) both describe conflict resolution as an important governance responsibility.

Participants must agree to submit to the structure and mechanisms utilized by the blockchain, and must agree on the contents and usage of the smart contracts deployed. The automated performance of the smart contracts could be expected to minimize the potential for process-oriented conflicts, and the transparent and immutable nature of transactions on blockchain equally should minimize the potential of data-oriented conflicts.

If and when agreed by the participants, smart contracts may contain code to automatically ensure adherence to network rules and regulations. Code could be inserted to address requirements such as the use of accredited suppliers, tax specifications such as applicable rates, identity requirements for anti-money-laundering regulations, restrictions on the sale of certain products to certain markets, and countless other scenarios, with updates of control parameters possible via ‘oracle’ feeds. The transparent and immutable nature of transactions on blockchain could also be used to satisfy the requirements of statutory bodies.

Based upon these factors, it can be posited that Blockchain can perform the functions generally required of a mechanism of governance for a business network, that is, blockchain can protect an entity’s rights during the processing of its transactions.

Expanding upon Williamson’s (1975, p. 8) assertion that the method of governance chosen will depend on the relative efficiency of each mode, this article posits that this determination may also be based upon the ability of the governance mechanism to support the development of additional sources of inter-firm competitive advantage, for example by facilitating participation in joint value-creating initiatives (Dyer & Singh, 1998). As a decentralized digital platform, blockchain can facilitate a range of value-adding activities which may represent new avenues of business (Allen et al., 2020). One such case is the developing field of the tokenization of assets, whereby fixed assets such as real estate, movable assets such as inventory, financial assets such as accounts receivable, or financial instruments such as shares, taken as a whole or fragmented, can be represented as tokens on the blockchain and thus exchanged digitally (Crypto Valley Association, 2019).

Blockchain provides the structure which can further foster dynamic, recurring linkages of value between network participants. While in general a network can be seen as a "nexus of contracts", a blockchain network can be seen as a "nexus of smart contracts" (Beck et al., 2018, p. 1027).

Thus the ability of blockchain to generate additional streams of value whilst delivering effective governance may act as an incentive to its adoption, and the degree of preference an entity will have for blockchain as a mechanism of governance will be positively related to the extent to which the blockchain can facilitate value creation activities relevant to that entity.

Many of the blockchains successfully implemented to date have been permissioned blockchains driven by collaborations between industry leaders and technology organizations, such as Tradelens by Maersk and IBM, and IBM Food Trust by Wal-mart and IBM (IBM, 2020). A major reason for this model is the need to finance and to provide confidence in the development and secure operation of such blockchains (Risius & Spohrer, 2017). Additionally, adoption may be forced down the supply chain, as in the case of Wal-mart and the IBM Food Trust, an approach that Wal-mart had also adopted in a previous generation of interconnectivity, that achieved via EDI (Allen & Berg, 2020). However, while such models may enable and facilitate the adoption of blockchain solutions, they may also lead to issues relating to market power, due to the role of the central authority (Allen & Berg, 2020).

When a blockchain consortium is led by a firm such as Maersk or Wal-mart possessing significant market power, potential blockchain entrants from the same industry may be concerned that they will be at a competitive disadvantage. The central coordinating entities must convince other participants of their goodwill and willingness to operate fairly, and they may move to decentralize control over the blockchain or to institute safeguards so as to achieve this, whilst still ensuring the effective and secure operation of the blockchain. However, as noted by Lacity, Steelman, and Cronan (2019), organizations typically have little experience of sharing control, and will need assistance in understanding and operating within the shared governance structures of blockchains.

In comparison, within the decentralized structure of a permissionless blockchain, transactions cannot be prevented from processing or participants excluded unilaterally by a single party, and there is no risk from a single point of failure as relating to the availability of a central coordinator (Catalini & Gans, 2016). Although there may be greater concerns over security and privacy in such a permissionless structure, there will be an enhanced expectation of impartiality.

Thus the decentralized structure of control of the blockchain can act as an incentive to its adoption as a mechanism of governance, or remove otherwise a disincentive against its adoption. The degree of willingness of an entity to join a blockchain network will be positively related to the perceived level of impartiality of the blockchain governance mechanism.

There has long been recognition that trust is required to enable (Arrow, 1974; Macaulay, 1963) and improve the performance of (Heide & John, 1992; Poppo et al., 2008; Poppo & Zenger, 2002; Zaheer & Zaheer, 2006) inter-organizational exchanges.

However, by applying blockchain governance technologies, it has now been suggested that blockchain can provide a business network which is self-monitoring, self-governing, and self-enforcing, and is thus “trustless”, that is, which does not require trust to be present between the trading partners, either direct or via intermediaries (Davidson et al., 2018, p. 5). Davidson, De Filippi, and Potts (2018) and Lumineau, Wang, and Schilke (2021) find that blockchain can thus represent a substitute governance mechanism to the use of relational governance.

If blockchain participants have the necessary trust in the network, then the participants should not require the corresponding presence of relational governance. Thus the degree of relational governance (trust) required between blockchain participants in processing a transaction should be inversely related to the participants’ level of trust in the blockchain governance mechanism.

As well as being a substitute for relational governance, Davidson, De Filippi, and Potts (2018) and Lumineau, Wang, and Schilke (2021) also posit that blockchain can provide a substitute governance mechanism to the use of contractual governance.

If blockchain participants have the system-level trust that the blockchain and its smart contract construct will function as required, then the participants should not require the corresponding presence of contractual governance.

The extent to which this substitution of blockchain governance for contractual governance can be effected will depend upon the ability to embed contractual governance functions within the code of the blockchain smart contracts programs, including both legal provisions and deal parameters, and for these smart contracts to then be processed effectively. Thus the degree of contractual governance required between blockchain participants in processing a transaction will be inversely related to the perceived ability of the blockchain smart contract construct to completely codify and accurately process in a timely and transparent manner.

This section has thus posited that, as has been suggested, blockchain has the properties required to function as a governance mechanism, that is, to automatically protect the rights of entities during the processing of transactions on a blockchain network. The key variables relating to the mechanisms of automated governance by blockchain are presented in Figure 10 below. The elements on the left-hand-side of this framework represent the identified factors affecting the feasibility of the adoption of automated governance by blockchain. The right-hand-side elements represent the scope of utilization of blockchain automated governance, that is, to what extent automated governance by blockchain can substitute for the traditional mechanisms of relational and contractual governance.

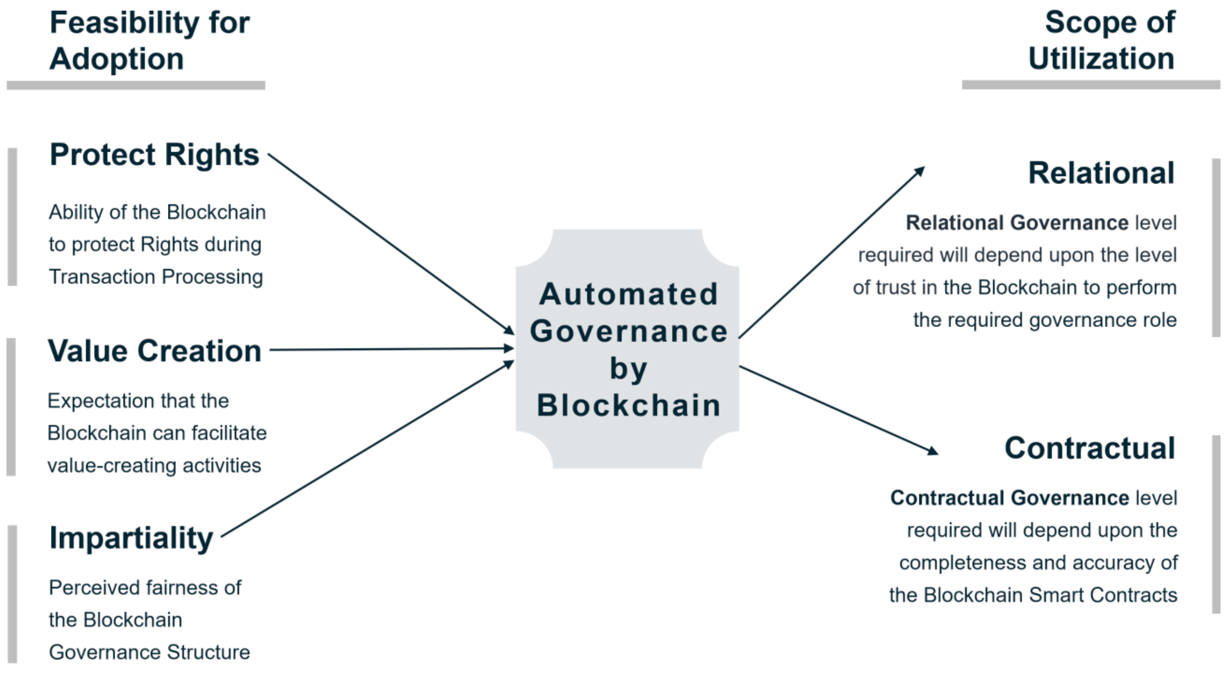


Figure 10 – Factors Influencing Automated Governance by Blockchain

5. The Extent of Blockchain Delivered Governance

Later chapters in this thesis will seek to examine the effects and effectiveness of automated governance by blockchain, considering factors such as those described below.

Blockchain utilization. Blockchain's effectiveness and acceptance as a mechanism of governance can be validated from the experiences of participants along the dimensions described in this introduction, namely the protection of participation rights, the coordination of transaction processing, the monitoring of this processing, the control of opportunistic behaviour, the resolution of conflict, and the proving of compliance.

Experiences will also vary depending upon key variables such as the degree of decentralization of control of the blockchain, the extent to which it is permissionless or permissioned, the consensus method for validation and acceptance of submitted transactions, the usage of dapps, and the scale and scope of the employment of smart contracts.

Since blockchain governance can be applied at multiple levels – at the level of the blockchain, of the dapp, and of the smart contract – the relative merits of applying rules at each level will be further evaluated in subsequent chapters of this thesis.

These governance capabilities of blockchain must be perceived as sufficiently effective in order to incentivize entities to participate in the network. .

Blockchain facilitating value creation activities. The blockchain structure as digital platform can enable the creation of new business models and the development of additional value streams, whilst providing the mechanisms of governance. Such digital transformation via the adoption of information and connectivity technologies (Vial, 2019) can extend beyond process digitization to the provision of entirely new digital products across reconfigured organizational boundaries (Westerman et al., 2011).

This incremental value created by the blockchain can be measured by the amounts of revenue generated and equity built by the entities involved, and by the intention of entrants to blockchains to leverage this capability.

Blockchain governance impartiality. The presence of an industry power championing the use of a blockchain may have positive effects in encouraging participation in the blockchain from downstream suppliers, but it may also have negative effects in disincentivizing other entities from participating in the blockchain, since they may resent or fear the power of the – real or perceived - blockchain leader. These negative effects must be anticipated and mitigated for participants, potential entrants, and entities which have decided against entry to the blockchain.

The entity controlling the blockchain network must provide a unified view of the application and must consider the roles of stakeholders beyond the single enterprise (Hafsi & Assar, 2016) across the interconnected yet independent organizations.

Blockchain substituting for relational governance. With blockchain proposed as a self-managing structure which can eliminate both the need for trust between trading partners, and the need for trusted intermediaries, further examination is made of the propensity of participants on a blockchain to transact with new and less familiar trading partners.

Blockchain substituting for contractual governance. Likewise, with blockchain proposed to facilitate the digital enablement of contracts, consideration must can be made of the propensity of participants to use blockchain constructs in place of written contracts. This must consider the extent to which blockchain level rules, dapp level rules, and smart contracts can codify, monitor, and enforce the terms and deal parameters of the transactions.

6. This Thesis

This thesis will consider the literature on alternative mechanisms of governance, and compare the facets of traditional governance with the capabilities of the emerging technology of blockchain.

It will seek to make a contribution by drawing together the perspectives from multiple disciplines to put the functions of governance for business networks in context, and to then present a conceptual framework which defined the construct of automated governance by blockchain, and which make propositions to describe the feasibility of blockchain as a method of governance and its ability to substitute for the alternate mechanisms of relational and contractual governance.

Within this framework it is apparent already that the structure of the blockchain and the capability of its smart contract construct are the key elements which will determine the extent of the role that automated governance by blockchain will play.

This thesis will then seek to test these concepts empirically via case studies of the we,trade trade finance network.

For further context, please refer to Part G. Appendices, section II for an overview of selected other trade finance networks in existence, and please refer to Part G. Appendices, section V for an overview of key interview subjects who contributed to this case study.

II. Epistemology and the Case Study Method in this Thesis

This thesis is concerned with the construction of a framework and model of blockchain delivered governance of transactions within business networks, and then with the employment of the case study method for deductive testing of these theoretic concepts. The case study approach was adopted within this blockchain domain as per the prescription of Yin (2014), so as to overcome the lack of available quantitative data, and to gather real-world evidence within a context too contemporary to allow the collection survey data. The case study does not represent a sample and cannot be used to extrapolate probabilities, rather it allows for the analytic generalization of theoretical propositions (Yin, 2014), and for the illumination of features which may apply to a set of cases (Gerring, 2007).

This thesis utilizes an approach which while positivist at base in that an objective reality is deemed to be both possible and desirable (Iacono et al., 2011), also includes post-positivist consideration of the socio-technical factors at work in the specific context of the single case under examination (Chukwudi et al., 2019).

Much testing of theory via the case study method has been conducted from the positivist perspective, in which testable propositions are formulated, cases are selected to align with the theoretical domain, relevant data collected, and observable patterns are matched to the theoretical constructs to produce a state which is either 'present' or 'absent' (Chukwudi et al., 2019), and thus to enable the development of what can represent a predictive platform (Orlikowski & Baroudi, 1991).

However, since a case study is an investigation of a past and/or current phenomena, derived from multiple sources including both direct interviews and observation, and both public and private archives, the specific context within which each artifact is collected and verified is highly relevant (Leonard-Barton, 1990). As noted by Eisenhardt (1989), within a case study the researcher must focus upon understanding the dynamics present within that single setting. Further, the boundaries between phenomena and context are not always apparent (Heim et al., 2018).

Thus context-specific consideration of the post-positivist perspective can enrich the insights available from the case, and strengthen the desired predictive nature of the framework and model under study within this thesis.

This thesis is based upon a single case study. Although such use of a single case may involve the risk of misjudging the relative importance of individual events and pieces of data, it does provide the opportunity for a greater depth of analysis, which may further support the testing of the theoretical constructs and the prediction of future outcomes (Voss et al., 2002).

The "we.trade" case was purposely selected for this thesis (that is, non-randomly), since as per Gerring (2007) this can be regarded as a case which is relatively central to the theory under examination.

The hypotheses tested within the we.trade case are presented in the form of deterministic necessary conditions (Dul & Hak, 2007) in order to support the single case approach. If the stated cause of a particular hypothesis is not present within the we.trade case, then that hypothesis is rejected. If both a theorized cause and its effect are found to be present in the we.trade case, while this will not be sufficient to prove causality, this will demonstrate that the particular hypothesis is not disproved, and thus this may provide support for further study of the framework.

Part C. The Three Studies

Chapter 1. Automating Governance: Blockchain Delivered Governance for Business Networks

Abstract

This conceptual article seeks to integrate blockchain into current theory on the governance of inter-organizational exchanges within business networks. It posits that a blockchain governance structure comprised of administrative, platform, and application level mechanisms represents a significant new antecedent and causal factor determining the extent of the need for the traditional contractual and relational mechanisms of governance. Further, that blockchain delivered governance can perform the functions of transaction coordination and safeguarding which are required in order to substitute for those traditional mechanisms of governance. A discussion points the way towards empirical verification of the framework created, and towards avenues for further theoretical research, and examines the implications of blockchain delivered governance for practitioners. In developing this framework, this article also seeks to make a contribution by placing attention on the need for the building of theory applying to blockchain, and for quantitative measurement of the effects of blockchain on organizations and business networks. This article concludes that the emergence of blockchain technology now provides the means by which automation of the specification, validation, and enforcement of private ordering between exchange participants can be achieved, and that this should stimulate a reevaluation of existing theories of inter-organizational governance.

1. Introduction

Blockchain has become a strategic priority for firms within many industries worldwide (Deloitte, 2020, p. 4), and its pioneering application, the Bitcoin cryptocurrency, has generated a frenzy of media headlines (CNN, 2021). But what exactly is blockchain? Treiblmaier (2018, p. 547) defines a blockchain as a "digital, decentralized and distributed ledger in which transactions are logged and added in chronological order with the goal of creating permanent and tamperproof records", and notes that a permissioned ledger can be established for the private use of a dedicated group of users. Thus blockchain, and in particular the 'smart contract' function that it enables, can be utilized to provide a platform for the integration and automation of processes and information flows across organizations in applications such as financial services and supply chains.

At the same time, blockchain has been gaining attention as an emerging institutional technology for the governance of inter-organizational exchanges (Allen et al. 2020, Davidson 2018, Lumineau et al. 2020, MacDonald et al. 2016). This article seeks to extend this discussion by examining the ability of blockchain to perform the specific functions required of a governance structure for a private business network of buyer-seller relationships, and as a result the ability of blockchain mechanisms of governance to substitute for the traditional contractual and relational mechanisms of governance. This article will differ from much of the literature by focusing on the systematic assessment of the functions of governance within such a business network and blockchain context.

First, this article will integrate blockchain into current theory on governance within this context. An extremely wide range of usage of the term 'governance' exists across research streams (Jones et al., 1997). This article adopts Commons' (1932, p. 13) transaction-based definition of governance as those "working rules" which combine law, economics and ethics to resolve conflict, and to ensure mutuality and order during the processing of transactions. These rules can be applied through institutional arrangements (Williamson, 1993b) and inter-firm management structures (Achrol & Gundlach, 1999) within which members can cooperate. Of the many diverse theories employed to examine governance structures in the business network context (Schepker et al., 2014), the theoretical lens found by Roehrich et al (2020) to be dominant remains transaction cost economics (Williamson, 1975, 1985), which emphasizes the use of contractual governance mechanisms via written contracts and formal written rules. Alternate perspectives involve the relational governance mechanisms of trust (Arrow, 1974; Macaulay, 1963), informal rules and procedures (Macneil, 1978; Poppo et al., 2008), the application of social mechanisms (Granovetter, 1985), and behavior in networks (Klijn & Koppenjan, 2006).

This article posits that a blockchain-enabled business network can employ mechanisms at each conceptual level of its structure – that is, at its administrative, platform, and application levels – to automate the functions required for the governance of inter-organizational exchanges, namely the coordination of transaction processing and the safeguarding against exchange problems. While prior IT integration technologies could facilitate inter-organizational relationships (Lee et al., 2012), they operated within a structure of traditional governance mechanisms such as written contracts. Blockchain, however, possesses in itself the structure and mechanisms needed for the autonomous execution and enforcement of agreements between parties (Lumineau et al., 2021). Blockchain thus represents a significant new antecedent and causal factor determining the extent of the need for the traditional contractual and relational mechanisms of governance. Further, the elements of a blockchain delivered governance structure can themselves substitute for those contractual and relational mechanisms. With these capabilities, blockchain leads the literature of inter-organization relationships and governance in a previously unexplored direction:- towards self-governing agreements and automated enforcement.

Second, this article places attention on the need to develop theory relating to the implications of blockchain technology, particularly in a business context. To date there is little theory yet established on any aspect of blockchain (van Pelt et al., 2021). Additionally, the majority of general literature has focused on public networks and in particular Bitcoin (Constantinides et al., 2018; Fosso Wamba et al., 2020), rather than on the business use of blockchain which is almost exclusively conducted via private networks or consortia (Deloitte, 2020; Rauchs et al., 2019). The governance structures, modes and methods employed within such blockchain consortia have not yet been investigated in detail (Lohmer et al., 2021).

It is hoped that the discussion of a methodology by which the conceptual model in this article can be empirically verified will also place attention on the need to address the significant research gap currently caused by the absence of quantitative measurement of the effects of blockchain on business domains (Fosso Wamba et al., 2020), and on the structure of organizations (Constantinides et al., 2018).

More generally, it has been suggested that the diversity of perspectives and levels of analysis of governance has perhaps resulted in the fragmentation of insights across the multiple research streams involved, which include economics, organization studies, law, strategy, marketing, and operations management (Roehrich et al., 2020), and thus holistic understanding of the antecedents that influence the use of particular governance mechanisms and their resultant effectiveness has been impeded (Cao & Lumineau, 2015; Roehrich et al., 2020). Incorporating the integrative technology of blockchain into this field of theory presents the concurrent opportunity to synthesize related theories from across these multiple streams.

Third, this article recommends that practitioners consider the potential opportunities and implications relating to blockchain delivered governance. Business environments today reward the ability to respond dynamically to threats and opportunities, while managing associated risks and costs (PWC, 2021), however the traditional mechanisms of governance are constrained in their ability to adapt accordingly to these needs. Contractual mechanisms are onerous and expensive to create, monitor, and enforce (Joskow, 1985; Schwartz, 2004; Zou et al., 2019), and are still inevitably incomplete (Burkert et al., 2012; Grossman & Hart, 1986; Williamson, 1996). Relational mechanisms of trust, informal processes, and social structures are likewise difficult, time-consuming, and costly to build and maintain (Larson, 1992). As Arrow (1974, p. 23) noted, trust is not a commodity which can be easily acquired: "if you have to buy it, you already have some doubts about what you have bought". Additionally, the tremendous growth in the volume and complexity of trade conducted through international business networks (World Trade Organization, 2020), spanning ever more environment-level permutations of nationality, culture, language, and regulatory regimes, and firm-level variations in nature, size, bargaining position, skill, and management style (Ganne, 2018; International Chamber of Commerce, 2020), is exacerbating the difficulty of deploying the traditional governance structures effectively (Van Der Valk et al., 2020). Understanding the elements of blockchain delivered governance will enable practitioners to more effectively view, design, implement, and operate blockchain structures, and business networks as a whole, so as to address these current realities.

The following foundations section describes the functions required of governance for inter-organizational exchanges within the business network context, reviews the traditional mechanisms of governance employed, and then introduces blockchain, and the new field of governance by blockchain. The conceptual section presents a framework to explain how blockchain mechanisms can perform the required functions of governance within the business network context, and thus function as substitutes for the traditional mechanisms. A discussion considers the implications of the framework, reviews methods by which the propositions of the framework can be verified, and examines avenues for future research and for application by practitioners.

2. Theoretical foundations

Within the context of the governance of inter-organizational exchanges which is the concern of this article, the dominant theoretical lens employed by theorists (Roehrich et al., 2020) is transaction cost economics (Williamson, 1975, 1985), which combines institutional economics and organizational theory, and builds upon the definition of the transaction as the basic unit of economic analysis (Commons, 1932) and of the alternate structures of firm and market.

Alternate theoretical perspectives primarily involve social networks, which can be related to trust (Arrow, 1974; Macaulay, 1963), informal rules and procedures (Macneil, 1978; Poppo et al., 2008), and the application of social mechanisms as an influence on market behavior (Granovetter, 1985), and at a wider level, network theory (Klijn & Koppenjan, 2006; Provan & Kenis, 2007) which focuses on the relationships between organizations, rather than on the organizations themselves (Brass et al., 2004).

2.1. The role of governance on inter-organizational exchanges

In today's increasingly globalized economy, inter-organizational exchanges may occur at a distance in time and space, and may range from market-type provision of standardized commodities by individual entities to the complex creation of highly adapted products and solutions within a network (Gereffi et al., 2005; Sturgeon, 2002). Regardless of the dimensions of the exchange, mechanisms of governance will be required to perform the following roles to varying degrees.

The major role of governance is seen to be the organizing or coordinating of transactions by both transaction cost economics (Williamson, 1975; Williamson & Ouchi, 1981) and social network theory (Jones et al., 1997). This coordination role also necessitates the performance of safeguarding functions to prevent and/or mitigate exchange hazards during performance of the transaction (Poppo & Zenger, 2002; Williamson, 1985, 1991). Such hazards may include:

Environmental uncertainty. Unforeseen future contingencies are unlikely to affect all parties to the transaction equally, and thus would introduce asymmetries and the need for adaptations (Williamson, 1991) which are not possible to anticipate.

Information Asymmetry. Asymmetries in the distribution of information available to each party can introduce unequal risks and costs to the exchange parties (Arrow, 1969), and potentially enable opportunistic behavior.

Bounded Rationality. Limitations in the ability to effectively process information and to develop solutions (Simon, 1947) can result in suboptimal decision making. This hazard would be further exacerbated by conditions of uncertainty and/or information asymmetry.

Opportunistic Behavior. Possible malfeasance by a party involved in the transaction is a major concern of transaction cost economics (Williamson, 1975, 1985), providing a justification for the internalization of processes within a hierarchic organization. Again this hazard would be increased by conditions of uncertainty and/or information asymmetry.

The safeguarding functions required to address these potential exchange hazards must fundamentally include:

Monitoring. Due to the impossibility of perfect information distribution to the parties and the potential for uncertainty, monitoring of performance of the transaction is required in order to deter and detect opportunistic behavior (Alchian & Demsetz, 1972; Williamson, 1975).

Conflict Resolution. Given the wide range of potential disputes that may occur during the processing of a transaction (World Economic Forum, 2020), a method must be available for the resolution of the conflicts between the parties involved (Commons, 1932; Williamson, 1975, 1985).

Sanctions. Sanctions, ideally graduated in relation to the severity of the offence (Ostrom, 1990), must be available to apply in order to deter transgression or to punish those entities discovered by monitoring or during conflict resolution to have violated transaction processing rules (Jones et al., 1997).

2.2. The role of governance within business networks

For the purposes of this article, a network can be defined as consisting of independent yet interrelated organizations whose dyadic exchanges and inter-organizational relationships can be analyzed at the level of a network. An illustrative example is that of a supply chain, which as defined by Carter et al. (2015) is a network consisting of nodes and links, and which can be seen to be comprised of relational ties which are channels for the flow of resources between interdependent entities (Hoffer Gittell & Weiss, 2004; Wasserman & Faust, 1994). It should be noted that this article focuses on buyer-supplier exchange relationships, rather than on other forms of networks such as partnerships, strategic alliances, and collaborative agreements.

Expanding consideration of the roles of the governance of inter-organizational exchanges to include business networks, such as a supply chain, the management of participation becomes pertinent. Consistent with the club theory of Buchanan (1965), the common pool resources theory of Ostrom (1990), and network theory (Klijn & Koppenjan, 2006), governance over the access and behavior of network members will be required, necessitating additional processes – formal or informal – for monitoring, conflict resolution, and sanctions.

2.3. The mechanisms of governance

The mechanisms employed to perform these required roles of governance may be described as contractual or relational in nature, and in fact may be combined as complementary measures (Gundlach & Cannon, 2010; Heide et al., 2007; Poppo & Zenger, 2002; Woolthuis et al., 2005).

Contractual Governance. Transaction cost economics (Williamson, 1975, 1985, 1993b) primarily emphasizes the use of contractual mechanisms of written contracts and formal written rules for the governance of inter-organizational exchanges. From this perspective, contracts would specify foreseeable responsibilities, and would define processes for addressing unforeseeable contingencies. This approach may also necessitate the use of third party intermediaries (Fung et al., 2007) to provide related contractual governance services such as escrow arrangements (Saberi et al., 2019).

Relational Governance. The concept of embeddedness embodies relational governance, based as it is upon the use of "concrete personal relations and structures (or 'networks') of such relations in generating trust and discouraging malfeasance" (Granovetter, 1985, p. 490). The limitations inherent in traditional contracting – particularly incomplete contracts and issues of enforcement – and their effect on uncertainty, information asymmetry, bounded rationality, and opportunistic behavior, have meant that relational factors such as trust have long been recognized in enabling (Arrow, 1974; Macaulay, 1963) and improving the performance of inter-organizational exchanges (Heide & John, 1992; Poppo et al., 2008; Poppo & Zenger, 2002; Zaheer & Zaheer, 2006). Arrow (1974) noted that there would be an element of trust in every transaction.

Antecedants and Moderating Factors. As prescribed by transaction cost economics (Williamson, 1975), environmental elements such as institutional uncertainty have been found to act as antecedents (Roehrich et al., 2020) and moderating factors (Cao & Lumineau, 2015) affecting the use of contractual and relational governance mechanisms. At the inter-organizational level, Burkert et al (2012) found that the internationality of business relationships would moderate the usage of contractual and relational governance mechanisms, and writers such as Cao and Lumineau (2015) have identified relationship type and length as moderating factors.

Governance within Networks. To Klijn and Koppenjan (2006, p. 144), "networks may be regarded as institutions", and these network institutions are in fact "sets of rules". These rules can be controlled with network composition strategies to define the participants and their access rights, and network interaction strategies to manage the linkages between the participants (Klijn & Koppenjan, 2006).

2.4. The impact of blockchain upon business networks

2.4.1. Introduction to blockchain

In addition to these traditional mechanisms of contractual governance and relational governance, blockchain has been proposed as a new mechanism for coordinating inter-organizational relationships (Hanisch et al., 2021).

The development of blockchain sprang from the work of the pseudonymous Nakamoto (2008) who synthesized concepts from cryptography, digital cash, and peer-to-peer computing to create the Bitcoin white paper and network. This has subsequently been generalized into distributed ledger technology – in which transactions can be submitted and validated by nodes across a decentralized database and network, with new data appended to the previous data, and as such practically immutable – and to blockchains where these transactions are grouped into blocks for processing (Dhar & Stein, 2017; Glaser, 2017).

This decentralized structure has in turn enabled the implementation of the 'smart contracts' concept – defined as "a set of promises, specified in digital form, including protocols within which the parties perform on these promises" (Szabo, 1996, p. 1) – as programmed, self-executing, rule-based functionality across multiple blockchain platforms (Smart Contracts Alliance, 2016). Upon the satisfaction of predefined terms and conditions agreed between the parties, Blockchain smart contracts can execute transactions automatically, for example for the payment by a buyer upon the submission of a verified proof of delivery criteria by the seller. The smart contract may replace a written contract in full, or may be referenced by a written contract to provide specific elements of the agreement between the parties. Extant literature regards smart contracts variously as an alternate form of contract, a complement to contact, or computer code which cannot be regarded as contract (Van Der Valk et al., 2020). Smart contracts can be combined into a layer residing on top of a blockchain, known as a 'dapp', or decentralized application (Arrunada & Garicano, 2018). The scope of functionality to be performed by smart contracts can be expanded with the use of 'oracles', or off-blockchain external data feeds (Lauslahti et al., 2017).

2.4.2. Blockchain in a business context

The orientation of a blockchain network may be regarded as laying along a continuum from permissionless (that is, public) to permissioned (private), as suggested by Lacity (2019). In network terms, this continuum reaches from a participant governed network in which governance is shared and no single entity represents the network, to what can be called a network administrative organization in which governance is centralized in the hands of a major participant or participants or their designee (Provan & Kenis, 2007). Despite the domination of blockchain-related literature by permissionless blockchains such as Bitcoin (Constantinides et al., 2018; Fosso Wamba et al., 2020; Risius & Spohrer, 2017), business blockchains are almost exclusively implemented as permissioned blockchains (Deloitte, 2020; Rauchs et al., 2019).

The distinction between permissionless and permissioned blockchains is critical, since governance mechanisms will differ fundamentally between these two structures.

Any entity can participate in a permissionless blockchain such as Bitcoin, in which the network itself automatically defines how entities can join the network, raise transactions, and validate transactions: that is, where is no central controlling body and which participants must rely upon the network to regulate itself and self-enforce performance.

However, on a permissioned blockchain, an authority representing the operating consortium will control which entities can join, transact, and validate, typically reinforced with digital management of identity and off-blockchain contracts.

While incentives are critical in permissionless blockchains in order to attract entities to perform the role of validation (Beck et al., 2018), incentives do not apply in permissioned blockchains within which validation is performed by nodes specified by the designated authority (Ølnes et al., 2017).

A specific example of blockchain in a business context can be provided by the we.trade supply chain and trade finance platform (we.trade, 2022). Established by a consortium of major European banks and operational since January 2019, we.trade connects buyers, sellers, banks, insurers and logistics organizations within an end-to-end trade ecosystem aimed at simplifying the trading process and reducing risk by automating transactions and integrating the parties involved (IBM, 2021a). Typical stages in this process (Rabobank, 2021) may include:

1. On the we.trade network, the buyer and seller would define the trade transaction and its terms and conditions, including the data set needed for generation of the relevant smart contracts, such as the goods/services description, pricing, delivery terms, payment terms, and settlement conditions.
2. As required, the buyer and/or seller may request additional financial services such as a guaranteed payment or invoice financing.
3. The banks involved would accept the transaction and any related financial services, and the smart contracts would be finalized. The security structure of the permissioned blockchain will define which related parties may access the relevant transactions and data.
4. The delivery of the goods/services would take place, under the specified terms and conditions.
5. The smart contracts would automatically ensure that the seller receives payment once the conditions of the transaction are fulfilled.

Thus within the we.trade network, the transaction processing cycle is made systematic, with the responsibilities of the parties automated. This mitigates, for example, the major risks inherent in open account trading (that is, without payment in advance), and in trading with new partners, and reduces the delays and costs due to manual steps, error, fraud, and uncertainty. International trade in particular is greatly facilitated via these mechanisms (IBM, 2021a).

2.4.3. Blockchain and governance

Davidson, De Filippi, and Potts (2016) have written that while blockchain initially appeared to be an information systems innovation, blockchain in fact represents a wider revolution in institutions, organization, and governance. Lumineau, Wang, and Schilke (2021, p. 1) agreed that blockchain provides an automated framework that offers a "way to enforce agreements and achieve cooperation and coordination that is distinct from both traditional contractual and relational governance as well as from other IT solutions".

Blockchain differs from other information systems theories and technologies which may affect inter-organization relationships, in that blockchain enables the autonomous execution and enforcement of agreements (Lumineau et al., 2021). Thus while in general IT integration between organizations can build relationship predictability which may lead to reciprocity and stability and positive performance outcomes for the parties (Lee et al., 2012), these traditional solutions such as EDI must be supported by a structure of contractual and/or relational governance mechanisms in order to provide enforcement. The smart contract blockchain construct, however, can enforce the rules of a transaction automatically, without the need for subsequent intervention (Treiblmaier, 2018).

MacDonald, Allen, and Potts (2016, pp. 283–284) advanced that blockchain is "best understood as a new institutional technology that makes possible new types of contracts and organizations". Brennan, Subramaniam, and van Staden (2019, p. 1) described blockchain as a major disruptive technology leading a "revolutionary paradigm shift" in thinking about business structures and governance.

Davidson, De Filippi, and Potts (2018, p. 4) expanded on their earlier work to posit that as well as being a "trustless" technology – removing the need for trust between trading partners, either direct or via intermediaries – blockchain and its smart contract construct provide the means for the network to be self-monitoring, self-governing, and self-enforcing, forming a self-contained decentralized autonomous organization or DAO (Davidson et al., 2018, p. 5), in which the governance rules are specified in the blockchain itself (Beck et al., 2018).

The effects of blockchain upon governance has been examined both internally for the management of the blockchain itself, and externally for the control of inter-organizational exchanges. Ølnes et al (2017) distinguished between governance *of* the blockchain, and governance *by* the blockchain, as did De Filippi and McMullen (2018) in contrasting governance *of* the infrastructure with governance *by* the infrastructure. Much further literature has been directed towards the governance of the blockchain itself (Beck et al., 2018), and for this purpose a multi-layered technical viewpoint has often been employed, as with the protocol layer, a network layer, and topmost application layers of Platt (2017), and the protocol and application levels of Rossi et al (2019). Governance would include both "off-chain" mechanisms such as measures performed manually by managers, and "on-chain mechanisms" such as functions executed automatically by blockchain code (Catalini & Gans, 2016).

3. Conceptual framework

3.1. The blockchain governance structure

Existing theory on governance structures in the business network context focuses upon the contractual mechanisms of transaction cost economics (Williamson, 1975, 1985), and the relational mechanisms of trust, social exchange and network theory (Granovetter, 1985; Klijn & Koppenjan, 2006; Poppo et al., 2008). These mechanisms were not required to address technology within the core of their frameworks, since while extant IT integration technologies could facilitate inter-organizational relationships (Lee et al., 2012), they operated within a structure of the traditional governance mechanisms. Blockchain, however, redefines the role of technology in inter-organizational governance, since blockchain possesses in itself the capability for the autonomous execution and enforcement of agreements between parties (Lumineau et al., 2021). The following conceptual framework seeks to address this gap in existing theory by specifying the structure and mechanisms by which blockchain can deliver the automation of governance.

Much literature on inter-organizational relationships and exchange does not describe in detail the mechanisms by which the specific functions required of a governance structure are delivered. This framework will make explicit the methods by which blockchain delivered governance addresses the key exchange objectives of the coordination and safeguarding of transactions.

The presented blockchain governance structure can be viewed as a hierarchy comprising three distinct conceptual levels of blockchain delivered governance which act in concert to coordinate and safeguard transactions:– the administrative level mechanisms, the platform level mechanisms, and the application level mechanisms.

Each level from administrative to platform to application adds further governance capabilities while providing the necessary foundation for the following level. The application level mechanisms specify the rules within which the members interact, while the platform level mechanisms control the operation of the blockchain itself, and the application level mechanisms deliver the automated agreements and process enforcement. It is noted that this structure exists within a macro environment – comprising factors such as the legal/institutional framework, transactional uncertainty and the nature of the relationship between the participating organizations – which affects the operation of all components of any governance ecosystem.

The blockchain governance structure of administrative, platform, and application level mechanisms has been created in this article by evaluating the facets (Lacity et al., 2019), functionality (Glaser, 2017), and capabilities of blockchain (Catalini & Gans, 2016) which have been described in the extant literature, and by characterizing these by the nature of their contribution to the collective blockchain governance structure. The multi-level approach to the design of this framework is consistent with views of blockchain and of IT platforms in general in the literature (De Filippi & McMullen, 2018; Platt, 2017; Rossi et al., 2019).

The blockchain delivered governance structure can be analyzed at these levels.

Administrative level mechanisms include both off-chain and on-chain processes for the control of member access and behavior. Within a permissioned blockchain, the consortium or organization leading the network will typically appoint a form of network administrative organization or NAO (Provan & Kenis, 2007) to manage blockchain operations. The scope of decision-making powers, the level of centralization - that is, the extent to which the NAO represents the membership - and the degree to which members can participate in the maintenance of the operational rules will be specified by the controlling consortium (Lacity et al., 2019).

Using the example of the we.trade platform, member banks first verify the bona fides of buyers and sellers through off-chain know-your-customer processes before they are granted access to the network. Once transacting within the network, the access rights and behavior of members is regulated by the on-chain processing of the applicable smart contracts.

Platform level mechanisms relate to the core blockchain technology itself, most importantly the consensus based validation algorithm which ensures transactions are processed as expected, and the distributed data design which safeguards those transactions, and ensures that the transactions remain immutable and transparent to permissioned members.

Application level mechanisms relate to the business-level functionality developed on the blockchain platform, most importantly the smart contract constructs for the automation of verification and subsequent processes. Smart contracts can ensure that if for example the seller fulfills its agreed responsibilities as specified in the smart contract, then the relevant trigger will ensure that payment is initiated from the buyer (IBM, 2021a).

This hierarchy of blockchain delivered governance mechanisms progressively rules the behavior of participants of a blockchain network and their submitted transactions. Figure 11 presents this framework in which blockchain forms an additional antecedent to the usage of traditional governance within business networks, and further, in which blockchain delivered governance acts as a substitute for the use of the traditional mechanisms themselves for the performance of the functions of governance within the business networks.

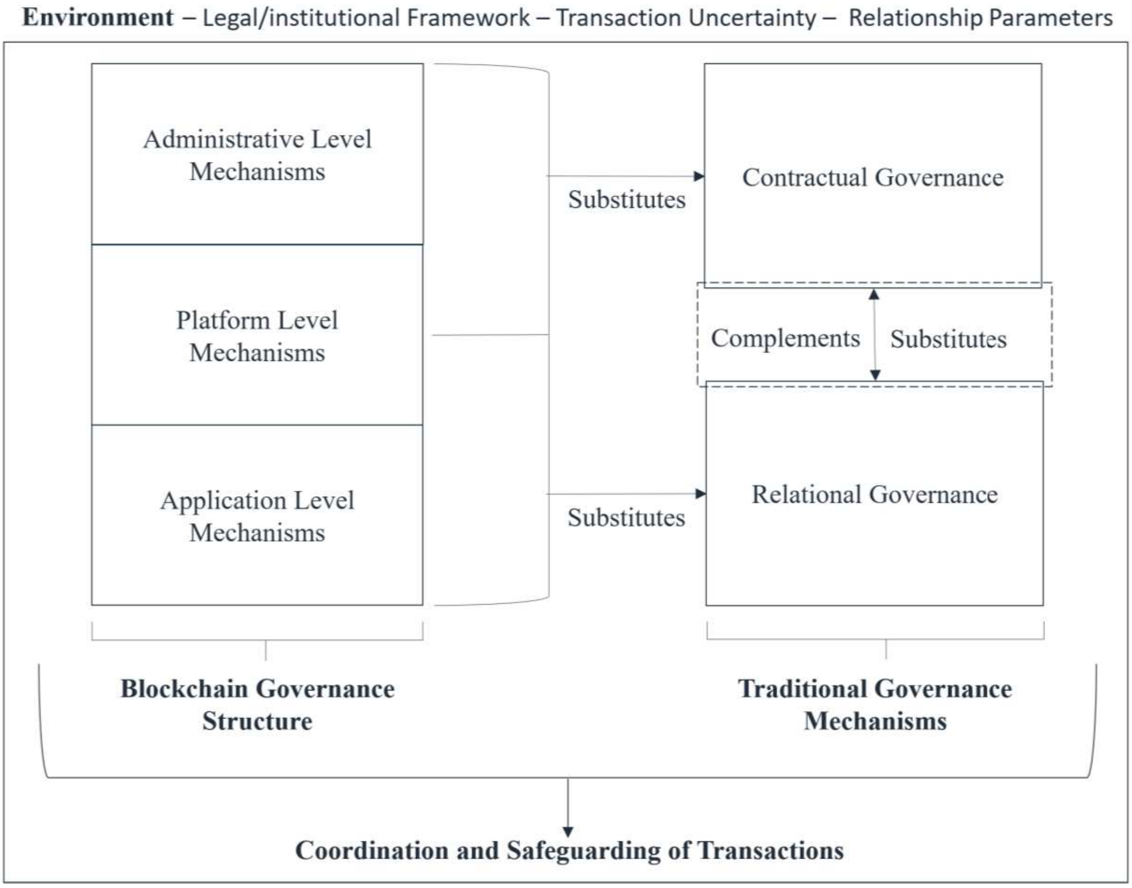


Figure 11 – Conceptual Framework of Blockchain Delivered Governance

The remainder of this section expands upon the mechanisms of blockchain delivered governance which operate within this structure.

3.2. The blockchain governance mechanisms

The specific blockchain governance mechanisms can be analyzed at each level of the structure.

Administrative level governance mechanisms set by the NAO will include both off-chain and on-chain processes for the control of member access, behavior, and conflict. As in the case of the we.trade platform, members must have initial contracts with the consortium to set the rules for operation upon the blockchain, then the blockchain mechanisms of governance will reduce and may virtually eliminate the need for contracts and relational structures on individual transactions (we.trade, 2021).

The NAO will be responsible for the management of participation rights in the network. The boundaries for the inclusion and exclusion of participants will be defined by the policy of the consortium stakeholders (off-chain), then implemented by the technology of the blockchain (on-chain). These policies can reflect the consortium's expectations for future environmental uncertainty, and the consortium's willingness to accept the risks inherent in the membership of different grades of entity, in terms of their financial strength, business nature, and geographic focus. As with the example of the we.trade platform, member banks will first perform off-chain know-your-customer processes to verify the suitability of buyers and sellers before they are granted access to the network. Once transacting within the network, the continued compliance of the member with general regulations such as know-your-customer and anti-money-laundering provisions, and with specific rules of the blockchain itself, will be monitored by both off-chain and on-chain processes.

Access of members to the blockchain can be granted or restricted along multiple dimensions when necessary, such as being limited to specific channels or subsets of access. In the Tradelens supply chain blockchain (Tradelens, 2020), a channel is established for each participating ocean carrier, and only specific members which will interact with that carrier are granted access to the channel; meaning that none of that ocean carrier's sensitive information is distributed to rival ocean carriers.

Admission as a member to the blockchain can in itself represent a signal (Spence, 1973) or an assurance of trustworthiness, providing what Williamson (1991, p. 290) described as a "nonhierarchical contracting relation" to efficiently communicate reputation effects to related parties, and making it appear more attractive and less risky to conduct business with fellow members of the blockchain network.

After member admission, the NAO will facilitate the coordination of transactions by defining off-chain and implementing on-chain the specific rights of members for submitting transactions to the blockchain for validation and processing (Lacity et al., 2019).

In order to perform the function of conflict resolution between parties, the NAO can define off-chain the parameters of expected behavior and monitor on-chain their execution (Rossi et al., 2019). The NAO can anticipate the possible scenarios which may lead to conflict and prepare actions to mitigate those instances, and can communicate a formal model for the management of the resolution process (World Economic Forum, 2020). The NAO can deploy online conflict resolution techniques which may be able to operate with a certain degree of automation (Rabinovich-Einy & Katsch, 2019).

The application of sanctions to punish or remove those members discovered by monitoring or during conflict resolution to be violating operating rules (Jones et al., 1997) can be defined in policy by the NAO and, depending upon the specific sanction, may be implemented on-chain on the blockchain (Howell & Potgieter, 2019).

It must be noted that a precondition for the acceptance and effective implementation of these blockchain mechanisms will be the impartiality of the NAO as recognized by its members (Lacity et al., 2019).

The NAO, through its off-chain and on-chain mechanisms, thereby exerts governance over participation rights, the coordination and safeguarding of transactions, monitoring and sanctions, and conflict resolution:- functions which have traditionally been enacted by written measures as per contractual governance, or by the presence of trust, informal rules, and informal access to an embedded social structure as per relational governance (Jones et al., 1997).

Thus at the administrative level of blockchain governance, the following propositions can be made:

Proposition 1a: The greater the effectiveness of the governance mechanisms instituted by the administrative level of the permissioned blockchain structure, the lower will be the amount of contractual governance utilized by blockchain participants.

Proposition 1b: The greater the effectiveness of the governance mechanisms instituted by the administrative level of the permissioned blockchain structure, the lower will be the amount of relational governance utilized by blockchain participants.

Platform level governance mechanisms are delivered via those elements inherent within the core blockchain technology itself. These unique functionalities of blockchain provide the foundation for the automated coordination and safeguarding of transactions on the blockchain network.

Transaction cost economics theory has been much concerned with the impacts of information asymmetry, bounded rationality, and opportunism, and the resulting non-verifiability, upon the processing of transactions (Williamson, 1975), leading to the finding that "the manner in which private ordering is implemented turns crucially on the attributes ascribed to human actors" (Williamson, 2002, p. 440). Blockchain, by automating the processes of verification, can mitigate the risks concerned with human behavior and the limitations of traditional governance mechanisms (Williamson, 2002), and provide an optimal framework of governance for the self-enforcement of private ordering between participants in the business network.

The fundamental elements of blockchain technology may be said to be its consensus algorithm which ensures transactions are validated and processed as expected, and its distributed and encrypted data design which ensures transactions remain immutable and transparent for permissioned members (Christory et al., 2020). Together these elements form the exchange mechanism (Davidson et al., 2018) which gives blockchain the capability to efficiently coordinate and process transactions submitted by participants over its network. The permissioned blockchain platform can provide fast settlement times and resource efficiency (Lacity et al., 2019). Validation of transactions is performed automatically by the consensus algorithm adopted in the architecture of the blockchain, and transactions and data found to be invalid will be excluded. Such incidents may be followed by off-chain action by the NAO against the submitting participant. In the TradeLens blockchain, specific nodes on the network operated by major participating members are designated as 'trust anchors', and these execute the blockchain consensus program code to validate transactions submitted by members and host the decentralized data (Tradelens, 2020). The majority shareholder of Tradelens, Maersk, was the first such 'trust anchor', and subsequently other major participants Hapag-Lloyd and Ocean Network Express were announced as also becoming 'trust anchors' (Tradelens, 2020).

Transaction data written to the blockchain is virtually immutable in an permissioned network, and this decentralized ledger forms a permanent historic record and audit trail of property rights (Davidson et al., 2018), since it is recorded in an append-only manner, with data only added and never updated or deleted (Catalini & Gans, 2016).

The authenticated transactions remain secure, by cryptographically restricting access to this data to those parties participating in the transaction. In the case of TradeLens, access rights are determined by a permission matrix which combines the party's role and the type of data.

These characteristics of blockchain technology address the key hazards which may be present in inter-organizational exchanges, that is of information asymmetry, bounded rationality, and opportunistic behavior. The transparency of the immutable data for the authorized parties to the transaction minimizes the inequalities in access to information which may lead to scenarios of information asymmetry, and ensures that decision makers have the best possible resources available to them in order to overcome tendencies towards bounded rationality. This understanding of the completeness and availability of the blockchain transaction record will act as a deterrent to opportunistic behavior, while the technology will also simplify the detection of any such actual malfeasance (Schmidt & Wagner, 2019).

Monitoring functions under traditional governance structures are post-transactional in nature, with contractual mechanisms relying upon third parties, and relational mechanisms based upon social constructs such as reputation (Jones et al., 1997). Blockchain however transforms monitoring to a real-time basis (World Economic Forum, 2016). Blockchain enables the proactive monitoring and the verification of performance of transactions, from the movement of goods to the movement of funds (Nascimento et al., 2019), greatly increasing the probability of detecting any malfeasance, and of achieving regulatory compliance.

Since all entered transactions can be transparently traced, from the point of creation by a member, through verification by the prescribed consensus algorithm, to publication throughout the decentralized network as immutable data, comprehensive monitoring of transactions is enabled (Roeck et al., 2020). Monitoring can be further enhanced by integration with other real-world data sources, such as notifications from 'oracles' or physical movement data (such as the geographical location of a shipment) from the 'internet-of-things' (Wu et al., 2017).

Likewise, the transparency of blockchain transactions facilitates conflict resolution. With the complete transaction history – including the provenance of assets, transfers of ownership, physical movements, and related legalities (Chang et al., 2019) – available on the blockchain in near-real time for inspection by the appropriate entities, there is little scope for misalignment either on process or data related disputes.

By delivering these mechanisms of governance, the blockchain generates system-level trust which, as the belief that the system will function as designed, is distinct from trust in another actor's goodwill (Hosmer, 1995). The blockchain thereby provides a substitute for the inter-organizational trust which is at the heart of relational governance.

Thus at the platform level of blockchain governance, the following propositions can be made:

Proposition 2a: The greater the effectiveness of the governance mechanisms inherent in the platform level of the permissioned blockchain structure, the lower will be the amount of contractual governance utilized by blockchain participants.

Proposition 2b: The greater the effectiveness of the governance mechanisms inherent in the platform level of the permissioned blockchain structure, the lower will be the amount of relational governance utilized by blockchain participants.

Application level governance mechanisms are primarily those enabled by blockchain smart contract functionality. Smart contracts provide the mechanism for encoding and automatically executing contract terms and conditions, with the smart contract code enforcing the rules which facilitate the exchange (Davidson et al., 2018), and thereby delivering the means for automated coordination of transactions across organizations. By ensuring the performance of actions triggered by the completion of specific criteria, the smart contract implements the routinization of business processes, adding certainty to the transaction. Smart contacts represent the processes as articulated conditions, monitor for those conditions, and execute actions based upon those conditions (Murray et al., 2019). As an example, the smart contract can reference verified documents to assure the buyer that the specified goods have successfully passed the relevant quality check and export clearance stages, and have then been shipped by the seller, and likewise can assure the seller that payment from the buyer has been initiated (we.trade, 2022).

In addition to enabling the automated coordination of transactions, the self-enforcement capability of smart contract addresses potential exchange hazards (Sheth & Subramanian, 2019). The coding and automatic execution of transaction terms and conditions, incorporating agreed external sources of information such as 'oracles', can minimize the occurrences of information asymmetry between the parties, and reduce the potential for bounded rationality in the decision making of the parties.

The parameterization and enforced execution of the transaction within the smart contract construct also reduces the likelihood of opportunistic behavior (Schmidt & Wagner, 2019). Smart contracts can monitor for transaction values or changes outside of an expected range, enhancing the ability to detect attempts at malfeasance (Ramos, 2016).

The automatic monitoring capability which can be encoded within smart contracts may replace in part or in full the traditional manual mechanisms of contract monitoring by the parties (Lacity, 2018; Rozas et al., 2021). Smart contracts also enable the systematic monitoring of the regulatory compliance of the transaction processing (Sulkowski, 2018), allowing adherence to the ever more complex rules of global trade (United Nations Centre for Trade Facilitation and Electronic Business, 2020).

The nature of smart contracts can diminish the potential for conflict between exchange parties. Inherent in their form as coded and parameterized agreements, smart contracts can remove or reduce the prevalence of those ambiguities (Chang et al., 2019) which can plague the implementation of contractual and relational governance. Since smart contracts are performed automatically, the possibility of the non-performance of obligations is greatly reduced. Since transactions are immutable and transparent to the parties involved, the possibility of data-oriented conflicts is also minimized. Further, by providing an auditable record of transaction execution, smart contracts may reduce the scope of the involvement of legal institutions within the process, simplifying conflict resolution (Raskin, 2017) and minimizing the need for sanctions to be applied.

Smart contracts can thus function as substitutes for contractual governance between the members of a blockchain, with their self-enforcement capability resulting in a reduction in the use, scope, and complexity of written contracts, and in the need for third party intermediaries (Fung et al., 2007) to provide related contractual governance services such as escrow arrangements (Saberi et al., 2019).

The limitations inherent in traditional contracting – such as incomplete contracts, the cost of contracting, and issues of enforcement – have meant that relational factors such as trust and informal rules have often been required as supplements to contracts (Gundlach & Cannon, 2010; Heide et al., 2007). With smart contracts able to substitute for written contracts and to overcome their limitations, smart contracts can thus additionally reduce the need for the supplemental use of relational governance. Where some degree of relational governance is still required, for example where there remains a substantial need for trust in the transaction, the relational inter-organizational trust can be substituted by the system-level trust (Hosmer, 1995) that the parties, as members, would place in the blockchain.

Thus at the application level of blockchain governance, the following propositions can be made:

Proposition 3a: The greater the effectiveness of the governance mechanisms enabled by the application level of the permissioned blockchain structure, the lower will be the amount of contractual governance utilized by blockchain participants.

Proposition 3b: The greater the effectiveness of the governance mechanisms enabled by the application level of the permissioned blockchain structure, the lower will be the amount of relational governance utilized by blockchain participants.

These components of blockchain delivered governance, and their ability to substitute for the traditional contractual and relational mechanisms, are presented in Figure 12.

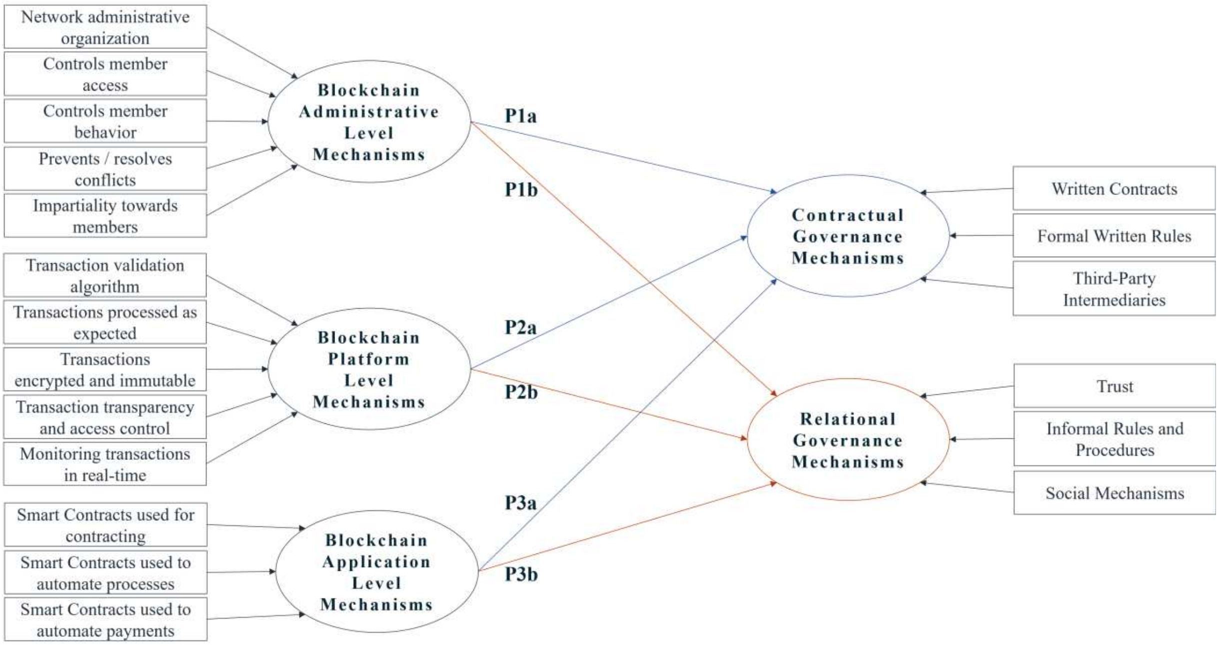


Figure 12 – Model of Blockchain Delivered Governance and its Substitutionary Effects

The specific mechanisms through which blockchain delivered governance can substitute for traditional means of governance are summarized in Table 3.

Role	Permissioned Blockchain Delivered Governance Mechanisms	Contractual Governance Perspective	Relational Governance Perspective
Coordination via:	• Member access & behavior control • Transaction validation • Smart contracts	• Formal contracts & institutions	• Informal structures

<table>
<tr><th>Role</th><th>Permissioned Blockchain Delivered Governance Mechanisms</th><th>Contractual Governance Perspective</th><th>Relational Governance Perspective</th></tr>
<tr><td colspan="4">Safeguarding against:</td></tr>
<tr><td>Environmental uncertainty</td><td>• Member access & behavior control
• Smart contracts</td><td rowspan="4">• Contract
• Third-party intermediaries</td><td rowspan="4">• Social structures
• Embeddedness
• Trust
• Participation rights</td></tr>
<tr><td>Information Asymmetry</td><td>• Transparency
• Smart contracts</td></tr>
<tr><td>Bounded Rationality</td><td>• Transparency
• Smart contracts</td></tr>
<tr><td>Opportunistic Behavior</td><td>Deter & Detect:
• Transparency
• Immutability
• Smart Contracts</td></tr>
<tr><td colspan="4">Delivery of:</td></tr>
<tr><td>Monitoring</td><td>• Member control
• Transparency
• Smart Contracts</td><td>• Contract
• Third-party intermediaries</td><td>• Social structures</td></tr>
<tr><td>Conflict Resolution</td><td>• Member control
• Transparency
• Smart Contracts</td><td>• Arbitration
• Courts</td><td>• Informal</td></tr>
</table>

Role	Permissioned Blockchain Delivered Governance Mechanisms	Contractual Governance Perspective	Relational Governance Perspective
Sanctions	• Member control • Smart Contracts	• Contract • Courts	• Reputational

Table 3 – Blockchain Delivered Governance vs. Traditional Mechanisms

4. Discussion

4.1. Implications of the conceptual framework

The automated coordination and safeguarding of transactions and the auto-enforcement of agreements via smart contracts enabled by blockchain can be expected to have tangible implications for the use of traditional contractual and relational governance mechanisms. Anticipated results would include reduced utilization of written contracts between blockchain members, reduced reliance on trust between transacting parties, and willingness to extend beyond existing relationships to transact with new partners. Such implications are described in Table 4.

Effects of Blockchain Delivered Governance upon the use of:	
Contractual Governance Mechanisms	**Relational Governance Mechanisms**
When transacting on the blockchain, fewer written contracts are required	When transacting on the blockchain, the level of trust required in the other party does not need to be as high
When transacting on the blockchain, less complex written contracts are required	When transacting on the blockchain, it is easier and less risky to find and use new trading partners

Effects of Blockchain Delivered Governance upon the use of:	
Contractual Governance Mechanisms	**Relational Governance Mechanisms**
When transacting on the blockchain, fewer formal written rules are required	When transacting on the blockchain, fewer informal rules and procedures are required
When transacting on the blockchain, fewer third-party intermediaries are required	When transacting on the blockchain, less reliance on the promises of vendors is necessary

Table 4 – Expected Effects of Blockchain on Traditional Governance Mechanisms

Within a permissioned blockchain network, written contracts would be required primarily to support initial membership and to promise adherence to the parameters of the blockchain delivered governance. Subsequent buy-sell transacting would be facilitated by the three levels of the blockchain governance structure, removing the need for the traditional mechanisms of written contracts and third-party intermediaries on each such transaction.

In parallel, the members' system-level trust in blockchain delivered governance would replace the traditional need for trust in the good intentions of trading partners to not invoke exchange hazards. Members need have less reliance on the use of existing trading partners, and would face lower risks when developing new partners.

4.2. Empirical verification of the conceptual framework

For blockchain delivered governance to be integrated into theory of inter-organizational management, the validity of the constructs and relationships described in this article must be subject to rigorous empirical testing (Rossi et al., 2019). This section describes a methodology by which this could start to be achieved.

A quantitative measurement of the effects of blockchain governance upon the usage of traditional relational and contractual governance mechanisms could provide a robust basis for this empirical verification. Such a study may also be regarded as a significant contribution to the field of blockchain as a whole, given that a major research gap exists in the quantitative analysis of the effects of blockchain within business domains (Fosso Wamba et al., 2020).

The research setting for this study should be permissioned blockchain consortiums as addressed by this article, as these represent the overwhelming majority of business based blockchains (Deloitte, 2020; Rauchs et al., 2019). Supply chains may provide a suitable domain for analysis, since they contain a meaningful number of implementations of blockchain consortiums (Rauchs et al., 2019) such as we.trade cited in this article (we.trade, 2021), their inter-organizational exchanges continue to grow in volume, complexity and importance with the rapid globalization of trade (International Chamber of Commerce, 2020), and they involve organizations of diverse business nature, size, and nationality amongst which the levers of contractual and relational governance have traditionally played major roles (Roehrich et al., 2020; Van Der Valk et al., 2020).

This study could take the form of a survey of the members of one or more permissioned blockchain consortiums, with the aim of measuring the change in the levels of usage of contractual and relational governance mechanisms by a member after joining the consortium, and correlating these to the member's perception of the effectiveness with the mechanisms of the blockchain governance structure (as described previously in Figure 12) to determine the actual impact of these mechanisms.

Since the majority of blockchain participants would have been members for a comparatively short period of time – given the relatively recent availability of such blockchain networks – this measurement of the relative impact of blockchain upon governance practices could be achievable.

However, several challenges must be overcome in order to accurately apply such a methodology. Firstly, given the lack of prior quantitative research in this field, there is a corresponding lack in the availability of referenceable measurement items. Scales will have to be adapted to measure the efficacy of the blockchain mechanisms, and to measure the corresponding delta effects of these on traditional governance mechanisms.

Secondly, these effects may prove to be problematic to measure. Although the number of operational blockchain consortia is increasing, and with that the number of participating organizations (Deloitte, 2020), the proportion of involved entities is still only a fraction of the supply chain domain, and thus it may not be possible to reach a satisfactory sample size of active blockchain members. It may be desirable to enlist the cooperation of one or more specific consortia in surveying their members.

Given such scenarios, a longitudinal study of the use by a specific organization of traditional governance mechanisms before and after joining a blockchain consortium may provide a clearer perspective. Alternatively, direct measurement of the volume of usage of traditional governance mechanisms before and after the introduction of blockchain to an organization may be possible. This could involve measuring actual changes in the number or complexity of written contracts, or the number or volatility of supplier relationships, conducted by a blockchain member.

4.3. Agenda for further research

The analysis of the governance of inter-organizational exchanges has typically been fragmented across multiple research streams, including economics, organization studies, law, strategy, marketing, and operations management (Roehrich et al., 2020). In addition to the conceptual framework presented in this article which connected blockchain delivered governance with traditional mechanisms of governance from transaction cost economics and social exchange theory, there are myriad further opportunities to synthesize the integrative form of blockchain with related theories from across divergent research streams.

In the permissioned blockchain structure which is the concern of this article, it is the administrative level which may most reward further theoretical research. It is primarily these mechanisms in a permissioned blockchain which represent the major differences to a permissionless blockchain. With most attention in the literature given to permissionless blockchains (Fosso Wamba et al., 2020), it is not unexpected that the structures, modes and methods of governance employed within blockchain consortia have not yet been investigated in detail (Lohmer et al., 2021). Further, the administrative level consists of a blend of off-chain and on-chain mechanisms, extending the scope of the issues involved.

Agency theory can be examined as it relates to members assigning responsibilities to the blockchain consortium, and its NAO. An example is the know-your-customer verification, whereby the NAO rather than the individual existing members will control the process of approving new members for the blockchain. Further research can expand upon the finding of Schmidt and Wagner (2019) that blockchain significantly influences the principal-agent relationship, by affecting the major agency problems of conflicting interests and of differing appetites for risk between principal and agent, and by eliminating the need for certain levels of intermediation.

While individual members can still choose whether or not to transact with the new member, the new member's acceptance into the blockchain consortium can be expected to convey reliability and integrity. This will encourage members to trade with other members. The strength of this level of encouragement will have implications for the reputational effects of social exchange theory (Jones et al., 1997), and for signaling theory (Spence, 1973). The strength of this encouragement will affect the willingness and the perceived need to transact first with established partners, and the value placed on prior interactions between the parties, and will thus alter the calculus within close partner selection frameworks (Wuyts & Geyskens, 2005).

The need for the NAO of the blockchain to be accepted as acting with impartiality by consortium members as a precondition for the acceptance and effective implementation of the blockchain mechanisms of governance (Lacity et al., 2019) can be developed in the context of several theories. The power-dependence and power-network ("two or more connected relations") concepts of Emerson (1962) can provide a basis for explaining the structure of power within a blockchain consortium, and from there to predict the readiness of members to accept the authority of the NAO and thus of the governance mechanisms of the blockchain itself. Social network theory can explain external causes of technology adoption (Queiroz & Fosso Wamba, 2019), and of the blockchain and its governance mechanisms.

Two further key areas for future research can be mentioned at the level of the entire blockchain governance structure. The dimensions of trust within the permissioned blockchain can be examined so as to determine the conditions under which the blockchain enables the change from dyadic trust in a trading partner to system level trust in the blockchain consortium (Hosmer, 1995).

Finally, this article has not traced through the relative impact on performance outcomes – including cost structures, value generation, and strategic advantage – of the alternate combinations of blockchain and traditional governance mechanisms presented. This limitation could be addressed by subsequent studies.

4.4. Practical implications of blockchain delivered governance

The ability to explain and predict the ability of blockchain delivered governance to substitute for traditional mechanisms may contribute significantly to the approach by which practitioners view, design, implement, and operate permissioned blockchain structures, and more generally, business networks as a whole.

Given the highly dynamic nature of business environments today (PWC, 2021), intensified by the pace (World Trade Organization, 2020) and complexity (International Chamber of Commerce, 2020) of globalization, practitioners require highly responsive levers to manage their inter-organizational exchanges. However, the traditional mechanisms of governance are limited in their ability to provide such functionality: both contractual (Joskow, 1985) and relational (Larson, 1992) mechanisms are difficult, time-consuming, and expensive to build and maintain, and imperfect in operation.

Blockchain delivered governance, based as it is upon the execution of program code to process and safeguard transactions within the network, may provide participants with a governance structure offering greater effectiveness and responsiveness, at a lower level of risk and cost, than traditional governance mechanisms. In order to achieve this potential, practitioners must understand the mechanisms through which blockchain delivered governance operates, and thus can be managed and optimized. This article, with subsequent research and verification, can begin to make this contribution.

Practitioners can be apprised of the available mechanisms at each level of the blockchain governance structure defined in this article – administration, platform, and application – in terms of their substitutionary effect on traditional mechanisms, their complementary effect on other blockchain mechanisms, and ultimately their effect on performance. Management of the blockchain consortium and of its participating member organizations must seek to create a NAO which will protect the rights of members in an impartial manner, and which will convey the assurance of trustworthiness so as to substitute for the traditional protections of relational structures and detailed contracts. Technologists tasked with designing and implementing the blockchain must deliver a permissioned ecosystem which delivers the needed components for governance, including access rights to the network and its data, the accuracy of the consensus algorithm in validating and processing transactions, comprehensive monitoring against opportunistic behavior and to minimize conflict, and the execution of smart contracts. The network structure must control access both to member transactions, for example via the channel structure implemented within Tradelens (Tradelens, 2020), and to the private data of end-users.

At the administrative level, the ability of the NAO to be regarded as impartial may represent the greatest challenge to practitioners. As reported in a large scale survey of participants in blockchain consortia (Deloitte, 2020, p. 20), over 40% of respondents identified unfair governance rules, and poorly defined roles and responsibilities of members, as challenges to blockchain participation and operation. Practitioners must ensure that the NAO addresses such concerns with an effective set of administrative mechanisms accepted by participants and stakeholders.

At the platform level, practitioners may seek to optimize the key function of monitoring by examining the applicability of artificial intelligence (AI) for the anticipation of suspicious behavior, and of the Internet of Things (IoT) for the integration of physical traceability into monitoring processes (Weking et al., 2019).

At the application level, the ability of smart contracts to perform the function of written contracts –and also to remove the need for relational mechanisms as supplements to incomplete contracts – may require the most attention by practitioners, with legal, usability, and auditability implications involved.

Legally, there appears to be relatively widespread acceptance that smart contracts can be constructed so as to meet the definition of valid contracts, and thus that existing contract law can be applied to smart contracts (European Commission, 2020). Practitioners must focus on providing the framework to enable legal jurisdictions to accept the ability of smart contracts to substitute for written contracts.

Relatedly, practitioners should enhance the usability and auditability of smart contracts so as to facilitate their use as substitutes for written contracts. Currently smart contracts, being in the form of program code, are not easily readable or verifiable by non-programmers. Ideally functions would be provided to allow smart contracts to be parsed by both humans and software with minimal intervention (Ganne, 2018).

As suggested by earlier constructs such as the 'Ricardian Contract' of the 1990's (Grigg, 2004), the major elements of contracts to be automated would include codified processes, parameterized deal terms (such as dates, prices, and quantities), and links to prose legal terminology (Hazard & Haapio, 2017). Enhanced usability would involve practitioners recording such elements in a human-readable form that would then facilitate automated translation into the machine-readable smart contract code. Likewise, the code of a smart contract could be presented upon request to interested parties in a human-readable form. While initiatives such as CommonAccord– which attempts to provide a modular library of codified legal templates (De Filippi, 2014) – could provide a basis for enhanced linkages of terms and smart contracts (Hazard & Haapio, 2017), much work remains to be done by practitioners in this area.

Solutions must be developed for certifying the validity of the external 'oracles' that are required as data feeds into smart contracts, in order to ensure accuracy, to provide transparency for the parties involved, and to prevent the contents from being intercepted for purposes of malfeasance.

Until the greater transparency between the elements of written and smart contracts can be achieved, the testing of smart contract operation will be of paramount importance. This testing must be able to demonstrably prove the accuracy of transaction processing via blockchain to the satisfaction of all parties involved, for all scenarios anticipated, and under conditions of uncertainty.

These benefits and challenges for practitioners of operationalizing blockchain delivered governance are summarized in Table 5.

Major Benefits of Operationalizing Blockchain Delivered Governance	
Type	**Expected Benefit**
Responsiveness	Faster to operationalize new relationships and new transactions
Cost	Less costly to coordinate and safeguard transactions
Risk	Less risk of exchange hazards in processing transactions
Major Challenges in Operationalizing Blockchain Delivered Governance	
Structure Level	**Areas Requiring Focus**

Administrative	• Impartiality of administrative authority • Acceptability of governance rules to members • Acceptability of member roles & responsibilities
Platform	• Technical capability of the Network • Technical capability of the Blockchain technology • Integration with related technology (e.g. AI, IoT)
Application	• Smart Contract legality • Smart Contract usability • Smart Contract auditability

Table 5 – Benefits and Challenges of Operationalizing Blockchain Delivered Governance

5. Conclusion

Prior to the emergence of blockchain technology, the means had not existed for the automation of private ordering arrangements between the parties to an exchange. By providing a multi-level structure and specific mechanisms for the automated specification, validation, and enforcement of such private ordering, not only does blockchain represent an additional antecedent influencing the usage of the traditional contractual and relational mechanisms of governance, but these administrative, platform, and application level blockchain mechanisms can specifically substitute for the traditional mechanisms themselves.

This article concludes therefore that the ability of blockchain to deliver this automated hierarchy of governance mechanisms should, with subsequent empirical verification, stimulate a reevaluation of existing theories of inter-organizational governance.

Chapter 2. Blockchain Delivered Governance in Action:- The we.trade Case

Abstract

This article tests the blockchain delivered governance framework (Petersen, 2022) against empirical observation of the we.trade network for trade finance. Participant buyers, sellers, and their banks place their trust in the we.trade blockchain network itself, replacing the need for traditional contractual and relational mechanisms of governance. This article finds to be true the hypotheses that present on such a network is a blockchain governance structure whose administrative, infrastructure, and application levels deliver the required processing and safeguarding of transactions. Additional research on other instances of blockchain driven networks, and/or quantitative analysis of survey responses from such network participants, is needed for further testing of these hypotheses. Most significant amongst the blockchain delivered governance mechanisms examined are smart contracts, which in addition to enabling the automation of transaction dataset processing as found on we.trade, can be further employed to automate the monitoring and enforcement of the governance ruleset itself.

1. Introduction

To many, blockchain may be synonymous with Bitcoin (Nakamoto, 2008), the first so-called 'cryptocurrency' which was first created so as to enable peer-to-peer transactions to be performed without intermediaries, and which has since become a cultural and financial sensation. Meanwhile, the decentralized network and database underlying Bitcoin has been generalized into distributed ledger technologies such as blockchain. In blockchain, new records are grouped into blocks and appended to a linked chain of data which can be considered practically immutable, since any attempt to tamper with a record will make the subsequent links in the chain invalid, resulting in detection (Catalini & Gans, 2016; Dhar & Stein, 2017).

While Bitcoin was based upon open access and processing rights, the requirements for security within most commercial use cases means that the majority of business blockchains to date are permissioned (Deloitte, 2020), wherein a controlling group or consortium designates an authority to control which entities can join, submit, and validate transactions on the blockchain. An oft-cited example is the Tradelens network which was created by leading shipping company Maersk and IBM to facilitate ocean transport (IBM, 2021b). Maersk appointed management controls membership of the network (with plans announced for the formation of a 'customer advisory group' of members), and designates itself and several of the largest participants to be 'trust anchor' nodes responsible for the validation and security of transactions submitted to the network (Tradelens, 2022).

Recent literature on the use of blockchain for business applications has theorized that blockchain can represent a "new institutional technology that makes possible new types of contracts and organizations" (MacDonald et al., 2016) via its capacity to autonomously execute and enforce the agreements made between parties (Lumineau et al., 2021). A major foundation of such perspectives are the 'smart contract' programs (Smart Contracts Alliance, 2016) which can run autonomously on a blockchain network to facilitate the automated processing of transactions.

Petersen (2022) posits that a blockchain enabled governance structure which leverages mechanisms at the levels of administrative, platform, and application can deliver the functions required to govern buyer-seller transactions within a business network – that is, to coordinate and safeguard transactions – as a substitute for the traditional methods of contractual and relational governance. This article seeks to contribute to the fields of blockchain and inter-organizational governance by examining whether support for this assertion can be found in a real-world instance. Given that there is little developed theory relating to blockchain, particularly in a business context (Lohmer et al., 2021; van Pelt et al., 2021), empirical testing of conceptual work relating to blockchain is sorely needed.

To perform this examination, this article studies the case of the we.trade trade finance network through the lens of the blockchain delivered governance structure. Launched in January 2019, we.trade was created to enable member buyers and sellers to conduct transactions digitally on a blockchain enabled network, presenting them also with the option of using embedded financial products offered by its member banks. It is known that on the we.trade instance, the proposed effects of blockchain delivered governance are present:- namely, that written contracts, trust and social structures are not required for the effective processing of transactions between the parties. This article seeks to determine whether the causal factors described in the blockchain delivered governance structure are also present – together with these effects – on the we.trade instance. While finding the presence of both the theorized causes and the effects on a single instance cannot prove causality, it may provide encouragement for further study of this framework.

The following theoretical framework section describes the blockchain delivered governance framework. The methods section outlines the case study approach to be used in this article. The results section places the observations of we.trade within the theorized framework. A discussion presents the findings of this examination, reviews the quality of the study and its limitations, suggests an agenda for further research, and identifies several significant implications of the findings for practitioners.

2. Theoretical framework

2.1 Precursors

Taking the basic unit of economic activity to be the transaction, governance can be defined as those "working rules" required to ensure order during transaction processing (Commons, 1932, p. 13). Traditionally these rules can either be applied formally in written contracts as per the contractual governance approach of transaction cost economics (Williamson, 1975, 1985, 1993a), or informally through the use of trust and the pressures of social structures known collectively as relational governance (Arrow, 1974; Granovetter, 1985; Jones et al., 1997; Poppo & Zenger, 2002).

Within the context of a business network such as a supply chain which consists of organizations independent though interdependent (Carter et al., 2015), the effectiveness of the inter-organizational exchanges is vital, and these can be leveraged to generate competitive advantage for the organization concerned (Dyer & Singh, 1998). Governance of the rights and behavior of network members requires specific rules and processes, as suggested by Buchanan (1965) on clubs and by Ostrom (1990) on common pool resources, and as described in network theory (Klijn & Koppenjan, 2006; Provan & Kenis, 2007).

While blockchain was initially regarded as purely an information systems innovation, it has come to be seen as encompassing a far wider sphere of influence (Davidson et al., 2016), providing a method to "enforce agreements and achieve cooperation and coordination that is distinct from both traditional contractual and relational governance as well as from other IT solutions" (Lumineau et al., 2021).

2.2 Blockchain delivered governance

Petersen (2022) further describes how blockchain can enable the mechanisms needed for governance over network members and their transactions, and in so doing, provides a substitute to traditional approaches. This blockchain delivered governance structure is comprised of three distinct conceptual levels:–

4. Administrative mechanisms must provide an acceptable and impartial set of rules governing the network and member behavior
5. Platform mechanisms must ensure that the blockchain infrastructure is technically secure and reliably governed
6. Application mechanisms must employ smart contracts to automatically process transactions, while governing adherence to the trade parameters agreed between the parties

Figure 13 outlines this framework.

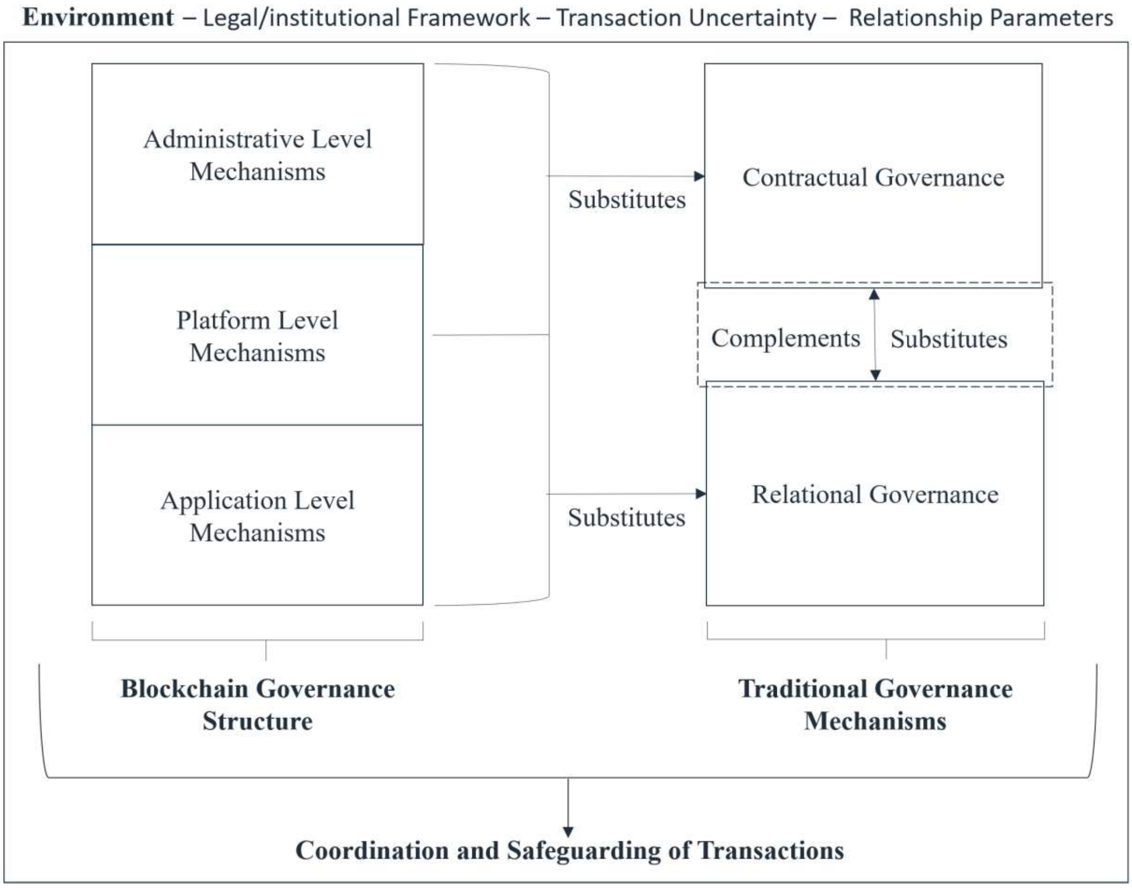


Figure 13 – Conceptual Framework of Blockchain Delivered Governance (Petersen, 2022).

Administrative mechanisms include 'on-chain' (automated) and 'off-chain' (manual) controls over network participation. In a permissioned blockchain, the entity or group of entities (that is, consortium) owning the network will normally assign a "network administrative organization" or NAO (Provan & Kenis, 2007, p. 6) to operate the blockchain. The NAO will specify the processes for the onboarding of members, the regulation of member access and member behavior, and the departure of members, and will control the extent of the decision making rights granted to the members. In so doing, the NAO will reveal the level of impartiality present in their treatment of the members.

Petersen (2022) proposed that the more effective the administrative mechanisms, the less contractual and relational governance will be used by network participants.

Platform mechanisms relate to the blockchain technology infrastructure, particularly the validation or consensus engine which ensures that transactions are processed as members expect, the protection of the data via encryption and the immutability of blockchain, the transparency of access for the appropriate users, and monitoring against malfeasance. Petersen (2022) proposed that the more effective the platform mechanisms, the less contractual and relational governance will be used by network participants.

Application mechanisms principally employ smart contract constructs to automate transaction processing and safeguarding, and to enforce compliance with transaction and blockchain rules. Petersen (2022) proposed that the more effective the application mechanisms, the less contractual and relational governance will be used by network participants.

These causal relationships are presented in the Figure 14 model.

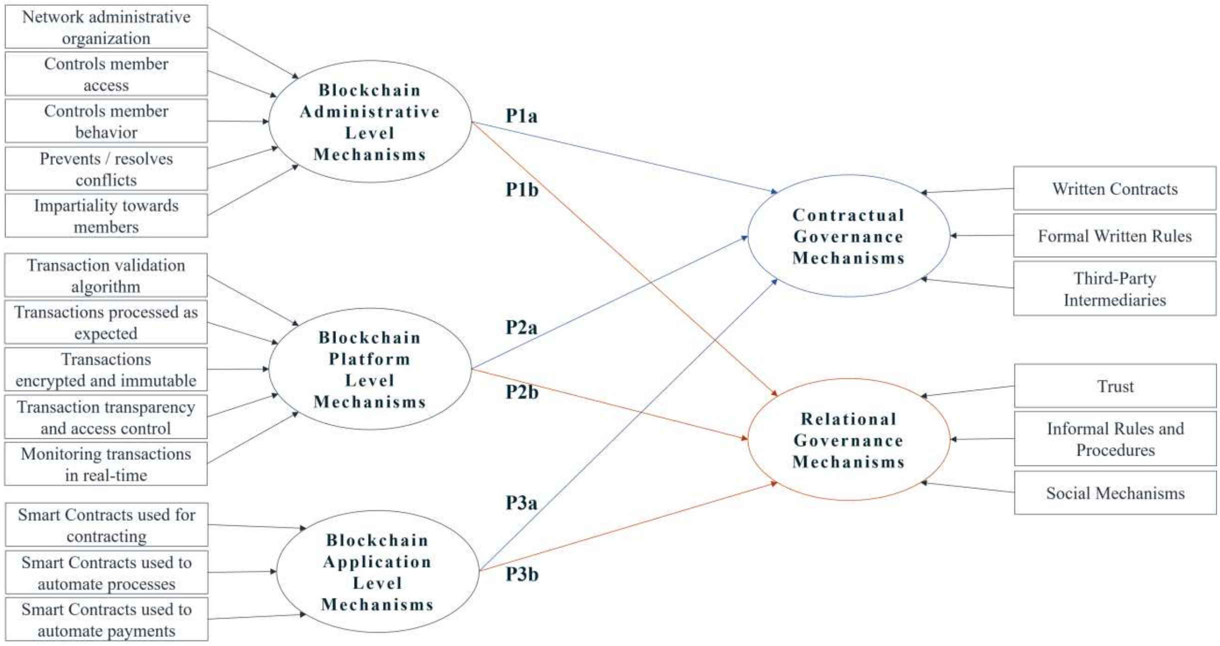


Figure 14 – Model of Blockchain Delivered Governance and its Substitutionary Effects (Petersen, 2022)

3. Method

3.1 The case study approach

Given the difficulty in obtaining quantitative data in the blockchain domain in which events are still too novel for suitable survey data to be collectable, the case study was adopted as the research strategy for this article (Yin, 2014). As suggested by Benbasat (1987), in fields such as information systems which are constantly evolving, and where research may trail practice in the study of new innovations, the case study can provide a strategy for the generation and verification of theory from practice. The case study can be considered especially suited for testing the applicability of theory in real business settings (Ulriksen & Dadalauri, 2016; Voss et al., 2002).

While the test of a single case cannot prove a hypothesis, it can show that it is not yet disproved, and thus that it may deserve further study (Yin, 2014). At the same time, as suggested by Gerring (2007), the single use case can inform understanding of a class of like scenarios.

This case study was conducted in accordance with the techniques described by Yin (2014) and was informed by the process based approaches of Blatter & Haverland (2012), George & McKeown (1985), and Hall (2006). The approach adopted for the testing of theory via case study was drawn from Hall (2006), Gerring (2007), Dul & Hak (2007), Yin (2014), Ulriksen & Dadalauri (2016), and Chukwudi et al. (2019) and can be summarized as:

a) operationalizing the conceptual propositions into testable hypotheses that describe a verifiable relationship between observable phenomena
b) selecting a case which may present the functioning of these phenomena
c) collecting empirical data reflecting the functioning of these phenomena in the case setting
d) transforming the collected data into patterns, and comparing these against those predicted by the theory

These steps are outlined in the following sections.

3.2 Hypotheses

The propositions of Petersen (2022) are restated here as hypotheses for the case study examination. These hypotheses are presented in the form of deterministic necessary conditions (Dul & Hak, 2007) to enable testing via a single instance of the domain under study, that is, within this single case study.

Hypothesis 1 (administrative level): There must be an acceptable and impartial set of rules governing network and member behavior, in order for members to employ blockchain governance as a substitute for contractual and relational governance

Hypothesis 2 (platform level): There must be a trusted technology infrastructure, in order for members to employ blockchain governance as a substitute for contractual and relational governance

Hypothesis 3 (application level): There must be smart contracts to automate the processing of transactions and the adherence to rules, in order for members to employ blockchain governance as a substitute for contractual and relational governance

A suitable case study must be selected in which the specified effect within these hypotheses is present. If the stated cause in a particular hypothesis is not present within that case study instance, that hypothesis is then rejected.

3.3 Case selection

we.trade was selected as the subject for this study as it suitably fulfils the needed criteria. Firstly, the supply chain domain provides many of the business-oriented blockchain networks in operation today (Rauchs et al., 2019). Secondly, within this domain, the trade finance sector combines both operational and financial processes (International Chamber of Commerce, 2020) thus enabling the study of a full transaction lifecycle. Thirdly, we.trade is one of the few blockchain networks in which all participants must be members, and within which the complete end-to-end flow of processes are all performed and visible upon the blockchain platform.

Finally, according to the theory testing process of Dul and Hak (2007), and of Yin (2014), the selected case study must present the effect described in the hypotheses under examination. Here, this is the requirement that the members of the blockchain network have employed blockchain governance as a substitute for contractual and relational forms of governance.

5.1.1. Blockchain has replaced traditional mechanisms of governance on we.trade

we.trade satisfies this criteria. Firstly, we.trade substitutes for the use of contracts. The rules of we.trade – which all members must accept as a condition of membership – specify that all communications sent via we.trade are legally equivalent to transactions, documents, and communications made in writing (we.trade, 2018). Interviews with we.trade management and traders (that is buyers and/or sellers) confirm that the use of the digitized we.trade platform itself has replaced the use of contracts in the performance of transactions (D. Fitzgerald, personal communication, December 5, 2021; M. Lopez, personal communication, December 28, 2021).

Secondly, we.trade provides traders with methods for venturing beyond their existing connections to find new partners, including a searchable client directory within we.trade, and a tool for inviting new co2mpanies to join we.trade (we.trade, 2019). Further, the protections against malfeasance traditionally enforced by the need for an organization to maintain its reputation and position within its social structure (Jones et al., 1997), can also be delivered by the automated safeguarding of transactions provided within the we.trade network and the accompanying rules of the we.trade NAO.

3.4 Data collection

Interviews were the major source of information for the case study, with interviews conducted with 15 interviewees between July 2021 and January 2022. Interviews were semistructured, lasting between 45-90 minutes, with an average length of approximately 60 minutes. Multiple interviews were conducted with several participants. Interviewees included representatives of banks within the we.trade consortium, other banks using we.trade, traders using we.trade, we.trade's technology service provider IBM, and we.trade past and present employees from the areas of operations, technology, and sales. Interviewee names are not mentioned when comments were agreed to be 'off the record'.

Other sources consulted included webinars and recordings of online events in which we.trade representatives participated, the web sites of we.trade and of its members, press articles, the we.trade governance document (its 'rulebook' of 70 pages), and the we.trade user manual (its application guide of 82 pages).

The theoretical framework under examination was used to guide data collection. Whilst this suggests a realist perspective, the triangulation of information from multiple sources provided relativist perspective, while enabling the corroboration of the information collected, and strengthening the validity of the case study's findings (Patton, 2002; Yin, 2014).

4. Results

4.1 What is we.trade?

4.1.1 An introduction to Trade Finance

International trade can be categorized as being either documentary (e.g. a payment process managed via letters of credit), or open account (e.g. payment after delivery), in nature. Open account trade, while avoiding the time and cost of letters of credit, involves the risk of payment not being received and the difficulty of managing cash flows, particularly for small-and-medium sized enterprises (SMEs). It is estimated that up to 80% of merchandise trade depends upon trade finance in some form, be it loans, guarantees, or the financing of receivables or inventories (International Chamber of Commerce, 2020).

4.1.2 Development of we.trade

The idea for we.trade can be traced back to 2015. The head of trade finance at Belgian bank KBC at that time, Hubert Benoot, connected the capabilities of blockchain with a past customer comment. That customer, a potato farmer, when asked why he didn't export his produce outside of Belgium, cited the risk: when he didn't know a potential customer, how could he trust that entity and be sure he would be paid? (H. Benoot, personal communication, December 20, 2021; P. Sangha, personal communication, October 12, 2021).

Benoot believed that the new blockchain technology could help to provide the needed trust. Several European banks agreed to collaborate on a proof-of-concept, with the objective of creating a complete ecosystem for the open account trade for buyers, sellers, their banks, and their service providers such as insurers and logistics providers. The platform would reduce the risk and the complexity of the trading process by integrating the buyers and sellers, and automating transactions, and would allow the banks to offer new financing products for the open account trade, without detracting from their existing letter of credit business (IBM, 2021a). we.trade has estimated that 95% of trade within Europe is conducted on an open-account basis, and that this rises to 99% in the case of SMEs (Gnagnarella, 2019).

The proof of concept (called the Digital Trade Chain) was completed in 2016. A consortium of seven shareholder banks was then established in 2017, with two further banks joining later in 2017, and three more banks joining in 2019 from the closing Batavia trade finance consortium (Wass, 2018). IBM and CRIF (a credit information provider) both subsequently became we.trade shareholders so as to inject further needed funds into the venture (Ledger Insights, 2020; Wragg, 2021). The participant roles in we.trade are presented in Figure 15.

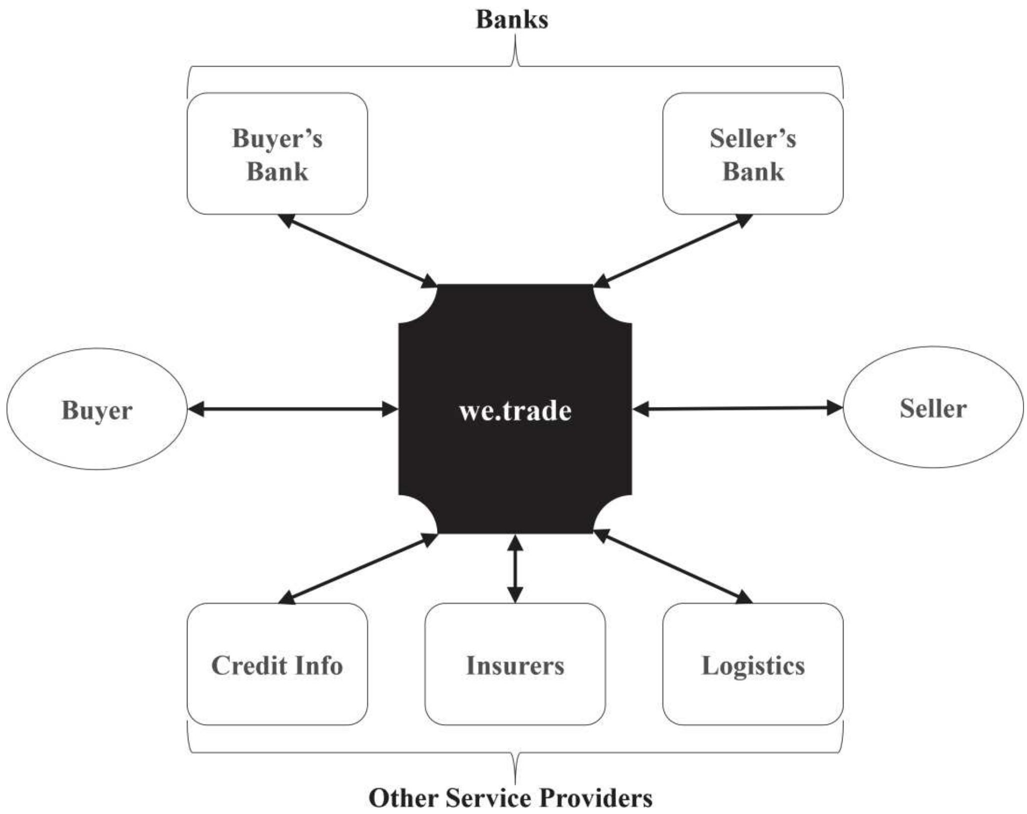


Figure 15 – Participant roles in we.trade

In 2018, the we.trade joint-venture (JV) company was registered in Ireland, a regional hub for technology firms. we.trade officially began processing live transactions in January 2019 (Rao, 2019).

As of January 2022, we.trade covers much of Europe, via its shareholder banks Caixa (Spain), Deutsche Bank (Germany), Erste (Austria), HSBC (UK), KBC (Belgium), Natixis (France), Nordea (Scandinavia), Rabobank (Netherlands), Santander (Spain), Société Générale (France), UBS (Switzerland), and UniCredit (Italy), and its non-shareholder banks

Akbank (Turkey), CBC (Belgium), Eurobank (Greece), UniCredit (Germany), and ČSOB, Komerční Banka and Česká Spořitelna (Czech Republic).

The consortium in control of we.trade today comprises its shareholder banks, and its shareholder service providers IBM and CRIF. Together the consortium entities own the shares of the we.trade JV, and assign executives to its board of directors.

The consortium sets and monitors the strategy and the rules of we.trade, while the we.trade JV operates the infrastructure and application. The member banks introduce their customers to be traders on we.trade, and it is the banks rather than the we.trade JV who communicate with those member traders. Since the start of 2021, the we.trade JV does not have a CEO or General Manager, and has been led by its CTO, Mark Cudden (M. Cudden, personal communication, July 7, 2021; Wragg, 2021).

4.1.3 The trade finance process on we.trade

we.trade was created for the open account trade. Given their resource limitations, and their inability to afford facilities such as letters of credit, it is the SME sector which has the greatest need for such a solution. This contrasts with other digital platforms such as Contour and Komgo which focus on letters of credit, and Marco Polo which addresses corporate finance (OECD, 2021). The typical process as performed on we.trade (we.trade, 2019) is summarized in Figure 16.

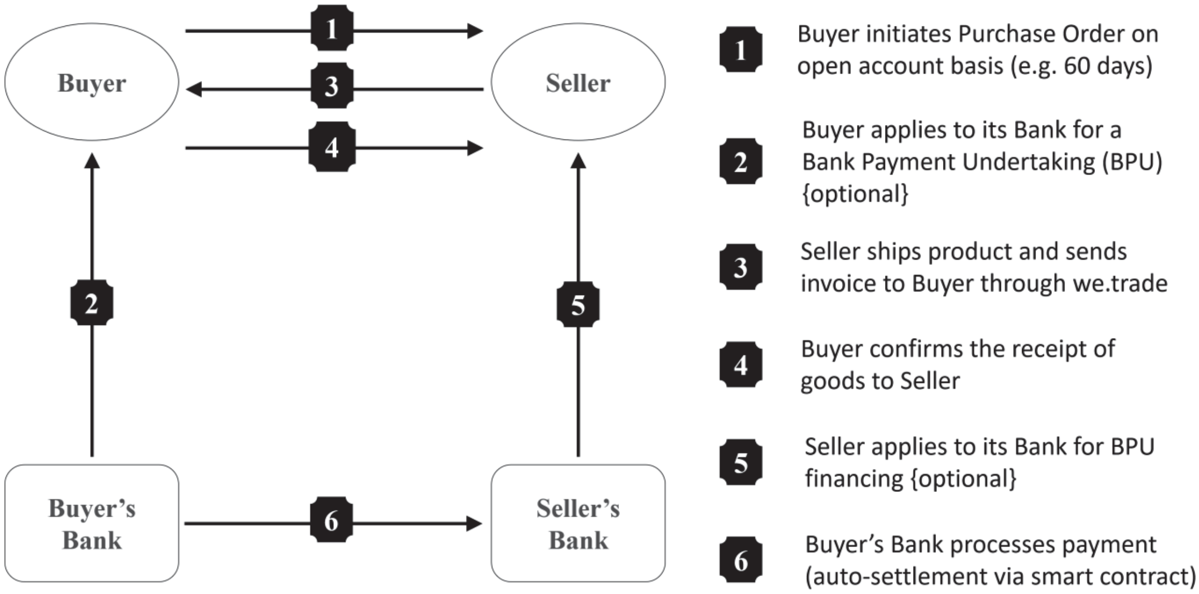


Figure 16 – The we.trade process

The steps of purchase order creation (step 1), seller shipment (step 3), and buyer receiving (step 4) are standard across trading processes, but it is the optional new banking products of Bank Payment Undertaking (BPU) (step 2) and BPU Financing (step 5), and the auto-settlement via smart contract of the payment to be made by the buyer's bank (step 6) which are unique to we.trade, as described below (we.trade, 2018).

Bank Payment Undertaking (BPU) is the we.trade extension of the International Chamber of Commerce's Bank Payment Obligation (BPO) standard for the exchange of electronic documentation (OECD, 2021), with we.trade introducing the automated settlement of payment via smart contract. Generally at the request of the seller, the buyer applies for a BPU from its bank. If the bank accepts, it will then guarantee that the required payment will be made to the seller's bank, upon verification of the settlement conditions as determined by a smart contract. Thus with a BPU in place, the seller is guaranteed to receive payment once the settlement conditions are met. In return for this lesser risk, and for the buyer absorbing the cost of the BPU, the seller may grant the buyer more advantageous terms, such as reducing prepayment and extending payment terms, which in turn aids the cash flow of the buyer.

BPU Financing can be requested by the seller from its bank using the BPU as a negotiable instrument, so as to receive cash flow support during the period before receiving payment from the buyer's bank.

Auto-Settlement can be performed via a smart contract, once it determines that an agreed settlement condition has been satisfied (such as the goods having been delivered). The buyer's bank will be notified to make the payment to the seller's bank, and will do so either by the normal process, or through full automation if both parties have so agreed.

Upon any step in the we.trade process occurring, real time notifications are sent to the concerned parties, and data is written to the we.trade blockchain.

4.1.4 we.trade members

In 2020, we.trade announced that 46% of its members were from industrial/manufacturing, 40% from clothing / apparel, and 5% from foods (Morris, 2020).

Ekoï, a French company providing clothing and accessories for cyclists worldwide, is one of these companies. According to Ekoï management (M. Lopez, personal communication, December 28, 2021), we.trade is used for all transactions with four of their Italian suppliers who are also on we.trade, with over 50 transactions having been conducted in the prior two months. With large order quantities and lengthy order cycles involved, it was stated that Ekoï values we.trade for facilitating communication along each stage of the process, and for the completeness and transparency of transaction information.

Ekoï financial management adjudged the financial products available on we.trade to be much simpler and less expensive than letters of credit. The BPU facility has allowed sellers to extend payment terms, enabling the buyer to sell most of the delivered products within that period. Additionally the sellers can request BPU Financing as required.

4.1.5 Benefits of we.trade

The benefits reported by buyers and sellers from their participation on we.trade primarily relate to improving liquidity through the BPU and BPU Financing instruments and more preferential trading terms, while at the same time reducing the risk of late or non-payment; and to improving transaction processing efficiency, transparency, and security (Hyperledger Foundation, 2020; IBM, 2021a; Ledger Insights, 2020; Morris, 2020; PYMNTS, 2018; Rao, 2019; Wragg, 2020).

Additionally, the establishment of new partnerships is streamlined by the digitization of the processes involved, and the corroboration from the bank responsible for enrolling its customer as a we.trade member. Verifiability of identity and transaction data provides the needed protection against malfeasance.

Buyers and sellers have also reported reputational benefits of credit worthiness and reliability arising from their membership on we.trade.

The participating banks meanwhile generate additional revenue streams from the new financing products, and derive efficiencies from the digitalization of the processes, in terms of faster processing times, lower transaction costs, and lesser risk of fraud.

4.1.6 The impact of COVID-19

The COVID-19 pandemic has certainly impacted the level of adoption of we.trade. SMEs in particular suffered severe disruption to their operations and viability, limiting their ability to invest time and resources in new endeavours (and although entities in certain locations received government support during this period, such support actually reduced their need for we.trade's financial products). However, the pandemic has also made clear many of the benefits of digital operations. Interviews with we.trade members suggest that we.trade has been able to mitigate some of the effect of COVID-19 through digitization of partner enrollment and payment processes, and that even conservative management traditionally resistant to change were becoming willing to move to a digital platform. David McLoughlin, the Head of Commercialisation at we.trade during the first year of the pandemic, said that COVID-19 was acting as a "catalyst" for change: "with COVID-19, the digitisation of trade and trade finance is now no longer a luxury, but a must" (Basquill, 2020).

4.1.7 Constraints to the growth of we.trade

As a platform in which all participants must be members, we.trade is more susceptible to the network effect than other platforms which do not require this (such as Marco Polo). we.trade must ensure that its ecosystem has enough participants and generates enough transactions so as to be viable with respect to the value it provides its members, and thus that it discourages its traders and banks from moving to other alternatives.

In May 2020, we.trade announced a target of 25,000 users and 2.5 million transactions within three to four years (Ledger Insights, 2020). However, the volumes it announced at the end of 2021 represented but a fraction of this target: 400 members and 1,500 transactions (we.trade, 2022). Thus there remains a major gulf for we.trade to overcome in order to achieve the desired scale.

Given that we.trade is a bank-centric model, with its consortium comprised mainly of banks, its member traders typically introduced to the network by their bank, and many of its benefits such as its novel financial instruments provided by the banks, the lengthy onboarding cycle for new participant banks represents a constraint to growth. The time needed for due diligence and to redesign internal processes accordingly was said in interviews conducted with bank executives to require at least one year, and two years in the case of Akbank of Turkey (S. Yüksel, personal communication, December 20, 2021).

A factor constraining the number of traders may be the limitation of the scope of we.trade to Europe. While members have stated the desire to trade with partners in Asia (M. Lopez, personal communication, December 28, 2021) and South America (Nordea Bank, 2018), we.trade has not announced any plan for implementation of the complex process and governance changes required for expansion outside Europe.

4.2 How blockchain delivers governance on we.trade

This section examines each of the hypotheses introduced earlier in this article against the phenomena observed within we.trade.

4.2.1 Administrative level mechanisms

Hypothesis 1 (administrative level): There must be an acceptable and impartial set of rules governing network and member behavior, in order for members to employ blockchain governance as a substitute for contractual and relational governance

The core of the administrative level mechanisms employed by we.trade is an extensive 'rulebook' which provides a detailed framework for all operations. The we.trade consortium of shareholder banks developed the rulebook based upon English trade laws (Hyperledger Foundation, 2020), with a major role played by HSBC in its creation (Blockchain Ireland, 2021).

we.trade ensured that the rulebook was in place and accepted by all participants before commercial operations of we.trade commenced in January 2019. A general manager of we.trade, Ciaran McGowan, has stated that the establishment of the rulebook took more time than the technical development of the platform itself (Morris, 2020).

These rulebook provisions include (we.trade, 2018):

- the enrollment processes for a bank, and for a trader
- the operation of we.trade, and handling of exceptions
- the operation of bank products, and handling of exceptions
- security, confidentiality, data, and privacy protections
- dispute resolution processes
- termination of access processes for a trader, or for a bank

As per the rulebook, we.trade can enroll a new bank upon their satisfaction of agreed criteria in a 'licence and services agreement' made between the parties. In that document, the bank undertakes to include specific 'customer adherence rules' in each 'customer agreement' that it subsequently executes with a new trader that it enrolls to join we.trade. These customer adherence rules bind both bank and trader to accept and adhere to the contents of the rulebook. The bank is additionally responsible for performing all of the know-your-customer (KYC) processes necessary to verify the trader's identity and bona-fides, and for ensuring compliance with all legal and regulatory requirements.

Most central of the rulebook provisions are the explicit commitments that each party makes to accept the processing of smart contracts on we.trade:- that any acceptance submitted in relation to a smart contract is irrevocable, that any subsequent amendment/cancellation to a smart contract requires the approval of all parties as per the process described in the rulebook, and that any bank products included in a smart contract are fully enforceable (we.trade, 2018). The rulebook also describes the procedures of the smart contract lifecycle, including the meaning and the requirements for key smart contract elements such as settlement conditions, delivery terms, payment dates, and expiry date.

A bank or a trader can choose to terminate their participation in we.trade in accordance with the terms of their enrollment agreements. Additionally, trader participation can be terminated by the bank, or bank participation by we.trade, if they contravene specific criteria in their respective enrollment agreements, such as compliance with we.trade or regulatory requirements.

The rulebook specifies the processes for the resolution of disputes between traders (i.e. between a buyer and a seller), or between a buyer or seller and their bank, or between the bank of a buyer and the bank of a seller.

Currently, the majority of the administrative level mechanisms of we.trade are performed 'off-chain', that is by manual processes in accordance with the rulebook. It is believed that we.trade has the intention to automate the operation of as many as possible of the rulebook functions, but there is no specific documentation yet published relating to this.

Equal rights and responsibilities for all participants in we.trade is mandated in the rulebook (we.trade, 2018). No mention of partiality in the treatment of members has been recorded in the press or in interviews.

Power within the we.trade JV is dispersed relatively evenly between the shareholders, with the ownership level ranging from the 2.77% of Deutsch Bank to the 13.63% of Société Générale, and the board of directors comprised of 16 executives from across the 13 shareholders, as of the end of 2021 (Amadeus, 2022). While the chairperson of the we.trade board as of that time is Agnès Joly, also the Head of Innovation and Strategy - Global Transaction Banking for Société Générale (A. Joly, personal communication, December 17, 2021), which is the largest shareholder of the we.trade JV, previous chairpersons have been selected from other consortium banks including HSBC, Nordea, and KBC.

IBM's representative for the we.trade project, Parm Sangha, has stated that banks generally prefer a platform run by a neutral entity, rather than one dominated by another bank, so as to avoid possible bias in the use of platform assets and in the value generated by those assets (P. Sangha, personal communication, October 12, 2021; Wragg, 2020).

Table 6 compares the administrative level mechanisms described in the conceptual model to the phenomena observed in we.trade.

Blockchain Governance Administrative Level Mechanisms		
Conceptual Model Mechanism	Present in we.trade	
Network administrative organization	Yes	• we.trade JV entity established to manage operations under the direction of the consortium
Controls member access	Yes	• Banks and traders must be enrolled and commit to adhere to rulebook • Banks perform KYC on members to verify identity, bona fides, compliance
Controls member behavior	Yes	• Rulebook allows enrollment to be withdrawn for contravening rulebook criteria
Prevents / resolves conflicts	Yes	• Rulebook describes the procedures for dispute resolution

Impartiality towards members	Yes	• Rulebook prescribes equal rights for members • Composition of board of directors and ownership of the we.trade JV prevents domination by one shareholder in particular

Table 6 – Presence of Blockchain Governance Administrative Level Mechanisms in we.trade

4.2.2 Platform level mechanisms

Hypothesis 2 (platform level): There must be a trusted technology infrastructure, in order for members to employ blockchain governance as a substitute for contractual and relational governance

we.trade was developed using the Linux Foundation's Hyperledger Fabric blockchain technology, implemented by IBM on its blockchain platform. Early prototype work in 2016 was based on Ethereum (EU Blockchain Observatory and Forum, 2022), but a subsequent evaluation process decided upon Hyperledger and IBM. That selection process took the we.trade consortium over six months, and was most influenced by stability:- Hyperledger was already then an established technology, and IBM was accepted to have made a long-term commitment to the blockchain field. With we.trade commercially available since January 2019, further extension, testing, and support has also been performed by technical staff of the we.trade JV.

The we.trade user interface layer is a SaaS (Software as a Service) executing on a public cloud from several European data centers. A bank can also arrange an instance to be installed on a data center in a specific location, for example in its country of registration so as to fulfill local regulations (we.trade, 2021). As required by EU financial regulations, each bank ensures ‘strong customer authentication’, for example through the use of multi-factor authentication of approval steps performed by the user during trade creation, acceptance, or amendment.

Each bank is a node deployed on the IBM blockchain platform which is encrypted, which ensures the immutability of the chain data, and which provides tools for transaction monitoring. we.trade uses the Hyperledger Fabric ‘channels’ feature to create a private subnetwork within which only the appropriate members (the buyer, the seller, and their respective banks) have transparent access to the transaction data. Only authorized nodes for the channel process and store the data. A wider set of involved actors – such as logistics providers, adding track and trace capabilities – can store their data anonymously. The blockchain does not contain personal data, and does not store document attachments directly (rather it stores a reference to external file storage). It is noted that the Hyperledger Fabric channel design is often used for permissioned business blockchains, for example in the Tradelens ocean transport network (IBM, 2021b).

Being a permissioned network, we.trade uses the term ‘trust system’ to describe its process for the validation of submitted transactions by assigned nodes per channel (EU Blockchain Observatory and Forum, 2022), rather than the more general term of ‘consensus protocol’ used in permissionless blockchains such as Bitcoin which employ incentive based algorithms.

No mention has been made in interviews with stakeholders, or found in the media in general, of any incident suggesting that we.trade is anything but technically secure and reliable, nor that any transactions have not be processed as expected.

Table 7 compares the platform level mechanisms described in the conceptual model to the phenomena observed in we.trade.

Blockchain Governance Platform Level Mechanisms		
Conceptual Model Mechanism	Present in we.trade	
Monitoring transactions in real-time	Yes	• Via IBM blockchain platform utilizing Hyperledger Fabric
Transaction transparency and access control	Yes	• Via IBM blockchain platform, Hyperledger Fabric 'channel' architecture, and the web user-interface layer
Transactions encrypted and immutable	Yes	• Via IBM blockchain platform utilizing Hyperledger Fabric
Transactions processed as expected	Yes	• No reports found to the contrary
Transaction validation algorithm	Yes	• 'Trust system' of nominated nodes used for validation, on this permissioned network

Table 7 – Presence of Blockchain Governance Platform Level Mechanisms in we.trade

4.3 Application level mechanisms

Hypothesis 3 (application level): There must be smart contracts to automate the processing of transactions and the adherence to rules, in order for members to employ blockchain governance as a substitute for contractual and relational governance

Transactions are processed on we.trade automatically via smart contracts.

The process begins with the buyer or seller using a template on the we.trade user interface to create a smart contract data set with the details of the potential trade, including:

- Buyer and seller information
- Purchase order identifier
- Currency
- Amount
- Buyer's bank and the buyer's bank details
- Seller's bank and the seller's bank details
- Delivery terms
- Payment terms
- Settlement conditions
- Expiry date
- Bank financing products requested (optional)
- If bank financing products are requested, the following elements are required:
    - Total price tolerance
    - Goods or services description
    - Country of origin of any goods included
    - Price (unit price, tax rate, and quantity) of the goods or services

The smart contract data set will be submitted to the other party for approval, and to the banks for approval of any requested financing products. After all parties have given approval, the smart contract data set is transformed into the parameters of the smart contracts which are then generated for the appropriate channel of the we.trade blockchain network.

The logical components of a smart contract on we.trade are shown in Figure 17. Each bank has a node on the blockchain, and each such node has a collection of smart contracts. Each transaction between a buyer and a seller will involve one or more smart contracts comprised of the transaction ruleset (derived from the rulebook), the transaction dataset, and access to necessary real-time event data (such as notifications of quality checks, customs clearances, or deliveries). In combination, these components enable the smart contracts to automate the processing and enforcement of the transaction.

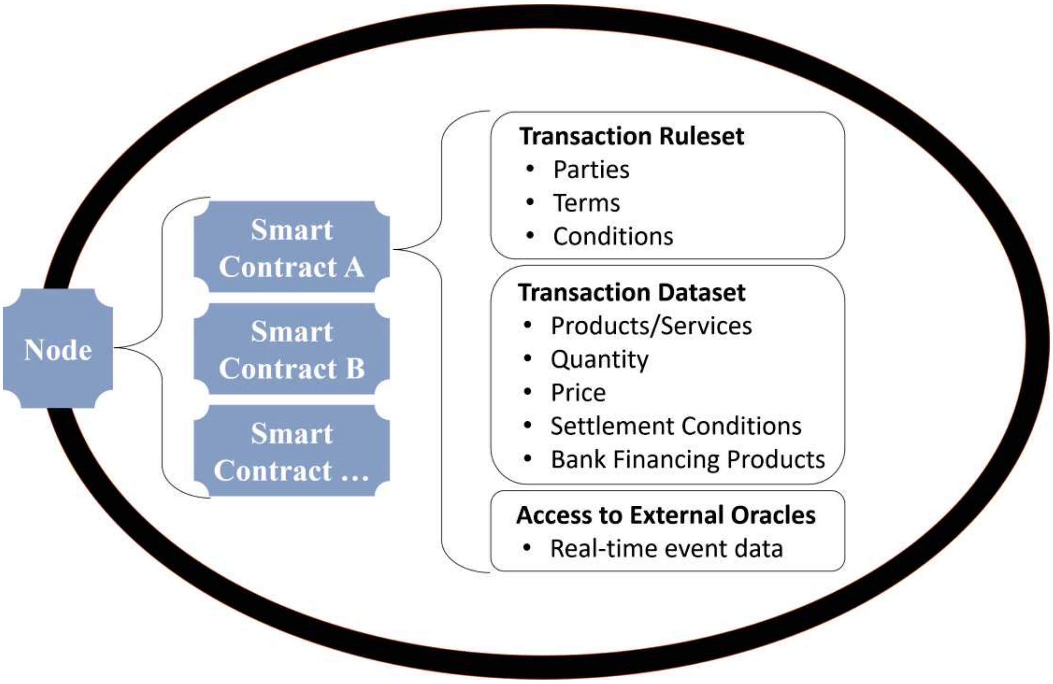


Figure 17 – The components of we.trade smart contracts

A smart contract monitors for notification of a specified settlement condition. Upon detecting such an event, the appropriate transaction processing is triggered and executed automatically, ensuring that the functions agreed of the buyer and seller and their banks are performed. Thus the smart contract automates the processing of the contractual clauses of traditional written contracts.

One such example is an interface from a logistics provider to confirm the movement of goods:- this triggers a related delivery settlement condition, which in turn launches the appropriate payment process. Events which may be agreed between buyer and seller to trigger payment processes include the initial agreement of the trade, the invoice being sent by the seller or accepted by the buyer, and the goods shipment being confirmed by the seller or the goods delivery being confirmed by the buyer. The buyer and the seller, and their banks, will agree together when constructing the transaction whether the payment is to be fully automated, or whether the bank will still control the payment process.

A manager from a we.trade member bank mentioned in an interview that they found that buyers and sellers may sometimes be 'scared' at first of the autonomy and power of smart contracts. However, since we.trade does provide the facility for the cancellation or the amendment of a smart contract at any time before the related settlement condition is reached – upon the approval of all parties, as per the processes outlined in the rulebook – it has been found that the buyers and sellers do come to accept the utility of smart contracts.

During the original we.trade implementation, the consortium banks each provided their own set of solution requirements for their needs, and for the needs of their customers as understood. These were standardized into a form that could then be transformed into smart contract code (which for we.trade is written in the Node.js and Javascript languages (Gnagnarella, 2019) for the chaincode construct of Hyperledger Fabric). The smart contracts of we.trade are intended to be highly modular, meaning that they are divided into components for the performance of specific functions, so as to optimize control over development, maintenance, and deployment processes.

Table 8 compares the application level mechanisms described in the conceptual model to the phenomena observed in we.trade.

Blockchain Governance Application Level Mechanisms		
Conceptual Model Mechanism	Present in we.trade	
Smart Contracts used for contracting	Yes	• After making their initial customer agreement with their bank to codify acceptance of the we.trade rulebook, buyers and sellers can subsequently specify and have processed their transactions wholly via we.trade smart contracts, without the need for traditional written contracts
Smart Contracts used to automate processes	Yes	• Smart contracts scan for events to trigger a specified condition • Upon encountering such an event, the smart contract executes automatically • The process then continues towards the next event
Smart Contracts used to automate payments	Part	• Payment could be made automatically via a smart contract, but generally the bank submits the payment as per their usual process

Blockchain Governance Application Level Mechanisms	
	• Even though such a payment is not fully automated, the bank does perform the payment process exactly in accordance with the notification they receive from the smart contract. There is no method by which the buyer could stop or delay the payment. Thus payment of the transaction is enforced upon the agreed settlement conditions.

Table 8 – Presence of Blockchain Governance Application Level Mechanisms in we.trade

5. Discussion

5.1 Findings

As presented in Table 9, this article finds that the presented hypotheses are supported by observation of the we.trade blockchain network.

Blockchain Delivered Governance	
Hypotheses	Supported by the we.trade case study
1 (administrative level): There must be an acceptable and impartial set of rules governing network and member behavior, in order for	Yes

Blockchain Delivered Governance	
Hypotheses	Supported by the we.trade case study
members to employ blockchain governance as a substitute for contractual and relational governance	
2 (platform level): There must be a trusted technology infrastructure, in order for members to employ blockchain governance as a substitute for contractual and relational governance	Yes
3 (application level): There must be smart contracts to automate the processing of transactions and the adherence to rules, in order for members to employ blockchain governance as a substitute for contractual and relational governance	Yes

Table 9 – Support for the blockchain delivered governance hypotheses

Several key phenomena in particular were observed during this study of we.trade. First, the creation of the we.trade rulebook of governance precepts and procedures, and its inclusion within the enrollment agreements of participating banks and traders, was critical in ensuring a transparent and accepted foundation for the processing and safeguarding of transactions by we.trade.

Second, it was then feasible for this foundation to be implemented as a permissioned blockchain network, utilizing the available blockchain technology to create a platform with the required combination of security and usability.

Finally, upon this platform, smart contracts provide the truly revolutionary element of we.trade, making possible the automation of transaction processing and the enforcement of the we.trade rulebook which provides participants with the safeguards required for them to accept blockchain delivered governance as the substitute for traditional contractual and relational governance.

5.2 Quality of the findings

Yin (2014) described four tests for establishing the quality of case study research. This study has sought to ensure that it satisfies these tests.

First, to provide 'construct validity', data was collected from multiple sources. Interviews were conducted with stakeholders from across the entire we.trade ecosystem:- the consortium banks, other member banks, the we.trade JV, the technology provider IBM, and traders using the network. Information was also gathered from webinars, web sites, press articles, and the rulebook and application guides of we.trade itself. The collected data was triangulated as much as possible in order to maximize the accuracy and relevancy of the findings.

Second, to ensure 'internal validity', all available evidence was considered, and only the available evidence was considered, in order for the observations to be applied against the hypotheses.

Third, for 'external validity', it was concluded that the hypotheses being tested were consistent with the case study subject of we.trade.

Finally, the case study approach described by Yin (2014) has been followed so as to ensure 'reliability' and the reproducibility of results.

5.3 Limitations

While this article can state that the examined hypotheses were found to be true within the bounds of the we.trade case study, this article cannot state that these hypotheses will be true across the entire domain of permissioned business blockchain networks without repeating the test in each instance of the domain (Dul & Hak, 2007). It is noted that had any of the hypotheses been found to be false in the we.trade instance, the hypothesis concerned could then have been removed from further consideration.

5.4 Agenda for further research

A wide range of strategies exists for further testing of these hypotheses.

Most straightforwardly, the same case study design could be applied to similar permissioned business blockchains. While there are few of these in open account trade finance, they exist with a more corporate finance focus (Marco Polo), and in the letter of credit sector (Contour and Komgo), for example. Apart from the trade finance sector, they can be found in other fields, although it must be ensured that the chosen field requires governance over the processing and safeguarding of transactions. Further, while ever more consortiums are being created, it is apparent that not all will survive to maturity.

A longitudinal study of we.trade would be useful in order to observe the continuance of the operation of blockchain delivered governance.

Similar studies of alternate hypotheses subsequently created could provide valuable comparisons between theories.

Finally, quantitative studies could seek to analyze survey responses from the participants of such blockchains. It is noted that such a process was attempted for this study, however sufficient numbers of responses could not be received, despite the cooperation of we.trade JV management.

5.5 Implications for practitioners

Understanding the key components required for blockchain to deliver a structure of governance may allow practitioners to better effect the design and operation of permissioned blockchain business networks. In addition to generating competitive advantage through the optimization of inter-organizational exchanges (Dyer & Singh, 1998), such blockchain networks may become strategic and tactical necessities in sectors such as international trade.

With the scale and scope of trade ever expanding (World Trade Organization, 2020), and with its complexity growing accordingly (International Chamber of Commerce, 2020), digitized governance via blockchain can provide practitioners with the reach and responsiveness lacking in contractual and relational mechanisms (Joskow, 1985; Larson, 1992).

Furthermore, the COVID-19 pandemic and the war in Ukraine provide stern reminders to practitioners that major disruptions to business networks can occur with little warning. While traditional mechanisms may struggle to adapt in the face of such obstacles, blockchain delivered governance can mitigate certain of these effects through its digitization of the trade lifecycle:- from the searching, selection, and verification of partners, to the processing, monitoring, and safeguarding of transactions.

Examination of we.trade through the lens of blockchain delivered governance suggests several priorities in particular for practitioners. Firstly, it was seen that the presence and acceptance of a rulebook, or governance document covering all aspects of the blockchain network operation, has been vital to the effective operation of we.trade. Practitioners can seek to replicate not only this approach, but to go further and to more fully automate the transformation of the rulebook provisions for governance functions such as enrollment, monitoring, dispute resolution, and impartiality into smart contract code which manages the blockchain network autonomously via this ruleset.

In a survey, Deloitte (2020) found that almost half of respondents identified unfairness of governance rules, and poor definition of the duties of membership, as being challenges to their participation in blockchain networks. Whilst we.trade has thus far managed to ensure perceived impartiality between consortium members and amongst its traders, and has minimized the need for dispute resolution, it would regardless be prudent for practitioners to extend ruleset smart contracts so as to systematize impartiality in operations and in dispute resolution, perhaps with the aid of tools such as artificial intelligence.

Secondly, while there is widening acceptance that smart contracts can operate within current contract law frameworks (European Commission, 2020), the central role of smart contracts as substitutes for written contracts in networks such as we.trade should prompt practitioners to improve the usability of these tools. With smart contracts presently taking the form of coded programs, as with the Hyperledger Fabric implementation of we.trade, they are not readily comprehensible to non-technicians. As found in the we.trade study, users may be 'scared' of smart contracts, at least initially. Functionality which would enable both business people and the blockchain to read smart contracts, and which would transform business language directly into smart contract code, could thus greatly benefit smart contract usability and acceptance.

Thirdly, while there are multiple alternative architectures extant for incorporating external 'oracle' feeds into a permissioned blockchain network (IBM, 2019), and while we.trade successfully executes one such method to integrate needed event data such as delivery notifications into its smart contract driven processes, practitioners must recognize oracle integration as a focal point for ensuring network integrity and for assuring participants of process accuracy.

6. Conclusions

It has been seen in this case study that the traders and banks which participate in we.trade place their trust in the blockchain enabled governance delivered via the network, rather than in traditional contractual and relational methods.

Foremost amongst the blockchain governance mechanisms are smart contracts. These execute the transaction dataset in accordance with the applied ruleset and upon encountering the specified external event criteria. The extent to which smart contract code can be generated from a governance agreement, and the extent to which it can autonomously monitor and enforce the governance ruleset in addition to processing the transaction dataset, will be major determinants of the significance of the future role that blockchain plays in facilitating inter-organizational relationships.

Chapter 3. Transforming Trade Finance via Blockchain:- The we.trade Platform

Abstract

Trade finance represents one of the most tangible and the most valuable opportunities for digital transformation within supply chain management. Up to 80% of world merchandise trade involves some degree of trade financing, however traditional processes involve a multitude of inefficiencies due both to the complexity of international trade and the difficulty of companies – particularly SME's – in gaining necessary access to credit. Theory and anecdotal evidence suggest that blockchain has the potential to transform key elements of trade finance:- enabling greater access to services while at the same time reducing the level of risk; addressing needs for more efficient and transparent processes; and providing robust digitization which can mitigate the effects of severe disruptions such as COVID-19. This chapter examines these transformative capabilities of blockchain through their real-world application in the we.trade digital platform for trade finance. Specifically, this case study of we.trade assesses how blockchain can enable the members of a digital platform to optimize their inter-organizational processes, and as a result generate competitive advantage.

1. Introduction

Of the many sectors of supply chain management which offer potential for digital transformation via blockchain technology, trade finance represents one of the most tangible and the most valuable use cases. Theory and anecdotal evidence suggest that blockchain has the potential to transform key elements of the trade finance sector, addressing needs for more transparent and reliable processes, for greater control over risks, and for robustness of process in the face of supply chain disruptions such as COVID-19.

This chapter examines these transformative capabilities of blockchain through their real-world application in the we.trade digital platform for trade finance. Specifically, this case study of we.trade will assess how the use of blockchain can enable the members of a digital platform to optimize their inter-organizational processes, and as a result generate competitive advantages.

2. Background

2.1. Trade Finance

It is estimated that up to 80%, or approximately USD 16 trillion, of merchandise trade depends upon trade finance in some form (International Chamber of Commerce, 2020). Buyers and sellers may use a wide range of instruments and terms to facilitate trade, including loans, guarantees, and the factoring or financing of receivables and inventories. They may engage various intermediaries such as banks, financial institutions and service providers to do so (International Chamber of Commerce, 2020).

Trade can typically be categorized as being either documentary (via letters of credit), or open account (payment after delivery), in nature. Although the letter of credit instrument provides greater control over the process, these are costly and time consuming to execute. For this reason open account trade has been growing at a faster rate worldwide (International Chamber of Commerce, 2020). However, the use of open account trade makes more challenging the optimization of cash flow and the mitigation of the risk of payment not being received, and strains the resources of small-and-medium sized enterprises (SMEs) in particular. Combined with the lack of visibility and the possibility of fraud due to paper-based processes, and the varying degrees of trust present between trading partners, there is great need for reliable trade and trade finance processes.

Gaining access to trade finance can be a major issue at any time for SMEs, with approximately 65 million SMEs being credit constrained and rejection rates for credit applications running at 40% (McKinsey et al., 2021). In times of international crisis, such as the COVID-19 pandemic, the need for trade finance can become critical. Due largely to the greater perceived risk, the availability of credit is reduced while the cost of credit increases. In particular, less open account credit is forthcoming from trading partners and less financing available from financial intermediaries (Menichini, 2011), while the necessary trade credit insurance coverage becomes more expensive and more difficult to secure (Deckert, 2020).

2.2. Blockchain in a business context

Blockchain technology is comprised of several unique components, and the most important of these from a business perspective may be its decentralization design, the enhanced security it provides, and the 'smart contracts' that it enables. Blockchain allows transactions to be submitted and validated by appointed nodes across a distributed database and network. New data is appended to previous data such that the chain of data is practically immutable (that is, any attempted tampering would be detected), and all data is secured via encryption (Dhar & Stein, 2017; Glaser, 2017). Smart contracts can automate the processing of transactions upon being triggered by predefined criteria.

The vast majority of business blockchains are permissioned (that is, private) in nature. In this design, an authority representing the group or consortium which operates the blockchain will control which entities can join, transact, and endorse (that is, validate) transactions on the blockchain. Typically, this will include digital management of the identity of the members, and off-blockchain contracts detailing rights and responsibilities. This is very different to those permissionless (that is, public) blockchains such as Bitcoin, where is no central controlling body and where the network manages itself independently. While the nodes allowed to submit transactions and those responsible for endorsing transactions on a permissioned blockchain are appointed by the controlling authority, on a permissionless blockchain any node can submit transactions and any node can endorse the transaction if it ‘wins’ the right to do so (for example, by ‘mining’ on Bitcoin).

2.3. Business networks as digital platforms

A digital platform can be thought of as a two-sided or multi-sided market which electronically connects buyers and sellers and intermediaries within a network (Rochet & Tirole, 2004). As the number of buyers and sellers on the platform increases, the ecosystem grows in usefulness and value for its members. This is the network effect (Katz & Shapiro, 1994), which represents a virtuous circle of ever-extending mutual benefits for members (Gawer, 2014).

Digitization enables processes to be performed independent of location, removes the need for the holding of physical assets, and allows the creation of a powerful platform ecosystem within which supplementary service providers can participate and add value (Constantinides et al., 2018; Dhanaraj & Parkhe, 2006). Digital platforms can therefore provide a structure through which participants can seek to optimize their inter-organizational connections.

With the relational view of Dyer and Singh (1998) this can be taken further. The relational view – rather than focus on industry forces (Porter, 1980), or on firm-specific factors (Rumelt, 1984; Wernerfelt, 1984) – extends the area of analysis into the business networks within which the organization participates, and suggests that optimizing their inter-organizational processes can represent a method by which organizations can generate competitive advantages.

2.4. Blockchain enabled digital platforms

How can a blockchain enabled digital platform achieve the objective of optimizing inter-organizational processes and generating competitive advantages for its members? It is suggested that a structure comprising the following elements acting in concert is required (Petersen, 2022):

1. At an administrative level, there must be an acceptable and impartial set of rules governing the platform and member behavior
2. At the infrastructure level, the blockchain must be technically secure and reliably governed
3. At the application level, the blockchain must use smart contracts to automatically process transactions, and to govern adherence to the trade terms and conditions agreed between the parties

we.trade is one of the relatively few digital platforms in operation which utilizes blockchain technology to provide a complete end-to-end ecosystem, in this case with the purpose of facilitating trade transactions and trade finance. This chapter will examine we.trade according to the criteria outlined above.

3. we.trade – A blockchain trade finance platform

3.1. Development

The origins of we.trade date from 2015, when the then-head of trade finance at Belgian bank KBC, Hubert Benoot, upon being introduced to blockchain technology by the KBC IT department, recalled an event from two to three years before that. At a round table held for SME customers, a potato farmer had been asked why he didn't export his produce outside of Belgium. The farmer had responded that it was too risky: when he didn't know a potential new customer, how could he trust that partner, and how could he be sure that he would get paid? (H. Benoot, personal communication, December 20, 2021; P. Sangha, personal communication, October 12, 2021).

Benoot connected the need for providing trust throughout the trade process with the new blockchain technology, and the journey was begun. Several European banks were approached with a suggestion of collaboration, and a digital platform was envisioned as an end-to-end ecosystem to connect buyers, sellers, and service providers (especially the banks involved, but also including insurers, logistics organizations, and other entities). The platform would simplify the trading process, reduce risk by integrating participants and automating transactions, and enable the banks to offer any required financial services (IBM, 2021a).

From the perspective of the banks, we.trade would allow them to sell new financial products to the previously under-serviced market of companies engaged in open-account trading, without compromising their existing profitable letter of credit business. It has been estimated by we.trade that over 95% of intra-Europe trade is based upon open-account processes, and that this rises to 99% when considering only SMEs (Gnagnarella, 2019). While expanding the volume of trade facilitated, the we.trade platform would also eliminate much of the risk inherent in open-account trade for all parties.

The banks agreed to cooperate on a proof of concept called the Digital Trade Chain, which was completed in 2016. A consortium of shareholder banks was formally established with seven initial members in 2017, with two additional banks joining later in 2017, and with a further three banks joining in 2019 upon the folding of the Batavia trade finance consortium. Meanwhile the next generation of we.trade platform was designed. While the model can be said to be bank-centric in that the platform was led and funded by the consortium of banks, the needs of the buyers and sellers were encompassed in the design, and service providers were intended to play an essential part. Indeed, both IBM and CRIF (a credit information provider) have both subsequently also become we.trade shareholders. The participants of the we.trade platform are presented in Figure 18.

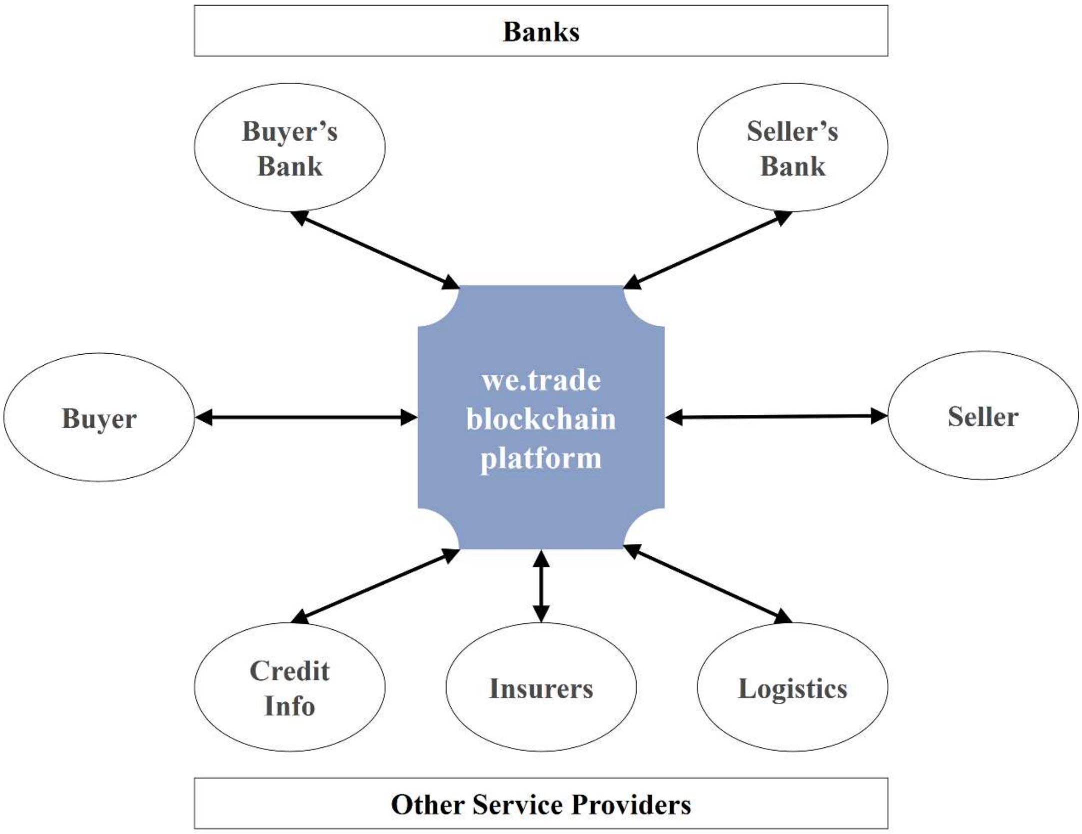


Figure 18 – The we.trade Platform

The we.trade joint venture (JV) company was registered in Ireland in 2018, a location which was considered certain to remain within the EU, and which offered a favorable environment for IT startups. A beta version of we.trade was produced in 2018, and the we.trade platform was formally launched in 2019. The timeline for the development of we.trade is shown in Table 10.

2015		Idea formed
2016		Proof of concept is created called “Digital Trade Chain”
2017	Q1	we.trade consortium is formed with initial members (Deutsche Bank, HSBC, KBC, Natixis, Rabobank, Société Générale, UniCredit)
	Q4	More banks join the we.trade consortium (Nordea, Santander)
2018	Q2	Rulebook is established to provide governance
	Q3	Joint venture company is established in Ireland
	Q4	First live transaction is processed
2019	Q1	Commercial launch of we.trade
	Q1	Batavia consortium folds and its member banks join we.trade (Caxia, Erste, UBS)
2020	Q2	IBM becomes a shareholder
	Q3	Additional banks become licensees (not shareholders)
	Q4	Capital is injected by shareholders
2021	Q1	CRIF (credit information provider) becomes a shareholder
	Q1	Major platform upgrade is released
	Q1	First phase of ERP integration is released
	Q4	First non-EU bank joins we.trade (Akbank of Turkey)

Table 10 – we.trade Timeline

As of January 2022, the we.trade platform provides extensive coverage across Europe, including the shareholder banks Caixa (Spain), Deutsche Bank (Germany), Erste (Austria), HSBC (UK), KBC (Belgium), Natixis (France), Nordea (Scandinavia), Rabobank (Netherlands), Santander (Spain), Société Générale (France), UBS (Switzerland), and

UniCredit (Italy), and the non-shareholder banks Akbank (Turkey), CBC (Belgium), Eurobank (Greece), UniCredit (Germany), and ČSOB, Komerční Banka and Česká Spořitelna (Czech Republic). To date agreement has been maintained between the shareholder banks and non-shareholder banks over the benefits which may accrue from shareholding. This might be as expected at the current stage in the development of we.trade, at which it is requiring continued investment, rather than providing returns. This accord between stakeholders may be more challenging to achieve in future stages if and when the investment/return balance changes. The banks which participate on the platform contribute a license fee for the right to do so.

The consortium which controls we.trade today is comprised of its shareholder banks, and shareholder service providers IBM and CRIF. Together these organizations own the shares of the we.trade JV, and nominate executives to its board of directors. As of the start of 2022, the chairperson of the board of we.trade is Agnès Joly, who is also Head of Innovation and Strategy - Global Transaction Banking for Société Générale.

The role of the we.trade consortium is to set and to monitor the direction and rules of the platform, while the role of the we.trade JV is to provide and operate the platform itself. Communication with the trading companies who buy and sell on the platform is performed by the participating banks, rather than by the we.trade JV. Currently, the we.trade JV does not have a CEO or General Manager, and is led by its CTO, Mark Cudden (Wragg, 2021).

Since its commercial launch in 2019, we.trade has steadily increased its membership. At the end of 2021, we.trade published the transaction volumes (we.trade, 2022) presented in Table 11.

Metric	Measure

Number of Participating Companies	400
Number of Transactions Performed to Date	1,500
Value of Transactions Performed to Date	EUR 120 million
Increase in Transactions 2021 over 2020	104%

Table 11 – we.trade Volume as of the end of 2021

3.2. Trade Finance on we.trade

While a large number of digital platforms have been created to address the needs of the trade finance sector, these differ in their approaches. As of 2021 for example, Contour and Komgo focus on the letter of credit process, Marco Polo on corporate finance, and eTradeConnect upon documentation flows (OECD, 2021).

The we.trade platform is directed to open account trade. While we.trade does not exclusively target SMEs, given the limited resources of this type of organization, the SME has the greatest need for trade finance solutions in open account trade. The major steps of this process when conducted on we.trade (we.trade, 2019) are summarized in Figure 19.

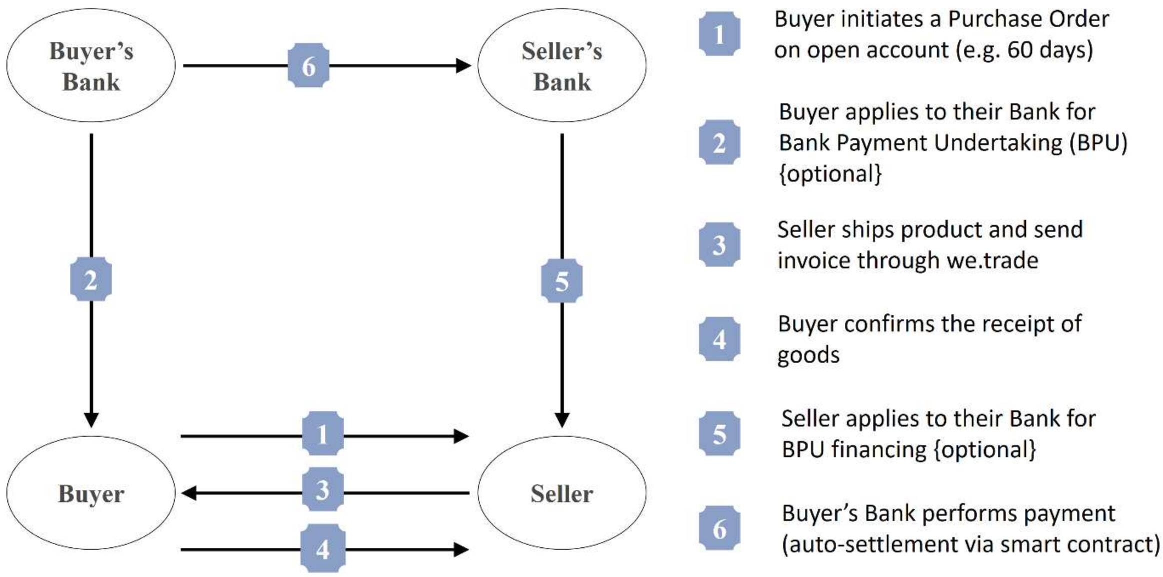


Figure 19 – The we.trade Process

While the standard trading steps of purchase order creation (step 1), seller shipment (step 3), and buyer receiving (step 4) certainly exist in this process, the unique aspects of we.trade can be seen in the steps for the optional new banking products of Bank Payment Undertaking (BPU) (step 2) and BPU Financing (step 5), and the auto-settlement via smart contract of the payment to be made by the buyer's bank (step 6). These key elements on the we.trade process for trade finance are further described below (we.trade, 2018).

Bank Payment Undertaking (BPU): Typically at the seller's request, the buyer can apply for a BPU from their bank, and if their bank accepts, then that bank will guarantee to make the required payment directly to the seller's bank, upon the satisfaction of the settlement conditions as determined by a smart contract. Thus when the buyer arranges a BPU, the seller is guaranteed to receive payment once the settlement conditions are met. In return for this lower risk, the seller may grant the buyer preferential terms, such as longer payment terms, which would in turn help their cash flow.

The BPU is the we.trade extension of the Bank Payment Obligation (BPO) standard for the exchange of electronic documentation which was introduced by the International Chamber of Commerce in 2013 (OECD, 2021), with we.trade introducing the capability of automated settlement of the payment process enabled via smart contract.

BPU Financing: If the seller requires additional cash flow support within the period before receiving the payment from the buyer, the seller can apply to their bank for financing, using the BPU as a negotiable instrument.

Auto-Settlement: If a smart contract determines that a predefined settlement condition has been met (e.g. the goods have been delivered), then the buyer's bank will process the payment to the seller's bank. This payment may be fully automated if agreed in advanced by all parties.

The trade finance process on we.trade is highly automated and is based upon event triggers controlled by smart contracts. Upon any of the steps in the we.trade process occurring, a notification is sent to each involved party in real time, and the data is written to the we.trade blockchain.

3.3. Buyers & Sellers on we.trade

According to a breakdown of we.trade members by sector in 2020, 46% of members were from industrial/manufacturing, 40% from clothing and apparel, and 5% from foods (Morris, 2020). Published reports have referenced the companies listed in Table 12 – we.trade Members as we.trade members (Hyperledger Foundation, 2020; IBM, 2021a; Ledger Insights, 2020; Morris, 2020; Rao, 2019; Wragg, 2020).

Member	Country	Industry	Bank
Actherm	Czech Republic	Steel	CSOB

Ekoï	France	Durables	Société Générale
Flattered	Sweden	Footwear	Nordea
Fluid Pumps	UK	Industrial	HSBC
Polimer Tecnic	Spain	Plastics	Caixa

Table 12 – we.trade Members

An illustrative member of the we.trade platform is Ekoï, a French company providing clothing and accessories for cyclists worldwide. According to an interview with Ekoï management in late 2021, they use we.trade for all transactions with four of their Italian suppliers who are also on we.trade, and had completed over 50 transactions in the prior two months. Since the order cycle for their products is relatively long, and the quantities large, Ekoï values the we.trade platform for facilitating communication between themselves and the sellers at each stage of the process, together with the fact that all information is assured to be complete and transparent. Ekoï management stated that they will ask all new suppliers to join we.trade if possible.

Ekoï financial management also expressed appreciation for the financial products available on we.trade as being much simpler and less expensive than letters of credit. The use of a BPU allows sellers to extend payment terms, providing time for the buyer to sell most of the delivered products in that period. The sellers meanwhile could request BPU Financing as required, and receive confirmation of that facility almost immediately.

3.4. How blockchain enables the we.trade platform

This section examines how blockchain enables the we.trade platform via a structure comprising three levels of governance: application level mechanisms which specify the rules by which the network and its members interact, infrastructure level mechanisms which provide the core blockchain functionality, and application level mechanisms by which smart contracts automate processing and enforcement (Petersen, 2022).

3.4.1. Administrative level mechanisms

It has been proposed that for a platform to be effectively enabled by a blockchain-driven governance structure, at the administrative level there must be an acceptable and impartial set of rules governing the network and member behavior in order for members to be willing to participate (Petersen, 2022). Can this be said to be present at we.trade?

Before being commercially launched in January 2019, the we.trade consortium designed and implemented a common framework to govern platform operations, which it called its rulebook. The rulebook was based upon English trade laws (Hyperledger Foundation, 2020), perhaps reflecting the significant role of HSBC in its creation (Blockchain Ireland, 2021).

Each of the banks, buyers and sellers using we.trade must commit to adhere to the provisions of the rulebook (we.trade, 2018), which include the specification of:

- the rights and responsibilities of the parties
- the enrollment processes for a bank, buyer, or seller
- the operation of platform services, and handling of exceptions
- the operation of bank products, and handling of exceptions
- security, confidentiality, data protection, and privacy
- termination of access of a buyer, seller, or bank
- dispute resolution processes, between buyer and seller, or with a bank, or between banks

As per the rulebook, new banks can be added to we.trade with the agreement of the board representing the consortium. New buyers and sellers are introduced to the platform by one of the participating banks, and that bank is then responsible for performing the know-your-customer (KYC) processes required to verify the company's bona-fides.

Perhaps most importantly of all the provisions of the rulebook, each member explicitly agrees to accept the results of the processing of any smart contract created on the we.trade platform (we.trade, 2018).

The general manager of we.trade in the year following the creation of the rulebook, Ciaran McGowan, was quoted as saying that establishing the governance rulebook took more time than the technical building of the platform itself (Morris, 2020).

With the board of the we.trade JV comprised of representatives from across the shareholder companies, no single shareholder has a significantly larger say than another, and this has helped to avert suggestions of impartiality between the banks (Wragg, 2021). Furthermore, the rulebook specifies that all participants will have equal rights and responsibilities (we.trade, 2018).

IBM's representative involved in the we.trade project, Parm Sangha, mentioned in an interview and in the press that, in general, banks prefer a platform run by a neutral entity, rather than join one dominated by another bank, in order to avoid the possibility of bias in the use of platform assets and in the value derived from those assets (P. Sangha, personal communication, October 12, 2021; Wragg, 2020). Neither do the most recent additions to the shareholding consortium, IBM and CRIF, hold any greater control than any of the other consortium members.

From interviews with stakeholders and a review of relevant media, there does indeed appear to be an acceptable and impartial set of rules governing the we.trade platform and its members.

3.4.2. Infrastructure level mechanisms

It has been proposed that for a platform to be effectively enabled by a blockchain-driven governance structure, at the infrastructure level members must be assured that the technology is secure and reliably governed in order to place their trust in it (Petersen, 2022). Can this be said to be the case at we.trade?

we.trade utilizes the Linux Foundation's Hyperledger Fabric as its blockchain technology, with the infrastructure and initial solution implemented by IBM on its blockchain platform. The selection of Hyperledger and IBM took the we.trade consortium over six months, and was greatly influenced by the stability both of Hyperledger (already an established technology at that time) and of IBM (which was expected to continue in the blockchain business line for the long term). Further extension, testing, and support has also been performed by we.trade JV technical staff.

The we.trade web interface layer is deployed as a SaaS (Software as a Service) public cloud service from several European data centers, with the additional option for a bank to have an instance installed on a data center in any location, for example if so required by local country regulations (we.trade, 2021).

For blockchain functions, we.trade uses the 'channels' feature in Hyperledger Fabric to form a private network within which transactions are only shared with the members of that channel. Each bank is a node on the network. Data sent to a channel is only present on authorized nodes, and nodes only store the data of the channels to which they are authorized. The detailed data for a trade transaction is uploaded to a channel used only by the buyer, the seller, and their respective banks. Track and trace data can be kept anonymously for a wider set of involved parties. The blockchain does not contain personal data, and neither does it hold document attachments directly, rather it stores a reference to external file storage. It is noted that this channels design is often used in permissioned business oriented blockchain networks which utilize Hyperledger Fabric, for example in the Tradelens network for the management of sea transport (IBM, 2021b).

Most importantly, each member of we.trade has confirmed with their acceptance of the rulebook that transactions created on the we.trade platform are fully enforceable, and that communications sent through the we.trade platform are equivalent to those in written form (we.trade, 2018).

It does appear that the we.trade platform is technically secure and reliable, and there has been no mention in interviews with stakeholders or in the media of any incident suggesting the contrary.

3.4.3. Application level mechanisms

It has been proposed that for a platform to be effectively enabled by a blockchain-driven governance structure, at the application level smart contracts must automate the processing of transactions and must govern adherence to the trade terms and conditions agreed between the parties (Petersen, 2022). Can this be said to be the case at we.trade?

In contrast to the physical document checks which drive the letter of credit process, transactions on we.trade are processed automatically through smart contracts. During the initial we.trade implementation, each of the consortium banks provided their business requirements, and these were standardized into a form that could be further rendered into smart contract code. The smart contracts are highly modular, in that they are divided into components to perform specific functions, and thus can be individually managed. The smart contract code ultimately deployed to run on the blockchain is written in Node.js and Javascript (Gnagnarella, 2019).

Transactions created for we.trade utilize smart contract data sets (that is, templates), which reflect the rules and criteria pre-agreed between the parties. Once the smart contract data set is agreed between the buyer and the seller, and their banks (if financing products have been requested), the smart contract is generated on the we.trade platform. The smart contract will then scan for notification of the relevant settlement conditions. When such an event is detected, this will trigger the appropriate transaction processing, ensuring that the buyer and seller and their banks perform their respective responsibilities. Thus the smart contract can automate the processing of the contractual clauses of traditional written contracts.

For example, an interface from a third-party transporter to confirm goods movement can trigger the delivery settlement condition, which can then launch the appropriate payment process. Other triggers which may be used to trigger payment processes include the initial agreement of the trade terms, the invoice being sent by the seller, the invoice being accepted by the buyer, the goods shipment confirmed by seller, and goods delivery confirmed by buyer. It should be noted that the buyer and seller, and their banks, will agree together when constructing the transaction whether the payment is to be fully automated, or whether the bank will still control the payment process.

The representative of a we.trade member bank mentioned in an interview that their buyers and sellers were at first sometimes 'scared' of the power of smart contracts. However, since these can be modified – with the approval of all parties – on the we.trade platform at any time before the relevant settlement condition is reached, the buyers and sellers subsequently became receptive to the use of smart contracts.

A we.trade smart contract data set will contain the following mandatory information:

- Buyer and seller details
- Purchase order reference

- Currency
- Amount
- Total price tolerance
- Buyer’s bank and the buyer’s bank account
- Seller’s bank and the seller’s bank account
- Delivery terms
- Payment terms
- Settlement conditions
- Expiry date

Where a bank financing product is selected, it will also contain this information:

- the goods or services involved
- the country of origin of any goods involved
- the price information (unit price, tax rate and quantity) of the goods or services

Smart contracts are indeed the core component of the we.trade platform, facilitating the automation of transaction processing and enforcement, and making possible the enhancements to competitive advantage that buyers, sellers, and banks can derive from participation in the we.trade platform.

3.5. we.trade enabled competitive advantage

What are these prospective enhancements to competitive advantage for members?

According to interviews and media articles, feedback from buyers and sellers on the use of we.trade has been positive, with the value derived from membership in the platform found to be greater than expected. This value primarily results from the ability of we.trade to facilitate improved liquidity while reducing risk and enabling gains in efficiency, transparency, and security. These benefits as reported by buyers and sellers and their banks are further described in Table 13 (Hyperledger Foundation, 2020; IBM, 2021a; Ledger Insights, 2020; M. Lopez, personal communication, December 28, 2021; Morris, 2020; T. Perger, personal communication, March 12, 2021; PYMNTS, 2018; Rao, 2019; Wragg, 2020).

Type	Benefit	Description
Greater Liquidity & Lower Risk	When there is no Letter of Credit	When it is not feasible to utilize a letter of credit, the we.trade platform can enhance the security and effectiveness of open account trade between buyer and seller. A letter of credit may be too expensive for an SME to afford, and may be too slow to process, for example when transport is made via ground within Europe.
	Enhanced Cash Flow	Buyers and sellers have enhanced access to the trade finance instruments offered by the banks on we.trade which can address cash flow needs. For example, the seller can use BPU Financing to receive payment earlier.
	When there is no Credit Insurance	When the limit for credit insurance has been reached, the added security provided by the we.trade platform may convince insurers to raise their limits, while at the same time the

Type	Benefit	Description
		reduced amount of open receivables can reduce the amount of insurance required.
	Less Risk of Late Payment	Risk and impact to the seller of late payment is eliminated if the buyer arranges a BPU.
	Less Need for Prepayment	The seller may relax requirements for prepayment of contract amounts if the payment is guaranteed by the buyer's bank as a BPU.
	Extended Terms	The seller may grant the buyer other favorable terms, such as a longer payment period, if the payment is guaranteed by the buyer's bank.
	Automatic Settlement	Agreed settlement conditions between buyer and seller are automatically processed by the appropriate smart contracts upon encountering the relevant event triggers.
Efficiency	Streamlined Partnership Process	Buyers and sellers can safely establish their relationship digitally, with corroboration performed by their respective banks, while minimizing the need for onsite communications.

Type	Benefit	Description
	Speed of Creation	The transaction can be created quickly between buyer and seller, and since any requests for financial products are now digital, they can also be processed by the respective bank much faster than was previously possible.
	Speed of Processing	Feedback on process events (e.g. a problem in delivery) is fast and online, with over 400 logistics providers on the we.trade platform.
	Paperless	The digital platform eliminates manual interventions, reducing the time and cost of processes, and removing opportunities for fraud.
Transparency	Manageability	Online visibility of process flows enables more effective management of the supply chain.
	Trust	Buyers and sellers can trust the we.trade platform and its mechanisms, whilst previously they may not have been able to trust each other.
	Reputation	Buyers and sellers have reported reputational benefits of credit worthiness and reliability

Type	Benefit	Description
		arising from their membership on the we.trade platform.
	Immutability	Immutable supply chain transaction data would simplify the resolution of any disputes that could arise.
Security	Network	As a permissioned, private blockchain, the we.trade platform is secure against unauthorized access and manipulation.
	Identity	The bona fides of buyers and sellers are assured by the KYC processes performed by their banks during the onboarding process.
	Transaction	Verifiability of supply chain transaction data provides protection against fictitious orders, invoices, and payment requests.

Table 13 – we.trade Benefits

Benefits for the participating banks correspond to the benefits to the buyers and sellers. The banks generate additional revenue streams with these new financing products for open account trade, and enjoy faster trade cycles, lower transaction costs, and lower risk of fraud due to efficient processing on the digital platform, with manual processes, paper documents, and the need for physical meetings minimized or eliminated.

The great majority of transactions (95%) on we.trade utilize BPU (we.trade, 2022), to the reported mutual benefit of all parties to the transaction, the buyer, the seller, and their banks.

3.6. The impact of COVID-19

The COVID-19 pandemic seriously impacted world trade, both operationally via border closures and quarantines, and financially through potential debt defaults and difficulties in receiving credit and insurance. A vicious circle began in which ever worsening company results made it ever harder for companies to be granted that credit and insurance. Many buyers and sellers were forced to find new trading partners, a task made even more difficult and risky by the restrictions on travel. With business processes in flux, new dangers arose from fraud.

Interviews with we.trade banks, buyers, and sellers suggest that the digital transformation enabled by we.trade became even more valuable to its members because of its role in mitigating the effects of COVID-19. The we.trade platform ensures that members have been properly vetted by their bank, the BPU instrument can mitigate the payment risk to sellers associated especially with new buyers, BPU Financing can overcome constraints on liquidity for sellers, and these factors can encourage sellers to be flexible in the terms they offer to buyers.

With traditional channels of communication and processes disrupted, the benefits of digital operations rapidly became apparent. David McLoughlin, Head of Commercialisation at we.trade in the first year of the COVID-19 epidemic, said that COVID-19, rather than inhibiting the move towards digital transformation, was in fact acting as a "catalyst" for it: "with COVID-19, the digitisation of trade and trade finance is now no longer a luxury, but a must" (Basquill, 2020). This finding was confirmed during interviews with we.trade banks, buyers, and sellers, in which it was suggested that even conservative companies traditionally resistant to change were becoming willing to move to a digital platform.

Meanwhile, SMEs in certain countries and industries have been receiving various forms of government financial support. It was mentioned by we.trade member banks in interviews that as such support concludes, the need for products such as we.trade's BPU and BPU Financing would become still greater.

3.7. Challenges

As a digital platform, we.trade must ensure that its ecosystem includes at least enough banks, buyers, and sellers, and generates at least enough transactions, to make the network viable in terms of the level of usefulness and value it provides its members. Only with such viability can the other important aspects of network effectiveness – such as the number, frequency, and size of connections, engagements, and relationships with existing and/or new partners – be meaningful.

In May 2020, the general manager of the we.trade JV gave a target of 25,000 users and 2.5 million transactions within three to four years (Ledger Insights, 2020). With the volumes at the end of 2021 reported earlier in this chapter representing but a small fraction of these figures, it is not yet certain that we.trade can accumulate the needed scale. Without this, buyers and sellers may gravitate towards other digital solutions, and the banks may invest in those other business priorities which are in competition for management attention and resources.

The typical barriers to diffusion of blockchain solutions such as lack of knowledge and expertise (Helliar et al., 2020) appear to be less of an obstacle in the case of we.trade, where the solution is promoted by the banks of the target users, that is, the buyers and sellers. So what challenges are constraining the growth of the we.trade platform?

As a multi-sided platform in which all participants must be members, we.trade is more susceptible to the network effect than are other platforms which do not require this (such as the Marco Polo platform). It can be said that we.trade has been suffering from the 'the-chicken-and-the-egg' dilemma:- buyers want sellers to be in place, and sellers want buyers to be in place, before either will agree to join the platform.

The country in which we.trade has the highest level of coverage of the trade sector is the Czech Republic. Whilst other countries have only one or two member banks each on the we.trade platform (and with these accounting for a minority of total trade in each country), the Czech Republic has three banks (ČSOB, Komerční Banka and Česká Spořitelna) which together serve approximately 80% of Czech companies engaging in trade (Morris, 2020). This high level of coverage allows we.trade in the Czech Republic to perform even domestic trades. It will be instructive to trace the future development of we.trade in the Czech Republic in order to determine to what extent the number of banks and the trade coverage should be expanded in all markets. It should be noted that the banks in different markets will have varying reactions to the addition of national competitors to the we.trade platform.

While the onboarding process for new buyers and sellers to join we.trade is relatively fast, especially for the banks' existing customers, the onboarding process for new member banks is resource-intensive, involving numerous internal and external processes. Banks are by nature relatively conservative and understandably careful with their processes, and must assign resources between a large number of competing projects. These factors – the costs of affiliation as described by Loux et al. (2020) – may represent a deterrent to new banks joining the we.trade platform.

In interviews, bank executives have acknowledged that adoption time is especially slow in the case of disruptive technologies. One bank representative stated that to convince the relationship managers in his own bank (who would propose we.trade to the bank's customers) of the value of the platform was a major challenge in itself. The significant effort required to on-board new banks onto we.trade (said in interviews conducted with bank executives to take at least one year, and up two years in the case of Akbank of Turkey) may then represent a significant constraining factor for the growth of we.trade.

A constraint affecting growth in the number of buyers and sellers may be the difficulty of expanding the scope of we.trade beyond Europe. While member buyers and sellers have expressed in the press and in interviews the desire to transact with partners in Asia and South America (Nordea Bank, 2018), we.trade has not yet published a timeline for the implementation of the complex process and governance changes needed to achieve this.

4. Conclusions

we.trade is an efficient, transparent, and secure digital platform that transforms the trade finance cycle for open account trade. The we.trade platform is enabled by a blockchain-driven governance structure of administrative, infrastructure, and application level mechanisms so as to coordinate and safeguard transactions which have traditionally been regulated manually via written contracts and social structures.

When the buyer and seller define their transaction on we.trade, they include the data set needed for generation of the relevant smart contracts, such as the goods/services description, pricing, delivery terms, payment terms, and the settlement conditions. The smart contracts then automatically process and enforce the parameters of the trade upon encountering the specified event triggers. Thus, the buyers, sellers, and their banks now place system-level trust (Hosmer, 1995) in the we.trade platform, replacing the need for trust in specific contracts or individuals.

This is a practical example of recent theoretical views of blockchain as a "new institutional technology that makes possible new types of contracts and organizations" (MacDonald et al., 2016) by possessing in itself the capability for the autonomous execution and enforcement of agreements between parties (Lumineau et al., 2021).

With the we.trade platform enabled by blockchain, its members can optimize their inter-organizational processes. This allows participating banks to create opportunities for enhancing competitive advantage via new and efficient revenue-generating services for the open account trade, while buyers and sellers can enhance their prospective competitive advantages as a result of their improved liquidity, reduced levels of risk, and greater efficiency in their trade processes. The digital transformation delivered by the we.trade platform has also helped to alleviate several of the serious barriers posed to trade by the COVID-19 epidemic. The major challenge now facing we.trade is to ensure that it reaches a viable scale of membership and of transactions.

Part D. Conclusion

I. Summary of Results

This thesis found support in the empirical we.trade case study for the hypotheses examined in Table 9 in Part C. Chapter 2 - which in turn were operationalized from the conceptual propositions outlined in Part C. Chapter 1.

From these hypotheses, this thesis concludes that:

4. A **blockchain governance structure** will be composed of multiple mutually-reinforcing levels, each of which requires the presence and effectiveness of specific mechanisms, and which in concert can allow blockchain delivered governance to function as a substitute for traditional contractual and relational forms of governance.
5. At the **administrative level**, a cohesive combination of on-chain and off-chain mechanisms must define and manage member access and behavior, and provide procedures to prevent and resolve between members and with the network. The network must be managed with impartiality, and be seen to be thus by the network participants. In the we.trade case, a representative consortium of stakeholders was formed, and this authority was responsible for the development of a rulebook to prescribe the process for transaction processing within the network.
6. At the **platform level**, the technology infrastructure must be trusted by the network participants to provide a secure – yet transparent, for the appropriate parties – ecosystem for transaction processing. In the we.trade case, the network was organized into channels linking buyers and sellers and their banks, and was continuously monitored for validity.

7. At the **application level**, smart contracts must automate the processing of transactions and the adherence to network rules. Smart contracts monitor for specified transaction events, and upon encountering such an event, automate the prescribed execution of the related actions. In the we.trade case, all details of the buyer-seller transaction are encoded in the datasets of the smart contracts, together with the relevant provisions of the rulebook. These form the basis of the subsequent automatic processing of transactions and the automated enforcement of the agreed terms and conditions within the we.trade network. As a result, written contracts are not required for the governance of transactions within we.trade.

Smart contracts represent the most revolutionary component of the blockchain governance structure, and the extent to which smart contracts can automate the process of agreement, execution, settlement, and safeguarding of transactions will be the greatest determinant of the value that the blockchain governance structure can provide to its participants.

As found in the we.trade case study, the administrative, platform, and application level mechanisms must be sufficiently effective in the processing and safeguarding of transactions so as to enable network participants to place system-level trust in the blockchain governance structure, rather than rely on the traditional contractual and relational methods.

In conclusion, this thesis posits that the emergence of blockchain technology now provides the means by which automation of the specification, validation, and enforcement of private ordering between exchange participants can be achieved, and suggests that this should stimulate a reevaluation of the existing theory and practice of inter-organizational governance.

II. Research Question Addressed

From the conclusions reached in the previous section, the research question of this thesis – namely, can the utilization of Blockchain Enhance the Governance of Business Networks and the Generation of Inter-Firm Competitive Advantage? – can be answered in the affirmative.

As theorized in Part C. Chapter 1 and as demonstrated in Part C. Chapter 2 of this thesis, the utilization of a blockchain governance structure of administrative, platform, and application level mechanisms can indeed enhance the governance of a business network:- by automating the performance of the necessary governance roles of coordination, safeguarding against environmental uncertainty, bounded rationality, and opportunistic behavior, and monitoring, conflict resolution, and the application of sanctions. The proof of this enhancement is that the blockchain governance structure, as shown in the case of we.trade, can substitute in full for the traditional methods of contractual and relational governance in the processing and safeguarding of buy/sell transactions.

Further, as demonstrated in Part C. Chapter 3 of this thesis, in addition to the efficiencies generated via substituting for traditional forms of governance as described in the first part of the research question, the utilization of a blockchain governance structure can enable the generation of additional sources of competitive advantage. As described in Table 13, in particular the introduction of automated enforcement into the buy/sell transaction process via smart contracts can enhance liquidity and optimize cash flow, while reducing risk and the costs of risk management, and thereby can make possible entirely new business streams for network participants.

III. Contributions to Theory

This thesis has sought to make several theoretical contributions to extend existing knowledge. As the advent of blockchain is relatively new, this thesis is presented with a grand opportunity to survey existing knowledge, identify the gaps in the current theoretical understanding, address these gaps with the development of new theoretical constructs, and to attempt to verify these constructs empirically.

First, this thesis addresses the significant gaps in the extant research on blockchain within a business context (Lohmer et al., 2021), seeking to place blockchain within the sphere of the disciplines with which it intersects – including economics, organization studies, law, strategy, marketing, and operations management (Roehrich et al., 2020) as well as information systems – for the purpose of supporting the development of theory which can synthesize the related multi-disciplinary constructs.

Second, this theory builds such a framework and model identifying the administrative, platform, and application level mechanisms by which a blockchain enabled structure can automate the functions of governance within a business network to coordinate transaction processing and to safeguard against exchange problems. In so doing, this thesis identifies blockchain as a significant antecedent and causal factor determining the extent of the need for the traditional contractual and relational methods of governance within a blockchain driven business network. Further, this thesis posits that the elements of a blockchain delivered governance structure can themselves actually substitute for those contractual and relational mechanisms. In developing this structure, this thesis can be seen to direct the literature of inter-organization governance towards the new frontier of self-governing agreements and automated enforcement.

Third, this thesis contributed to extant knowledge by empirically verifying the blockchain delivered governance structure that it developed. With most analysis of the effects of blockchain still speculative in nature and short on empirical evidence (Wang et al., 2019), this thesis has sought to advance the study of blockchain with a systematic validation of its framework and model. Given the relative newness of the blockchain domain, this thesis was not able to perform quantitative measurement of its theoretical constructs, and for this purpose instead examined the real-world case study of the we.trade blockchain-driven trade finance network.

This thesis tested hypotheses presented in the form of deterministic necessary conditions so as support the adopted single case approach, as prescribed by Dul and Hak (2007). Both the theorized cause and effects were found to be present in this we.trade case, thus the stated hypotheses were not disproved. Whilst this is not sufficient to prove causality, this does provide support for further study of these constructs, as discussed in the following section V.

Further, this thesis identified the potential effects of the elements of this framework and model upon the generation of competitive advantage within the we.trade setting, again seeking to add empirical weight to the largely speculative nature of extant research on the implications of blockchain technology within the business context.

IV. Contributions to Practice

The tested hypotheses presented in this thesis contribute actionable insights for practitioners.

Understanding from this thesis the identified administrative, platform, and application level mechanisms necessary for participants to place system-level trust (Hosmer, 1995) in the ability of a blockchain governance structure to coordinate and safeguard transactions may allow practitioners to more effective plan and operate permissioned blockchain business networks, and then via blockchain delivered governance to overcome the issues with governance which traditionally can result from the traditional methods of governance. As described in this thesis, formal contracts require significant resources to create, monitor, and enforce (Joskow, 1985; Schwartz, 2004; Zou et al., 2019), and yet are still inevitably incomplete (Burkert et al., 2012; Grossman & Hart, 1986; Williamson, 1996), while informal methods such as trust and social structures are perhaps even more difficult to utilize (Larson, 1992).

Understanding from this thesis the ability of blockchain to systematize the roles of governance in the transaction processing context may provide practitioners with a means to optimize inter-organizational exchanges and thus generate additional competitive advantage (Dyer & Singh, 1998), particularly within domains such as international supply chain management which contain significant environment-level and firm-level variations (Ganne, 2018; International Chamber of Commerce, 2020) which complicate still further the effective operation of traditional governance mechanisms of written contracts and social structures (Van Der Valk et al., 2020).

As an example of the value of these insights, the COVID-19 pandemic and the war in Ukraine have illustrated the fact that inter-organizational business processes may be susceptible to sudden and traumatic rupture, and that traditional approaches to governance within business networks may be less than adaptable in these circumstances. Practitioners may now recognize the value in employing blockchain delivered governance to mitigate such vulnerabilities in the trade lifecycle:- from the searching, selection, and verification of partners, to the processing, monitoring, and safeguarding of transactions.

This thesis has highlighted to practitioners the potential for enhancing the capacities of smart contracts beyond even the automated execution and enforcement of transaction parameters, towards encoding the rules of the governance framework itself. For smart contracts to encapsulate governance functions such as enrollment, monitoring, and dispute resolution could represent the functioning of a fully self-managing ecosystem.

Practitioners have been advised in this thesis that in order to address the observed concerns of surveyed blockchain network participants about the unfairness of governance rules (Deloitte, 2020), they should seek to prioritize the extension of smart contracts to systematize impartiality in operations and in dispute resolution. Practitioners have likewise been advised in this thesis to focus upon the integrity and the acceptance by participants of the external oracle feeds which provide the information used by smart contracts as event triggers :– as in the example of the quality and delivery information which is fed into we.trade.

Finally, the increasing importance of smart contracts as substitutes for written contracts and social structures will force practitioners to improve the usability and the auditability of these programs. Currently smart contracts cannot feasibly be created from written contracts, and cannot readily be comprehensible to non-technicians. As found in the we.trade study, users may be ‘scared’ of smart contracts, and convergence of written and smart contract lexicons would enhance smart contract acceptance and usability.

V. Limitations & Future Research

The major limitation of this thesis is its use of the single case study method. Although (as described in Part C. Chapter 2, section 5.2 of this thesis) this case satisfied the four tests for establishing the quality of case study research as described by Yin (2014), given the necessary access and resources, testing the theoretical hypotheses across multiple cases would have provided a greater degree of validation, and may have identified additional insights.

Future research on research questions such as that of this thesis could apply the case study approach across multiple permissioned business blockchains. Given the newness of blockchain and the relative scarcity of such networks in operation, it may not be possible for the additional networks to be exactly comparable to we.trade in terms of approach. While we.trade focuses on open account trade and the majority of its participants are small and medium enterprises, other blockchain-based networks which exist in the trade finance domain address other areas such as corporate finance (Marco Polo), or letters of credit (Contour and Komgo), and thus are less involved with the governance of transaction processing. Additional hypotheses may be required to address these differences between network focus.

Upon the further maturity of blockchain driven networks and growth in the number of active participants, it may be possible to utilize quantitative studies to analyze survey responses from such participants. The required minimum level of responses could not be achieved within this thesis despite the use of multiple different approaches. If sufficient respondents can be reached in future studies, measures such as those described in Part G. Appendices, section II could be used to create a survey such as that suggested in Part G. Appendices, section IV.

Further research could usefully also focus upon the use of smart contracts in governance far beyond the transaction processing domain which is the subject of this thesis. Information on the rules and adherence to rules of governance can be encoded within a wide variety of applications and industries (Crypto Valley Association, 2019), and across networks (Reijers et al., 2018).

Part E. Bibliography

Abdi, M., & Aulakh, P. S. (2012). Do country-level institutional frameworks and interfirm governance arrangements substitute or complement in international business relationships? *Journal of International Business Studies*, *43*(5), 477–497. https://doi.org/10.1057/jibs.2012.11

Achrol, R. S., & Gundlach, G. T. (1999). Legal and social safeguards against opportunism in exchange. *Journal of Retailing*, *75*(1), 107–124. https://doi.org/10.1016/S0022-4359(99)80006-2

Alchian, A. A., & Demsetz, H. (1972). Production, Information Costs, and Economic Organization. *The American Economic Review*, *62*(5), 20.

Alharby, M., & Moorsel, A. van. (2017). A Systematic Mapping Study on Current Research Topics in Smart Contracts. *International Journal of Computer Science and Information Technology*, *9*(5), 151–164. https://doi.org/10.5121/ijcsit.2017.9511

Allen, D. W. E., & Berg, C. (2020). Blockchain Governance: What we can Learn from the Economics of Corporate Governance. *Journal of the British Blockchain Association*, *2020*, 14.

Allen, D. W. E., Berg, C., Markey-Towler, B., Novak, M., & Potts, J. (2020). Blockchain and the evolution of institutional technologies: Implications for innovation policy. *Research Policy*, *49*(1), 103865. https://doi.org/10.1016/j.respol.2019.103865

Amadeus. (2022). *We.trade*. Amadeus Database. Subscription Service.

Arrow, K. J. (1969). The Organization of Economic Activity: Issues Pertinent to the Choice of Market versus Non-Market Allocation. *The Analysis and Evaluation of Public Expenditures: The PBB-System*. Joint Economic Committee, 91st Congress.

Arrow, K. J. (1974). *The Limits of Organization*. W. W. Norton.

Arrunada, B., & Garicano, L. (2018). Blockchain: The Birth of Decentralized Governance. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3160070

Barlette, Y., Gundolf, K., & Jaouen, A. (2017). CEOs' information security behavior in SMEs: Does ownership matter?: *Systèmes d'information & Management*, *Volume 22*(3), 7–45. https://doi.org/10.3917/sim.173.0007

Basquill, J. (2020, June 17). *Blockchain Platform we.trade Cuts Jobs Following Funding Slowdown*. Global Trade Review (GTR). https://www.gtreview.com/news/fintech/blockchain-platform-we-trade-cuts-jobs-following-funding-slowdown/

Beck, R., Avital, M., Rossi, M., & Thatcher, J. B. (2017). Blockchain Technology in Business and Information Systems Research. *Business & Information Systems Engineering*, *59*(6), 381–384. https://doi.org/10.1007/s12599-017-0505-1

Beck, R., Müller-Bloch, C., IT University of Copenhagen, King, J. L., & University of Michigan. (2018). Governance in the Blockchain Economy: A Framework and Research Agenda. *Journal of the Association for Information Systems*, 1020–1034. https://doi.org/10.17705/1jais.00518

Benbasat, I., Goldenstein, D. K., & Mead, M. (1987). The Case Research Strategy in Studies of Information Systems. *MIS Quarterly*, 18.

Benoot, H. (2021, December 20). *Interview with Hubert Benoot, ex-Head of Trade Finance at KBC, and ex-Chairman of the Board of Directors, we.trade* [Phone].

Blatter, J., & Haverland, M. (2012). *Two or three approaches to explanatory case study research?* 18.

Blockchain Ireland (Director). (2021, May 24). *We.trade Virtual Roundtable Discussion*. https://vimeo.com/578041324?embedded=true&source=vimeo_logo&owner=101039411

Brass, D. J., Galaskiewicz, J., Greve, H. R., & Tsai, W. (2004). Taking Stock of Networks and Organizations: A Multilevel Perspective. *Academy of Management Journal*, 24.

Brennan, N. M., Subramaniam, N., & van Staden, C. J. (2019). Corporate Governance Implications of Disruptive Technology: An overview. *The British Accounting Review*, *51*(6), 100860. https://doi.org/10.1016/j.bar.2019.100860

Buchanan, J. M. (1965). An Economic Theory of Clubs. *Economica*, *32*(125), 1. https://doi.org/10.2307/2552442

Burkert, M., Ivens, B. S., & Shan, J. (2012). Governance Mechanisms in Domestic and International Buyer–Supplier Relationships: An Empirical Study. *Industrial Marketing Management*, *41*(3), 544–556. https://doi.org/10.1016/j.indmarman.2011.06.019

Buterin, V. (2014). *A Next Generation Smart Contract & Decentralized Application Platform*. https://blockchainlab.com/pdf/Ethereum_white_paper-a_next_generation_smart_contract_and_decentralized_application_platform-vitalik-buterin.pdf

Cao, Z., & Lumineau, F. (2015). Revisiting the interplay between contractual and relational governance: A qualitative and meta-analytic investigation. *Journal of Operations Management*, *33–34*(1), 15–42. https://doi.org/10.1016/j.jom.2014.09.009

CargoX. (2022). CargoX. https://cargox.io/

Carter, C. R., Rogers, D. S., & Choi, T. Y. (2015). Toward the Theory of the Supply Chain. *Journal of Supply Chain Management*, *51*(2), 89–97. https://doi.org/10.1111/jscm.12073

Catalini, C., & Gans, J. S. (2016). Some Simple Economics of the Blockchain. *Rotman School of Management Working Paper No. 2874598; MIT Sloan Research Paper No. 5191- 16.*, 39.

Chang, Y., Iakovou, E., & Shi, W. (2019). Blockchain in global supply chains and cross border trade: A critical synthesis of the state-of-the-art, challenges and opportunities. *International Journal of Production Research*, 1–18. https://doi.org/10.1080/00207543.2019.1651946

Chin, W. W. (2010). How to Write Up and Report PLS Analyses. In V. Esposito Vinzi, W. W. Chin, J. Henseler, & H. Wang (Eds.), *Handbook of Partial Least Squares: Concepts, Methods and Applications* (pp. 655–690). Springer. https://doi.org/10.1007/978-3-540-32827-8

Christory, C. D., Benhamed, R., Xu, S., & Obadia, J. (2020). *Success Factors for a Blockchain Consortium* (p. 38). MIT Sloan School of Management.

Chukwudi, I., Zhang, M., & Gable, G. (2019). *Extensive Theory Testing Using Case Study*. 17.

CNN. (2021, February 19). *Bitcoin's market value tops $1 trillion*. CNN. https://edition.cnn.com/2021/02/19/investing/bitcoin-trillion-dollar-market-value/index.html

Coase, R. H. (1937). The Nature of the Firm. *Economica*, *4*(16), 386–405. https://doi.org/10.1111/j.1468-0335.1937.tb00002.x

Commons, J. (1932). The Problem of Correlating Law, Economics, and Ethics. *Wisconsin Law Review*, *8*.

Constantinides, P., Henfridsson, O., & Parker, G. G. (2018). Introduction—Platforms and Infrastructures in the Digital Age. *Information Systems Research*, *29*(2), 381–400. https://doi.org/10.1287/isre.2018.0794

Contour. (2021). *The Trusted Network for Global Trade | Contour Network*. Contour. https://contour.network/

Crypto Valley Association. (2019). *Asset Tokenization*.

Cudden, M. (2021, July 7). *Interview with Mark Cudden, CTO, we.trade* [Video Call].

Davidson, S., De Filippi, P., & Potts, J. (2016). Economics of Blockchain. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2744751

Davidson, S., De Filippi, P., & Potts, J. (2018). Blockchains and the Economic Institutions of Capitalism. *Journal of Institutional Economics*, *14*(4), 639–658. https://doi.org/10.1017/S1744137417000200

De Filippi, P. (2014). *Legal Framework For Crypto-Ledger Transactions*. https://wiki.p2pfoundation.net/Legal_Framework_For_Crypto-Ledger_Transactions

De Filippi, P., & McMullen, G. (2018). *Governance of Blockchain Systems: Governance of and by Distributed Infrastructure* (p. 40). Blockchain Research Institute and COALA.

De Moya, J., & Pallud, J. (2020). From panopticon to heautopticon: A new form of surveillance introduced by quantified-self practices. *Information Systems Journal*, *30*(6), 940–976. https://doi.org/10.1111/isj.12284

Deckert, A. (2020, October 20). *Market is tight for trade credit insurance; policy prices inflated from pandemic's uncertainty*. Crisis Management Update. https://crisismanagementupdate.com/market-is-tight-for-trade-credit-insurance-policy-prices-inflated-from-pandemics-uncertainty/

Deloitte. (2020). *Deloitte's 2020 Global Blockchain Survey*.

Dhanaraj, C., & Parkhe, A. (2006). Orchestrating Innovation Networks. *Academy of Management Review*, *31*(3), 659–669. https://doi.org/10.5465/amr.2006.21318923

Dhar, V., & Stein, R. M. (2017). *FinTech Platforms and Strategy*.

Diamantopoulos, A., & Winklhofer, H. M. (2001). Index Construction with Formative Indicators: An Alternative to Scale Development. *Journal of Marketing Research*, *38*, 259–277.

Dul, J., & Hak, T. (2007). *Case study methodology in business research*. Elsevier.

DuPont, Q. (2018). 8 Experiments in Algorithmic Governance: A History and Ethnography of "The DAO," A Failed Decentralized Autonomous Organization. In M. Campbell-

Verduyn (Ed.), *Bitcoin and Beyond: Cryptocurrencies, Blockchains and Global Governance*. Routledge, Taylor & Francis Group.

Dyer, J. H., & Singh, H. (1998). The Relational View: Cooperative Strategy and Sources of Interorganizational Competitive Advantage. *Academy of Management Review*.

Dyer, J. H., Singh, H., & Hesterly, W. S. (2018). The relational view revisited: A dynamic perspective on value creation and value capture. *Strategic Management Journal*, *39*(12), 3140–3162. https://doi.org/10.1002/smj.2785

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *The Academy of Management Review*, *14*(4), 532. https://doi.org/10.2307/258557

Emerson, R. M. (1962). Power-Dependence Relations. *American Sociological Review*, *27*(1), 12.

ETradeConnect. (2019). https://www.etradeconnect.net/Portal

EU Blockchain Observatory and Forum (Director). (2022, March 11). *Smart Contracts Webinar*. https://www.youtube.com/watch?v=relp8dgbzqY

European Commission. (2020). *Study on Blockchains: Legal, Governance and Interoperability Aspects*. Publications Office. https://data.europa.eu/doi/10.2759/4240

European Union Blockchain Observatory & Forum. (2019). *Blockchain in Trade Finance and Supply Chain* (p. 35).

Fitzgerald, D. (2021, December 5). *Interview with Danny Fitzgerald, COO, we.trade* [Video Call].

Fosso Wamba, S., Kala Kamdjoug, J. R., Epie Bawack, R., & Keogh, J. G. (2020). Bitcoin, Blockchain and Fintech: A Systematic Review and Case Studies in the Supply Chain. *Production Planning & Control*, *31*(2–3), 115–142. https://doi.org/10.1080/09537287.2019.1631460

Fung, P. K. O., Chen, I. S. N., & Yip, L. S. C. (2007). Relationships and performance of trade intermediaries: An exploratory study. *European Journal of Marketing*, *41*(1/2), 159–180. https://doi.org/10.1108/03090560710718166

Ganne, E. (2018). *Can Blockchain Revolutionize International Trade?* World Trade Organization.

Gawer, A. (2014). Bridging differing perspectives on technological platforms: Toward an integrative framework. *Research Policy*, *43*(7), 1239–1249. https://doi.org/10.1016/j.respol.2014.03.006

George, A., & McKeown, T. J. (1985). Case studies and theories of organizational decision making. In *Advances in managerial cognition and organizational information processing: Vol. Vol. 2*. JAI Press.

Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The Governance of Global Value Chains. *Review of International Political Economy*, *12*(1), 78–104. https://doi.org/10.1080/09692290500049805

Gerring, J. (2007). *Case Study Research: Principles and Practices*. Cambridge University Press.

Glaser, F. (2017). Pervasive Decentralisation of Digital Infrastructures: A Framework for Blockchain enabled System and Use Case Analysis. *Proceedings of the 50th Hawaii*

International Conference on System Sciences.

Gnagnarella, D. (2019, April 30). *Trade Finance SIG Meeting—Hyperledger Foundation*. Hyperledger Foundation. https://wiki.hyperledger.org/pages/viewpage.action?pageId=9110663

Granovetter, M. (1985). Economic Action and Social Structure: The Problem of Embeddedness. *American Journal of Sociology*, *91*(3), 481–510.

Grigg, I. (2004). *The Ricardian Contract*.

Grossman, S. J., & Hart, O. D. (1986). The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration. *Journal of Political Economy*, *94*(4), 691–719. https://doi.org/10.1086/261404

Grove, H., Clouse, M., & Schaffner, L. G. (2018). Digitalization impacts on corporate governance. *Journal of Governance and Regulation*, *7*(4), 51–63. https://doi.org/10.22495/jgr_v7_i4_p6

Gulati, R. (1995). *Does Familiarity Breed Trust? The Implications of Repeated Ties for Contractual Choice in Alliances*. 29.

Gundlach, G. T., & Cannon, J. P. (2010). "Trust but verify"? The performance implications of verification strategies in trusting relationships. *Journal of the Academy of Marketing Science*, *38*(4), 399–417. https://doi.org/10.1007/s11747-009-0180-y

Haddad, C., & Hornuf, L. (2016). *CESifo Working Paper no. 6131*.

Hafsi, M., & Assar, S. (2016). What Enterprise Architecture Can Bring for Digital Transformation: An Exploratory Study. *2016 IEEE 18th Conference on Business*

Informatics (CBI), 83–89. https://doi.org/10.1109/CBI.2016.55

Hall, P. A. (2006). Systematic process analysis: When and how to use it. *European Management Review*, *3*(1), 24–31. https://doi.org/10.1057/palgrave.emr.1500050

Hanisch, M., Theodosiadis, V., & Teixeira, F. (2021). *Digital Governance: How Blockchain Technologies Revolutionize the Governance of Interorganizational Relationships* (p. 22). Groningen Digital Business Centre (GDBC).

Hazard, J. G., & Haapio, H. (2017). Wise Contracts: Smart Contracts that Work for People and Machines. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2925871

Heide, J. B., & John, G. (1992). Do Norms Matter in Marketing Relationships. *Journal of Marketing*, *56*.

Heide, J. B., Wathne, K. H., & Rokkan, A. I. (2007). Interfirm Monitoring, Social Contracts, and Relationship Outcomes. *Journal of Marketing Research*, *44*(3), 425–433. https://doi.org/10.1509/jmkr.44.3.425

Heim, I., Han, T., & Ghobadian, A. (2018). Value Co-Creation in ICT Services Company: A Case Study of a Cross-Border Acquisition. *Journal of East-West Business*, *24*(4), 319–338. https://doi.org/10.1080/10669868.2018.1467841

Helliar, C. V., Crawford, L., Rocca, L., Teodori, C., & Veneziani, M. (2020). Permissionless and permissioned blockchain diffusion. *International Journal of Information Management*, *54*, 102136. https://doi.org/10.1016/j.ijinfomgt.2020.102136

Hoffer Gittell, J., & Weiss, L. (2004). Coordination networks within and across organizations: A multi-level Framework. *Journal of Management Studies*, *41*(1).

Hosmer, L. T. (1995). Trust: The Connecting Link Between Organizational Theory and Philosophical Ethics. *Academy of Management Review*, 26.

Howell, B. E., & Potgieter, P. H. (2019). *Governance of Blockchain and Distributed Ledger Technology Projects: A Common-Pool Resource View*. 25.

Hyperledger Foundation. (2020). *Case Study: How we.trade Helps Businesses Grow With Digital Smart Contracts Powered by Hyperledger Fabric*. https://www.hyperledger.org/learn/publications/wetrade-case-study

Iacono, J. C., Brown, A., & Holtham, C. (2011). *The use of the case study method in theory testing: The example of steel emarketplaces*. Cass Business School.

IBM. (2019, March 11). Oracles: Common architectural patterns for Hyperledger Fabric. *IBM Developer*. https://developer.ibm.com/articles/oracles-common-architectural-patterns-for-fabric/

IBM. (2020). *IBM Food Trust*. IBM Food Trust. https://www.ibm.com/products/food-trust

IBM. (2021a). *We.trade Case Study*. https://www.ibm.com/blogs/client-voices/we-trade-provides-intelligent-trading-solution/

IBM. (2021b). *The Tradelens Platform*. IBM. https://www.ibm.com/downloads/cas/AAREDOBM

International Chamber of Commerce. (2018). *Global Trade – Securing Future Growth 2018*. 174.

International Chamber of Commerce. (2020). *2020 ICC Global Survey on Trade Finance*. International Chamber of Commerce.

Jasperson, J. (Sean), Carte, T. A., Saunders, C. S., Butler, B. S., Croes, H. J. P., & Zheng, W. (2002). Review: Power and Information Technology Research: A Metatriangulation Review. *MIS Quarterly*, *26*(4), 397. https://doi.org/10.2307/4132315

Joly, A. (2021, December 17). *Interview with Agnès Joly, Head of Innovation and Strategy—Global Transaction Banking, Société Générale, and Chairperson of the Board, we.trade* [Video Call].

Jones, C., Hesterly, W. S., & Borgatti, S. P. (1997). A General Theory of Network Governance—Exchange Conditions and Social Mechanisms. *Academy Oí Management Review*, *22*(4).

Joskow, P. L. (1985). Vertical Integration and Long-term Contracts: The Case of Coal-burning Electric Generating Plants. *The Journal of Law, Economics, and Organization*. https://doi.org/10.1093/oxfordjournals.jleo.a036889

Katz, M. L., & Shapiro, C. (1994). Systems Competition and Network Effects. *Journal of Economic Perspectives*, *8*(2), 93–115. https://doi.org/10.1257/jep.8.2.93

Kim & Kankanhalli. (2009). Investigating User Resistance to Information Systems Implementation: A Status Quo Bias Perspective. *MIS Quarterly*, *33*(3), 567. https://doi.org/10.2307/20650309

Klijn, E.-H., & Koppenjan, J. F. M. (2006). Institutional Design: Changing Institutional Features of Networks. *Public Management Review*, *8*(1), 141–160. https://doi.org/10.1080/14719030500518915

Komgo. (2022). Solutions for the Trade Finance Industry. https://www.komgo.io/

Lacity, M. (2018). Addressing Key Challenges to Making Enterprise Blockchain Applications a Reality. *MIS Quarterly Executive*, *17*(3), 22.

Lacity, M., Steelman, Z., & Cronan, P. (2019). *Blockchain Governance Models: Insights for Enterprises* [White Paper]. University of Arkansas.

Larson, A. (1992). Network Dyads in Entrepreneurial Settings: A Study of the Governance of Exchange Relationships. *Administrative Science Quarterly*, *37*(1), 76. https://doi.org/10.2307/2393534

Lauslahti, K., Mattila, J., & Seppala, T. (2017). Smart Contracts How Will Blockchain Technology Affect Contractual Practices? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3154043

Ledger Insights. (2020, May 21). *IBM Invests in Trade Finance blockchain we.trade as it Readies to Gear Up*. Ledger Insights. https://www.ledgerinsights.com/ibm-invests-in-trade-finance-blockchain-we-trade-as-it-readies-to-gear-up/

Lee, R. P., Johnson, J. L., & Tang, X. (2012). An Investigation into the Role of IT Integration, Relationship Predictability and Routinization in Interfirm Relationships: From the Structuration Perspective. *Industrial Marketing Management*, *41*(2), 368–377. https://doi.org/10.1016/j.indmarman.2011.04.002

Leonard-Barton, D. (1990). A Dual Methodology for Case Studies: Synergistic Use of a Longitudinal Single Site with Replicated Multiple Sites. *Organization Science*, *1*(3), 248–266. https://doi.org/10.1287/orsc.1.3.248

Lohmer, J., Petzok, L., & Lasch, R. (2021). *Governance Design of Blockchain Consortia for*

Efficient and Transparent Procurement and Supply Chain Man- agement. 18.

Lopez, M. (2021, December 28). *Interview with Michaël Lopez, Responsable Administratif et Financier, Ekoï* [Video Call].

Loux, P., Aubry, M., Tran, S., & Baudoin, E. (2020). Multi-sided platforms in B2B contexts: The role of affiliation costs and interdependencies in adoption decisions. *Industrial Marketing Management*, *84*, 212–223. https://doi.org/10.1016/j.indmarman.2019.07.001

Lumineau, F., Wang, W., & Schilke, O. (2021). Blockchain Governance—A New Way of Organizing Collaborations? *Organization Science*, *32*(2), 47.

Macaulay, S. (1963). Non-contractual Relations in Business: A Preliminary Study. *American Sociological Review*, *28*.

MacDonald, T. J., Allen, D. W. E., & Potts, J. (2016). Blockchains and the Boundaries of Self-Organized Economies- Predictions for the Future of Banking. In *Banking Beyond Banks and Money* (p. 16). Springer.

Macneil, I. R. (1978). Contracts: Adjustment of Long-term Economic Relations Under Classical, Neoclassical, and Relational Contract Law. *Northwestern University Law Review*, 53.

Madhok, A. (1995). Revisiting Multinational Firms' Tolerance for Joint Ventures: A Trust-Based Approach. *Journal of International Business Studies*, *Vol. 26*(No. 1 (1st Qtr., 1995)), 22 pp. 117–137.

Malone, T. W., & Crowston, K. (1994). The interdisciplinary study of coordination. *ACM*

Computing Surveys, *26*(1), 87–119. https://doi.org/10.1145/174666.174668

Marco Polo. (2021). *Marco Polo Network—The new standard in trade finance*. Marcopolonetwork.Com. https://www.marcopolonetwork.com/

McKinsey, International Chamber of Commerce, & Fung Business Intelligence. (2021). *Reconceiving the global trade finance ecosystem*.

Menichini, A. M. C. (2011). Inter-Firm Trade Finance in Times of Crisis. *The World Economy*, *34*(10), 1788–1808. https://doi.org/10.1111/j.1467-9701.2011.01390.x

MineHub Platform. (2022). MineHub. https://minehub.com/

Moore, G. C., & Benbasat, I. (1991). Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation. *Information Systems Research*, *2*(3), 192–222. https://doi.org/10.1287/isre.2.3.192

Morris, N. (2020, January 21). *Automated trade payments prove popular for we.trade blockchain*. Ledger Insights - Enterprise Blockchain. https://www.ledgerinsights.com/wetrade-blockchain-trade-finance-automated-payments/

Murray, A., Kuban, S., Josefy, M., & Anderson, J. (2019). Contracting in the Smart Era: The Implications of Blockchain and Decentralized Autonomous Organizations for Contracting and Corporate Governance. *Academy of Management Perspectives*, amp.2018.0066. https://doi.org/10.5465/amp.2018.0066

Nakamoto, S. (2008). *Bitcoin: A Peer-to-Peer Electronic Cash System*.

Nascimento, S., Pólvora, A., Anderberg, A., Andonova, E., Bellia, M., Calès, L., Inamorato dos Santos, A., Kounelis, I., Nai Fovino, I., Petracco Giudici, M., Papanagiotou, E., Sobolewski, M., Rossetti, F., Spirito, L., European Commission, & Joint Research Centre. (2019). *Blockchain Now and Tomorrow: Assessing Multidimensional Impacts of Distributed Ledger Technologies*. http://publications.europa.eu/publication/manifestation_identifier/PUB_KJNA29813ENN

Nordea Bank (Director). (2018). *Transaction Banking Reflections with we.trade*. https://vimeo.com/320009653?embedded=true&source=vimeo_logo&owner=32309089

NTT Data Institute of Management Consulting. (2021). *International economic research project on Japan's measures to enhance trade facilitation*.

OECD. (2021). *Trade finance for SMEs in the digital era* (OECD SME and Entrepreneurship Papers No. 24; OECD SME and Entrepreneurship Papers, Vol. 24). https://doi.org/10.1787/e505fe39-en

Ølnes, S., Ubacht, J., & Janssen, M. (2017). Blockchain in government: Benefits and implications of distributed ledger technology for information sharing. *Government Information Quarterly*, *34*(3), 355–364. https://doi.org/10.1016/j.giq.2017.09.007

Orlikowski, W. J., & Baroudi, J. J. (1991). Studying Information Technology in Organizations: Research Approaches and Assumptions. *Information Systems Research*, 29.

Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press.

Ostrom, E. (2000). Collective Action and the Evolution of Social Norms. *Joumal of Economic Perspectives*, *14*(3), 23.

Ostrom, E. (2010). The Challenge of Self-Governance in Complex Contemporary Environments. *Journal of Speculative Philosophy*, *24*(4), 18.

Patel, D., & Ganne, E. (2020). *Blockchain & DLT in Trade* (p. 52). World Trade Organization.

Patton, M. Q. (2002). *Qualitative Research and Evaluation Methods* (Third Edition). SAGE Publications.

Perger, T. (2021, March 12). *Interview with Tomas Perger, we.trade Manager, Ceskoslovenska obchodni banka.* [Phone].

Petersen, D. (2022). Automating governance: Blockchain delivered governance for business networks. *Industrial Marketing Management*, *102*, 177–189. https://doi.org/10.1016/j.indmarman.2022.01.017

Petter, S., Straub, D., & Rai, A. (2007). Specifying Formative Constructs in Information Systems Research. *MIS Quarterly*, *31*(4), 623. https://doi.org/10.2307/25148814

Platt, C. (2017, January 16). *Of Permissions and Blockchains ... A View for Financial Markets*. https://medium.com/@colin_/ofpeDLrmissions- and-blockchains-a-view-for-financial-markets-bf6f2be0a62

Poppo, L., & Zenger, T. (2002). Do Formal Contracts and Relational Governance Function as Substitutes or Complements? *Strategic Management Journal*, *23*(8), 707–725. https://doi.org/10.1002/smj.249

Poppo, L., Zheng Zhou, K., & Zenger, T. (2008). Examining the Conditional Limits of Relational Governance: Specialized Assets Performance Ambiguity and Long-Standing Ties. *Journal of Management Studies*, *45*(7).

Porter, M. E. (1980). *Competitive Strategy*. Free Press.

Provan, K. G., & Kenis, P. (2007). Modes of Network Governance: Structure, Management, and Effectiveness. *Journal of Public Administration Research and Theory*, *18*(2), 229–252. https://doi.org/10.1093/jopart/mum015

PWC. (2021). *24th Annual Global CEO Survey: A Leadership Agenda to Take on Tomorrow*. https://www.pwc.com/gx/en/ceo-agenda/ceosurvey/2021/report.html

PYMNTS. (2018, July 3). *We.trade Executes First Corporate Transactions*. https://www.pymnts.com/news/b2b-payments/2018/blockchain-trade-wetrade/

Queiroz, M. M., & Fosso Wamba, S. (2019). Blockchain Adoption Challenges in Supply Chain: An Empirical Investigation of the Main Drivers in India and the USA. *International Journal of Information Management*, *46*, 70–82. https://doi.org/10.1016/j.ijinfomgt.2018.11.021

Rabinovich-Einy, O., & Katsch, E. (2019). *Blockchain and the Inevitability of Disputes: The Role for Online Dispute Resolution*. *2019*, 30.

Rabobank. (2021). *We.trade enables international trade transactions via blockchain*. Rabobank.Com. https://www.rabobank.com/en/about-rabobank/innovation/tech-trends/articles/wetrade-international-trade-transactions-via-blockchain.html

Ramos, J. M. (2016, September 21). How to Create a Smart Contract using Terms and

Conditions. *Términos y Condiciones*. https://terminosycondiciones.es/2016/09/21/how-to-create-smart-contract-using-terms-and-conditions/

Rao, R. (2019, March 15). First-ever We.Trade Blockchain Platform Goes Live. *Techutzpah*. https://techutzpah.com/staging/9070/first-ever-we-trade-blockchain-platform-goes-live/

Raskin, M. (2017). *The Law and Legality of Smart Contracts*. *1*, 37.

Rauchs, M., Blandin, A., Bear, K., & McKeon, S. B. (2019). *2nd Global Enterprise Blockchain Benchmarking Study*. University of Cambridge Judge Business School. https://www.ssrn.com/abstract=3461765

Reijers, W., Wuisman, I., Mannan, M., De Filippi, P., Wray, C., Rae-Looi, V., Cubillos Vélez, A., & Orgad, L. (2018). Now the Code Runs Itself: On-Chain and Off-Chain Governance of Blockchain Technologies. *Topoi*. https://doi.org/10.1007/s11245-018-9626-5

Ring, P. S., & van de Ven, A. H. (1992). Structuring Cooperative Relationships Between Organizations. *Strategic Management Journal*, *13*(7), 483–498. https://doi.org/10.1002/smj.4250130702

Risius, M., & Spohrer, K. (2017). A Blockchain Research Framework: What We (don't) Know, Where We Go from Here, and How We Will Get There. *Business & Information Systems Engineering*, *59*(6). https://doi.org/10.1007/s12599-017-0506-0

Rochet, J.-C., & Tirole, J. (2004). *Two-Sided Markets: An Overview* (p. 44). Institut d'Economie Industrielle.

Roeck, D., Sternberg, H., & Hofmann, E. (2020). Distributed Ledger Technology in Supply Chains: A Transaction Cost Perspective. *International Journal of Production Research*, *58*(7), 2124–2141. https://doi.org/10.1080/00207543.2019.1657247

Roehrich, J. K., Selviaridis, K., Kalra, J., Van der Valk, W., & Fang, F. (2020). Inter-Organizational Governance: A Review, Conceptualisation and Extension. *Production Planning & Control*, *31*(6), 453–469. https://doi.org/10.1080/09537287.2019.1647364

Rogers, E. M. (1983). *Diffusion of innovations* (3rd ed). Free Press ; Collier Macmillan.

Rossi, M., Mueller-Bloch, C., Thatcher, J. B., & Beck, R. (2019). Blockchain Research in Information Systems: Current Trends and an Inclusive Future Research Agenda. *Journal of the Association for Information Systems*, 1388–1403. https://doi.org/10.17705/1jais.00571

Rowe, F. (2012). Toward a richer diversity of genres in information systems research: New categorization and guidelines. *European Journal of Information Systems*, *21*(5), 469–478. https://doi.org/10.1057/ejis.2012.38

Rowley, T., Behrens, D., & Krackhardt, D. (2000). Redundant Governance Structures: An Analysis of Structural and Relational Embeddedness in the Steel and Semiconductor Industries. *Strategic Management Journal*, 18.

Rozas, D., Tenorio-Fornés, A., Díaz-Molina, S., & Hassan, S. (2021). When Ostrom Meets Blockchain: Exploring the Potentials of Blockchain for Commons Governance. *SAGE Open*, 14.

Rumelt, R. P. (1984). Towards a Strategic Theory of the Firm. In *Competitive Strategic Management, Richard B. Lamb, ed.*

Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L. (2019). Blockchain Technology and its Relationships to Sustainable Supply Chain Management. *International Journal of Production Research*, *57*(7), 2117–2135. https://doi.org/10.1080/00207543.2018.1533261

Sangha, P. (2021, October 12). *Interview with Parm Sangha, EMEA Blockchain Practice Leader, IBM* [Video Call].

Schepker, D. J., Oh, W.-Y., Martynov, A., & Poppo, L. (2014). The Many Futures of Contracts: Moving Beyond Structure and Safeguarding to Coordination and Adaptation. *Journal of Management*, *40*(1), 193–225. https://doi.org/10.1177/0149206313491289

Schmidt, C. G., & Wagner, S. M. (2019). Blockchain and Supply Chain Relations: A Transaction Cost Theory Perspective. *Journal of Purchasing and Supply Management*, *25*(4), 100552. https://doi.org/10.1016/j.pursup.2019.100552

Schwartz, A. (2004). The Law and Economics of Costly Contracting. *Journal of Law, Economics, and Organization*, *20*(1), 2–31. https://doi.org/10.1093/jleo/ewh022

Sheth, A., & Subramanian, H. (2019). Blockchain and Contract Theory: Modeling Smart Contracts using Insurance Markets. *Managerial Finance*, *46*(6), 803–814. https://doi.org/10.1108/MF-10-2018-0510

Simon, H. A. (1947). *Administrative Behavior*. The Free Press.

Smart Contracts Alliance. (2016). Smart Contracts 12 Use Cases for Business & Beyond. *Chamber of Digital Commerce*.

Spence, M. (1973). Job Market Signaling. *The Quarterly Journal of Economics*, *87*(3), 355. https://doi.org/10.2307/1882010

Sturgeon, T. J. (2002). Modular Production Networks: A Aew American Model of Industrial Organization. *Industrial and Corporate Change*, *11*(3), 451–496. https://doi.org/10.1093/icc/11.3.451

Sulkowski, A. J. (2018). Blockchain, Business Supply Chains, Sustainability, and Law: The Future of Governance, Legal Frameworks, and Lawyers? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3262291

Sutter, D. (2020). *The Evolution of Technology in Trade*. Marco Polo.

Szabo, N. (1994). *Smart Contracts*. https://web.archive.org/web/20011102030833/http://szabo.best.vwh.net:80/smart.contracts.html

Szabo, N. (1996). *Smart Contracts: Building Blocks for Digital Markets*. http://www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh.net/smart_contracts_2.html

TradeFinex | Trade Finance Distribution. (2022). TradeFinex. https://www.tradefinex.org/

Tradelens. (2020). *Tradelens*. Tradelens. https://www.tradelens.com/

Tradelens. (2022). *About TradeLens*. https://www.tradelens.com/about

Treiblmaier, H. (2018). The impact of the blockchain on the supply chain: A theory-based research framework and a call for action. *Supply Chain Management: An International Journal*, *23*(6), 545–559. https://doi.org/10.1108/SCM-01-2018-0029

Ulriksen, M. S., & Dadalauri, N. (2016). Single case studies and theory-testing: The knots and dots of the process-tracing method. *International Journal of Social Research Methodology*, *19*(2), 223–239. https://doi.org/10.1080/13645579.2014.979718

United Nations Centre for Trade Facilitation and Electronic Business. (2020). *White paper on Blockchain in Trade Facilitation*.

Van Der Valk, W., Lumineau, F., & Wang, W. (2020). Research on Contracting in Supply Chain Management and Related Disciplines: A Synthesis of Scholarly Recommendations and a Discussion of Future Opportunities. In T. Choi, J. Li, D. Rogers, J. Rungtusanatham, T. Schoenherr, & S. Wagner (Eds.), *Oxford Handbook of Supply Chain Management* (p. 42).

van Flymen, D. (2019, August 13). *Learn Blockchains using Spreadsheets*. Medium. https://medium.com/@vanflymen/learn-blockchains-using-spreadsheets-b97ad92b9b4d

van Pelt, R., Jansen, S., Baars, D., & Overbeek, S. (2021). Defining Blockchain Governance: A Framework for Analysis and Comparison. *Information Systems Management*, *38*(1), 21–41. https://doi.org/10.1080/10580530.2020.1720046

Vial, G. (2019). Understanding Digital Transformation: A Review and a Research Agenda. *The Journal of Strategic Information Systems*, *28*(2), 118–144. https://doi.org/10.1016/j.jsis.2019.01.003

Voss, C., Tsikriktsis, N., & Frohlich, M. (2002). Case Research in Operations Management. *International Journal of Operations & Production Management*, *22*(2), 195–219. https://doi.org/10.1108/01443570210414329

Wang, Y., Singgih, M., Wang, J., & Rit, M. (2019). Making sense of blockchain technology: How will it transform supply chains? *International Journal of Production Economics*, *211*, 221–236. https://doi.org/10.1016/j.ijpe.2019.02.002

Wass, S. (2018, October 3). *We.trade and Batavia merge blockchain platforms for trade finance*. Global Trade Review (GTR). https://www.gtreview.com/news/fintech/we-trade-and-batavia-merge-blockchain-platforms-for-trade-finance/

Wasserman, S., & Faust, K. (1994). *Social Network Analysis*. Cambridge University Press.

Weking, J., Mandalenakis, M., Hein, A., Hermes, S., Böhm, M., & Krcmar, H. (2019). The impact of blockchain technology on business models – a taxonomy and archetypal patterns. *Electronic Markets*. https://doi.org/10.1007/s12525-019-00386-3

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, *5*(2). https://doi.org/10.1002/smj.4250050207

Westerman, G., Calméjane, C., Bonnet, D., Ferraris, P., & McAfee, A. (2011). *Digital Transformation: A Road-Map for Billion-Dollar Organizations*. MIT Center for Digital Business and Capgemini Consulting.

we.trade. (2018). *We.trade Rulebook v 2.3*. we.trade.

we.trade. (2019). *We.trade User Manual / Application Guide v 2.9*. we.trade.

we.trade. (2021, August 11). *Leading The Way #1*. We.Trade. https://we-trade.com/resources/leading-the-way-1

we.trade. (2022). *We.trade*. https://we-trade.com/

Williamson, O. E. (1975). *Markets and Hierarchies: Analysis and Antitrust Implications*. The Free Press.

Williamson, O. E. (1985). *The Economic Institutions of Capitalism*. Macmillan.

Williamson, O. E. (1991). Comparative Economic Organization: The Analysis of Discrete Structural Alternatives. *Administrative Science Quarterly*, *36*(2), 269. https://doi.org/10.2307/2393356

Williamson, O. E. (1993a). Transaction Cost Economics and Organization Theory. *Industrial and Corporate Change*, *2*(1), 107–156. https://doi.org/10.1093/icc/2.1.107

Williamson, O. E. (1993b). *The Economic Analysis of Institutions and Organisations—In General and with Respect to Country Studies* (OECD Economics Department Working Papers, Vol. 133) [OECD Economics Department Working Papers]. https://doi.org/10.1787/802045548530

Williamson, O. E. (1996). Revisiting Legal Realism: The Law, Economics, and Organization Perspective. *Industrial and Corporate Change*, 38.

Williamson, O. E. (2002). The Lens of Contract: Private Ordering. *American Economic Review*, *92*(2), 438–443. https://doi.org/10.1257/000282802320191769

Williamson, O. E., & Ouchi, W. G. (1981). The Markets and Hierarchies Program of Research: Origins, Implications, Prospects. In A. H. van de Ven & W. F. Joyce (Eds.), *Perspectives on Organization Design & Behavior*. John Wiley & Sons.

Wold, H. (1980). Model Construction and Evaluation When Theoretical Knowledge Is Scarce. In *Evaluation of Econometric Models* (pp. 47–74). Elsevier. https://doi.org/10.1016/B978-0-12-416550-2.50007-8

Woolthuis, R. K., Hillebrand, B., & Nooteboom, B. (2005). Trust, Contract and Relationship Development. *Organization Studies*, *26*(6), 813–840. https://doi.org/10.1177/0170840605054594

World Economic Forum. (2016). *The Future of Financial Infrastructure*.

World Economic Forum. (2020). *Bridging the Governance Gap: Dispute Resolution for Blockchain-based Transactions*. World Economic Forum. https://fr.weforum.org/whitepapers/bridging-the-governance-gap-dispute-resolution-for-blockchain-based-transactions

World Trade Organization. (2020). *World Trade Statistical Review 2020*. https://www.wto.org/english/res_e/statis_e/wts2020_e/wts2020_e.pdf

Wragg, E. (2020, May 22). *IBM Joins Banks as Shareholder in we.trade*. Global Trade Review (GTR). https://www.gtreview.com/news/fintech/ibm-joins-banks-as-shareholder-in-we-trade/

Wragg, E. (2021, January 27). *Blockchain Platform we.trade Refills its Coffers, CEO Departs*. Global Trade Review (GTR). https://www.gtreview.com/news/fintech/blockchain-platform-we-trade-refills-its-coffers-ceo-departs/

Wu, H., Li, Z., King, B., Ben Miled, Z., Wassick, J., & Tazelaar, J. (2017). A Distributed

Ledger for Supply Chain Physical Distribution Visibility. *Information*, *8*(4), 137. https://doi.org/10.3390/info8040137

Wuyts, S., & Geyskens, I. (2005). The Formation of Buyer–Supplier Relationships: Detailed Contract Drafting and Close Partner Selection. *Journal of Marketing*, *69*(4), 103–117. https://doi.org/10.1509/jmkg.2005.69.4.103

Yin, R. K. (2014). *Case Study Research: Design and Methods* (Fifth Edition). SAGE Publications.

Yli-Huumo, J., Ko, D., Choi, S., Park, S., & Smolander, K. (2016). Where Is Current Research on Blockchain Technology?—A Systematic Review. *PLOS ONE*, *11*(10), e0163477. https://doi.org/10.1371/journal.pone.0163477

Yüksel, S. (2021, December 20). *Interview with Selim Yüksel, VP Innovation, Akbank* [Video Call].

Zachariadis, M., Hileman, G., & Scott, S. V. (2019). Governance and Control in Distributed Ledgers: Understanding the Challenges Facing Blockchain Technology in Financial Services. *Information and Organization*, *29*(2), 105–117. https://doi.org/10.1016/j.infoandorg.2019.03.001

Zaheer, S., & Zaheer, A. (2006). Trust across borders. *Journal of International Business Studies*, *37*(1), 21–29. https://doi.org/10.1057/palgrave.jibs.8400180

Zheng, J., Roehrich, J. K., & Lewis, M. A. (2008). The dynamics of contractual and relational governance: Evidence from long-term public–private procurement arrangements. *Journal of Purchasing and Supply Management*, *14*(1), 43–54.

https://doi.org/10.1016/j.pursup.2008.01.004

Zhu, Kraemer, Gurbaxani, & Xu. (2006). Migration to Open-Standard Interorganizational Systems: Network Effects, Switching Costs, and Path Dependency. *MIS Quarterly*, *30*. https://doi.org/10.2307/25148771

Zou, W., Brax, S. A., Vuori, M., & Rajala, R. (2019). The Influences of Contract Structure, Contracting Process, and Service Complexity on Supplier Performance. *International Journal of Operations & Production Management*, *39*(4), 525–549. https://doi.org/10.1108/IJOPM-12-2016-0756

Part F. Contents in Detail

Part G. Appendices

I. Synopses of Key Literature

This section presents a synopsis of key literature available at the time of the writing of this thesis, grouped by domain area.

The articles were reviewed in an integrated manner, that is, each article was also informed by the articles of the other sections, reflecting the fact that phenomena related to information systems are generally interdisciplinary (Jasperson et al., 2002).

Note that the values of the column 'Category' are inspired by the categorization of IS research genres described in Rowe (2012).

1. Contractual Governance

Significant contributions relating to the domain of contractual governance are described below in Table 14. The foundations of these concepts were laid by Commons (1932) and Coase (1937), and were subsequently developed by Williamson (1975) and other authors.

Author(s)	Title	Date	Category	Key Contribution
JR Commons	The Problem of Correlating Law, Economics, and Ethics	1932	Theory Development	Defines the Transaction as the basic unit of activity, and 'working rules' as the control over actions
RH Coase	The Nature of the Firm	1937	Theory Development	Explores the boundaries of firms and markets
HA Simon	Administrative Behavior	1947	Theory Development	Defines bounded rationality
OE Williamson	Markets and Hierarchies	1975	Theory Development	Develops the Transaction Cost Economics (TCE) concept to explain alternate governance structures

Author(s)	Title	Date	Category	Key Contribution
OE Williamson, WG Ouchi	The Markets and Hierarchies Program of Research: Origins, Implications, Prospects	1981	Theory Development	Clarifies the precepts and implications of the TCE concept
OE Williamson	The Economic Institutions of Capitalism	1985	Theory Development	Further develops the Transaction Cost Economics (TCE) concept
PL Joskow	Vertical Integration and Long-Term Contracts: The Case of Coal-Burning Electric Generating Plants	1985	Theory Development	Describes the component costs of contracting
SJ Grossman, OD Hart	The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration	1986	Theory Development	Introduces the concept of incomplete contracting
OE Williamson	The Economic Analysis of Institutions and Organisations - in General and with Respect to Country Studies	1993	Theory Development	Further clarifies the precepts and implications of the TCE concept
OE Williamson	Calculativeness, Trust, and Economic Organization	1993	Theory Development	Posits that the institutional framework can be regarded as a set of shift parameters
R Gulati	Alliances and Networks	1998	Theory Development	Proposes that social networks may mitigate appropriation concerns and coordination costs that can affect the choice of governance structure
OE Williamson	The New Institutional Economics: Taking Stock, Looking Ahead	2000	Theory Development	Adds institutional economics and social structures to the TCE framework

Table 14 – Contractual Governance Key Contributions

2. Relational Governance

Significant contributions relating to the domain of relational governance are described below in Table 15, including the major influence of the work of Granovetter (1985).

Author(s)	Title	Date	Category	Key Contribution
KJ Arrow	The Limits of Organization	1974	Theory Development	Highlights the importance of trust in exchanges
M Granovetter	Economic Action and Social Structure: The Problem of Embeddedness	1985	Theory Development	Stresses the social structural influences on governance, and develops the 'embeddedness' concept
B Uzzi	Social Structure and Competition in Interfirm Networks: The Paradox of Embeddedness	1997	Theory Development	Investigates the social structural and 'embeddedness' influences on network behavior
A Larson	Network Dyads in Entrepreneurial Settings: A study of the Governance of Exchange Relationships	1992	Empirical Interviews	Focuses on social control as a source of governance
JB Heide, G John	Do Norms Matter in Marketing Relationships	1992	Statistical Survey	Analyzes the role of norms in structuring valuable interfirm relationships
A Madhok	Revisiting Multinational Firms' Tolerance for Joint Ventures: A Trust-Based Approach	1995	Theory Development	Investigates the role of trust in multinational ventures
AC Wicks, SL Berman, TM Jones	The Structure of Optimal Trust: Moral and Strategic Implications	1999	Theoretical Development	Explores the concept of an optimal level of trust
FL Jeffries, R Reed	Trust and adaptation in relational contracting	2000	Theoretical Development	Describes the importance of trust and relational contracting

Author(s)	Title	Date	Category	Key Contribution
BB Tyler	The complementarity of cooperative and technological competencies: a resource-based perspective	2001	Theoretical Development	Describes how the unique history of a firm can affect its cooperative capabilities
L Poppo, T Zenger	Do Formal Contracts and Relational Governance Function as Substitutes or Complements	2002	Statistical Study	Finds that formal contracts and relational governance can function as complements
G Baker, R Gibbons, KJ Murphy	Relational Contracts and the Theory of the Firm	2002	Mathematical Model	Finds that relational contracts are prevalent within and between firms
JH Dyer, W Chu	The Role of Trustworthiness in Reducing Transaction Costs and Improving Performance: Empirical Evidence from the United States, Japan, and Korea	2003	Statistical Study	Investigates trust and information sharing in exchange relationships
S Zaheer, A Zaheer	Trust Across Borders	2006	Theory Development	Proposes that the levels and nature of trust differ across national contexts
JB Heide, KH Wathne	Friends, Businesspeople, and Relationship Roles: A Conceptual Framework and a Research Agenda	2006	Theory Development	Investigates alternate views of governance
D Faems, M Janssens, A Madhok, B van Looy	Toward an integrative perspective on alliance governance: Connecting contract design, trust dynamics, and contract application	2008	Case Study	Describes the effects of relational governance

Author(s)	Title	Date	Category	Key Contribution
L Poppo, K Zheng Zhou, T Zenger	Examining the Conditional Limits of Relational Governance: Specialized Assets Performance Ambiguity and Long-Standing Ties	2008	Statistical Study	Investigates the limitations of relational governance

Table 15 – Relational Governance Key Contributions

3. Complementary Contractual & Relational Governance

Significant contributions by authors who have described the usage of contractual and relational governance mechanisms in combination are described below in Table 16, including the influential works of Macaulay (1963) and Macneil (1978).

Author(s)	Title	Date	Category	Key Contribution
S Macaulay	Non-contractual Relations in Business: A Preliminary Study	1963	Empirical Case Studies	Describes the importance of both contractual and non-contractual mechanisms
IR Macneil	Contracts: Adjustment of Long-term Economic Relations Under Classical, Neoclassical, and Relational Contract Law	1977	Theory Development	Develops the concept of relational contracts (to extend beyond the scope of discrete transaction governance)
RS Achrol, GT Gundlach	Legal and Social Safeguards Against Opportunism in Exchange	1999	Game Model	Provides alternate views of governance

Author(s)	Title	Date	Category	Key Contribution
S Wuyts, I Geyskens	The Formation of Buyer–Supplier Relationships: Detailed Contract Drafting and Close Partner Selection	2005	Empirical Survey	Investigates the utility of contracts and non-contract relationships
RK Woolthuis, B Hillebrand, B Nooteboom	Trust, contract and relationship development	2005	Case Study	Examines whether trust and contract are complements and/or substitutes
Z Yang, C Su, KS Fam	Dealing with Institutional Distances in International Marketing Channels: Governance Strategies that Engender Legitimacy and Efficiency	2012	Theory Development	Adds consideration of the international context to governance
JB Heide, KH Wathne AI Rokkan	Interfirm monitoring, social contracts, and relationship outcomes	2007	Statistical Survey	Examines the effects of monitoring on interfirm relationships
J Zheng, JK Roehrich, MA Lewis	The dynamics of contractual and relational governance: evidence from long-term public–private procurement arrangements	2008	Empirical Survey	Explores the detail of contractual and relational governance mechanisms
K Lai	Linking Exchange Governance with Supplier Cooperation and Commitment: a Case of Container Terminal Operations	2009	Empirical Survey	Reviews the relative effectiveness of governance mechanisms, focusing on the logistics sector

Author(s)	Title	Date	Category	Key Contribution
GT Gundlach, JP Cannon	"Trust but verify"? The performance implications of verification strategies in trusting relationships	2010	Statistical Survey	Investigates how combinations of trust and verification enhance or detract from exchange performance
J Beuve, S Saussier	Interfirm Cooperation in Strategic Relationships: The Role of Formal Contract	2012	Empirical Survey	Reviews the relative effectiveness of governance mechanisms, focusing on the industrial sector

Table 16 – Complementary Contractual and Relational Governance Key Contributions

4. Network Governance

Significant contributions relating to the domain of network governance are described below in Table 17.

Author(s)	Title	Date	Category	Key Contribution
WW Powell	Neither Market Nor Hierarchy	1990	Empirical Case Studies	Describes the importance of networks as a governance structure
PS Ring, AH Van de Ven	Structuring Cooperative Relationships Between Organizations	1992	Theory Development	Compares the characteristics of alternative governance mechanisms, and the criteria which affect the selection
EJ Zajac, CP Olsen	From Transaction Cost to Transactional Value Analysis: Implications for the Study of Interorganizational Strategies	1993	Theory Development	Develops the concept of 'Transaction Value' as an extension to Transaction Cost Economics

Author(s)	Title	Date	Category	Key Contribution
JB Heide	Interorganizational Governance in Marketing Channels	1994	Theory Development	Seeks to integrate TCE and social structures, and to extend TCE from dyad to network
C Jones, WS Hesterly, SP Borgatti	A General Theory of Network Governance: Exchange Conditions and Social Mechanisms	1997	Theory Development	Extends discussions on governance for dyads to interfirm networks, and seeks to integrate TCE and social structures
JH Dyer, H Singh	The Relational View: Cooperative Strategy and Sources of Interorganizational Competitive Advantage	1998	Theory Development	Identifies competitive advantages from network participation, and identifies governance as a potential source of generating such advantage
M Ghosh, G John	Governance Value Analysis and Marketing Strategy	1999	Theory Development	Develops the concept of 'Governance Value' as an extension to 'Transaction Cost Economics' and 'Transaction Value'
T Rowley, D Behrens, D Krackhardt	Redundant Governance Structures: An Analysis of Structural and Relational Embeddedness in the Steel and Semiconductor Industries	2000	Empirical Survey	Provides empirical support from the Steel and Semiconductor industries for the network view that "the manner in which a firm reaches its partners and the shape and form of its network influence its performance" (Rowley et al., 2000, p. 370)
JH Gittell, L Weiss	Coordination Networks Within and Across Organizations: A Multi-level Framework	2004	Empirical Case Studies	Investigates coordination within networks
EH Klijn, JFM Koppenjan	Institutional Design: Changing Institutional Features of Networks	2006	Theory Development	Describes the relationship between institutions, networks, and rules, and the strategies for changing these

Author(s)	Title	Date	Category	Key Contribution
CR Carter, DS Rogers, TY Choi	Toward the Theory of the Supply Chain	2015	Theory Development	Views the supply chain as a network, and as a Complex Adaptive System

Table 17 – Network Governance Key Contributions

5. Blockchain Governance

The identified key contributions to the domain of blockchain governance are described below in Table 18.

Author(s)	Title	Date	Category	Key Contribution
S Nakamoto	Bitcoin: A peer-to-peer electronic cash system	2019	Theory Development	Originator of Bitcoin
N Szabo	Smart Contracts	1994	Theory Development	Develops the 'Smart contracts' concept
N Szabo	Smart Contracts: Building Blocks for Digital Markets	1996	Theory Development	Extends the 'Smart Contracts' concept
E Ostrom	Governing the Commons: The Evolution of Institutions for Collective Action	1990	Theory Development	Investigates self-governance of common resource pools
LT Hosmer	Trust: The connecting link between organizational theory and philosophical ethics	1995	Theory Development	Distinguishes between trust in another entity, and trust in a system
P Weill	Don't just lead, govern: How top-performing firms govern IT	2004	Empirical Study	Reviews governance of IT

Author(s)	Title	Date	Category	Key Contribution
K Riemer, S Klein	Is the V-form the next generation organisation? An analysis of challenges, pitfalls and remedies of ICT-enabled virtual organisations based on social capital theory	2008	Theory Development	Describes ICT-enabled virtual organisations
A Tiwana	Platform ecosystems: Aligning architecture, governance, and strategy	2013	Theory Development	Reviews the governance of platform ecosystems
TJ MacDonald, DWE Allen, J Potts	Blockchains and the Boundaries of Self-Organized Economies: Predictions for the Future of Banking	2016	Theory Development	
C Catalini, JS Gans	Some Simple Economics of the Blockchain	2016	Theory Development	Examines the effects of blockchain on 2 aspects of TCE : costs of verification and costs of networking
S Davidson, P De Filippi, J Potts	Economics of Blockchain	2016	Theory Development	Examines blockchain as more than an ICT innovation, also facilitating new types of economic governance
M Risius, K Spohrer	A Blockchain Research Framework	2017	Literature Review & Research Framework	Provides a survey of existing research on blockchain, and a detailed analysis of suggested further research areas for blockchain
R Beck, M Avital, M Rossi, JB Thatcher	Blockchain Technology in Business and Information Systems Research	2017	Theory Development	Discusses IS research areas on blockchain

Author(s)	Title	Date	Category	Key Contribution
S Davidson, P De Filippi, J Potts	Blockchains and the Economic Institutions of Capitalism	2018	Theory Development	Proposes that blockchain may represent an “institutional innovation”, providing a new “governance technology” (Davidson et al., 2018, p. 4)
R Beck, C Müller-Bloch, JL King	Governance in the blockchain Economy: A Framework and Research Agenda	2018	Empirical Case Study	Describes blockchain decentralized autonomous organizations (DAO) as a new form of organizational design
M Campbell-Verduyn	Towards a Block Age or Blockages of Global Governance?	2018	Theory Development	Discusses governance by blockchain, and governance of blockchain
P Constantinides, O Henfridsson, GG Parker	Introduction—platforms and infrastructures in the digital age	2018	Theory Development	Investigates digital platforms and infrastructures
M Lacity, Z Steelman, P Cronan	Blockchain Governance Models: Insights for Enterprises	2019	Empirical Survey	Describes blockchain governance models for an audience of business managers
S Saberi, M Kouhizadeh, J Sarkis, L Shen	Blockchain Technology and its Relationships to Sustainable Supply Chain Management	2019	Theory Development	Makes propositions about blockchain's impact on Supply Chain governance
C Catalini, J Boslego	Blockchain Technology and Organization Science: Decentralization Theatre or Novel Organizational Form?	2019	Theory Development	Reviews blockchain as new organizational forms

Author(s)	Title	Date	Category	Key Contribution
M Zachariadis, G Hileman, SV Scott	Governance and Control in Distributed Ledgers: Understanding the Challenges Facing blockchain Technology in Financial Services	2019	Theory Development	Describes governance approaches with blockchain
J Pereira, MM Tavalaei, H Ozalp	blockchain-based Platforms: Decentralized Infrastructures and its Boundary Conditions	2019	Theory Development	Makes propositions about the utility of blockchain, rather than centralized approaches, for the governance of platforms
M Higginson, MC Nadeau, K Rajgopal	Blockchain's Occam Problem	2019	Empirical Survey	Provides an industry survey of blockchain usage
DWE Allen, C Berg	Blockchain Governance: What we can learn from the economics of corporate governance	2020	Theory Development	Relates other theories of governance to the functioning of blockchain governance mechanisms
DWE Allen, C Berg, B Markey-Towler, M Novak, J Potts	Blockchain and the Evolution of Institutional Technologies: Implications for Innovation Policy	2020	Economic Model	Suggests that blockchain represents a new class of institutional technology which can propel a process of institutional evolution

Table 18 – Blockchain Governance Key Contributions

II. Overview of Selected Blockchain Trade Finance Platforms

1. CargoX

Major Stakeholders	Fracht AG, Milsped Group
Year of Establishment	2018
Region	Europe, Hong Kong
Sector	Supply Chain Management
Purpose	Encrypted documents can be issued, signed, exchanged, tracked, and managed by carriers, shippers, consignees, assignees, banks, forwarders, and partners across supply chains. Manufacturers have access to predictive analytics, inbound material previews, business planning, and secure document integration and exchange. Financial institutions have access to loan processing, and trade finance analysis.
Major Functions	• Digitization of trade documents • Document data exchange • Enhanced security via encryption
Blockchain Technology	Ethereum
Website	cargox.io

Sources:

(CargoX, 2022)

(OECD, 2021)

(Patel & Ganne, 2020)

2. Contour

Major Stakeholders	12 banks, R3, CryptoBLT, Bain & Company
Year of Establishment	2020
Region	Worldwide
Sector	Trade Finance
Purpose	Improving transaction efficiency and preventing fraud with electronic letters of credit
Major Functions	The preparation, verification, and sharing of trade documents
Blockchain Technology	R3 Corda
Website	www.contour.network

Sources:

(Contour, 2021)

(NTT Data Institute of Management Consulting, 2021)

(Patel & Ganne, 2020)

3. eTradeConnect

Major Stakeholders	Hong Kong Monetary Authority, Regional banks
Year of Establishment	2018
Region	Asia Pacific
Sector	Trade Finance
Purpose	Improving efficiency and transparency of trade finance
Major Functions	• Electronic sharing of trade documents • Open account financing • Monitor to prevent duplicate loans being made against the same Purchase Order
Blockchain Technology	Hyperledger Fabric
Website	www.etradeconnect.net

Sources:

(ETradeConnect, 2019)

(European Union Blockchain Observatory & Forum, 2019)

(Patel & Ganne, 2020)

4. Komgo

Major Stakeholders	Joint venture by multiple banks, trading companies, and oil companies
Year of Establishment	2018
Region	Worldwide
Sector	Trade Finance
Purpose	Efficient electronic KYC, and the digitization of trade finance processes, and the reduction of fraud via forged documents.
Major Functions	• Digitization of trade documents (such as letters of credit) • Document data exchange for KYC • Improved security via encryption • Trade finance facilitation services
Blockchain Technology	Quorum (Ethereum)
Website	www.komgo.io

Sources:

(Christory et al., 2020)

(Komgo, 2022)

(Patel & Ganne, 2020)

5. Marco Polo

Major Stakeholders	R3, TradeIX, and a consortium of user companies
Year of Establishment	2017
Region	Worldwide
Sector	Trade Finance
Purpose	Streamline the deployment and management of commercial and working capital between banks and customers
Major Functions	• Liquidation of accounts receivable • Payment guarantee • Financing of accounts payable
Blockchain Technology	R3 Corda
Website	marcopolonetwork.com

Sources:

(Marco Polo, 2021)

(Patel & Ganne, 2020)

(Sutter, 2020)

6. Minehub

Major Stakeholders	IBM, ING Group, Wheaton, Ocean Partners, Kutcho Copper, Capstone Mining, Kimura Capital
Year of Establishment	2019
Region	Canada
Sector	Supply Chain Management and Trade Finance for the mining and metals industry
Purpose	Provide a platform to digitize mine to market origination, contract management, credit management, invoicing and payment. To streamline operations for participants, improve key process efficiencies, and bring trust and transparency. Automating the acquisition of mineral provenance data will significantly reduce analysis and logistics conflicts.
Major Functions	• Trade in minerals • Delivery of minerals • Payment
Blockchain Technology	Hyperledger Fabric (IBM Blockchain Platform)
Website	minehub.com

Sources:

(MineHub Platform, 2022)

(NTT Data Institute of Management Consulting, 2021)

(Patel & Ganne, 2020)

7. Tradefinex

Major Stakeholders	XinFin
Year of Establishment	2017
Region	Singapore
Sector	Supply Chain Management and Trade Finance
Purpose	Enables peer-to-peer contracting between funders, suppliers, and beneficiaries, to make funding available while minimizing the role of intermediaries. Enables real time project tracking, enabling suppliers to overcome supply chain uncertainty and disruptions.
Major Functions	• Invoice Payment • L/C • Credit Collateral • Bill of Lading
Blockchain Technology	R3 Corda, Hyperledger Besu
Website	www.tradefinex.org

Sources:

(NTT Data Institute of Management Consulting, 2021)

(Patel & Ganne, 2020)

(TradeFinex | Trade Finance Distribution, 2022)

8. Tradelens

Major Stakeholders	IBM, Maersk
Year of Establishment	2018
Region	Worldwide
Sector	Supply Chain Management
Purpose	Real-time sharing of trade documents and cargo information
Major Functions	• Cargo Tracking and Tracing (Visibility) • Electronic sharing of trade documents (Document Sharing)
Blockchain Technology	Hyperledger Fabric (IBM Blockchain Platform)
Website	www.tradelens.com

Sources:

(European Union Blockchain Observatory & Forum, 2019)

(IBM, 2021b)

(Tradelens, 2022)

III. Quantitative Study Measurement Items

Measurement items for the three blockchain governance independent variables could be seen to be formative in nature, and could be designed in order to span the complete scope of the independent variables, as per Diamantopoulos and Winklhofer (2001). These could be derived from extant knowledge of blockchain characteristics, primarily the writings on blockchain governance by Lacity et al (2019). Measurement items for the dependent variables of relational governance and contractual governance could be seen to be reflective in nature, and could be adopted primarily from Abdi and Aulakh (2012), with their formulation informed by the "relative advantage" concept of Rogers (1983, p. 213), and subsequently developed by Moore and Benbasat (1991) and Kim and Kankanhalli (2009). Such indicative measures are presented below in Table 19.

Constructs	Measurement Items
Blockchain Administration Level Mechanisms	There is an appropriate decision-making authority for this blockchain
	Blockchain authority appropriately controls who can become a member
	Blockchain authority appropriately controls when any member must be punished or removed
	Blockchain authority prevents/resolves conflict between members
	Blockchain authority is impartial and does not favour certain members over others
Blockchain Platform Level Mechanisms	Blockchain ensures transactions are properly validated
	Blockchain ensures transactions are processed as expected
	Blockchain ensures transactions are secure
	Blockchain appropriately controls access to data
	Blockchain monitors against suspicious activity
Blockchain Application	We are using Smart Contracts instead of written contracts on this Blockchain

Constructs	Measurement Items
Level Mechanisms	We are using Smart Contracts to automate business processes
	We are using Smart Contracts to automate payment processes
Relational Governance Mechanisms	When transacting on the Blockchain, our business relationships can be characterized by lesser levels of trust than were needed before
	When transacting on the Blockchain, our business relationships are less guided by informal rules and procedures than they were before
	When transacting on the Blockchain, we need to rely less on the promises of vendors than we did before
Contractual Governance Mechanisms	When transacting on the Blockchain, less aspects of our agreement are specified in a written contract than they were before
	When transacting on the Blockchain, less aspects of our relationship are guided by formal written rules than they were before
	When transacting on the Blockchain, we make less use of third-party intermediaries than we did before

Table 19 – Measurement Items

Partial Least Squares Structural Equation Modelling (PLS-SEM) software such as SmartPLS could be considered for the assessment of the measurement model (the relationship between the constructs and the measures that comprise them) and the path model (the relationship between the constructs), as per Chin (2010). Given there is little prior theory and few empirical studies in this research context, the ability of the PLS to support causal-predictive analysis and theory development makes this approach recommended (Wold, 1980), as would the use of formative indicators in the model (Chin, 2010), and the potential for a comparatively small set of survey responses (Petter et al., 2007) due to the relatively low number of operational blockchain networks.

IV. Sample Survey of Blockchain Network

Please let us know your opinion on the statements below ...

Q1. The Administration ...

	Strongly agree (1)	Agree (2)	Somewhat agree (3)	Neither agree nor disagree (4)	Somewhat disagree (5)	Disagree (6)	Strongly disagree (7)
Provides an appropriate decision-making authority	○	○	○	○	○	○	○
Appropriately controls who can become a member	○	○	○	○	○	○	○
Appropriately controls when any member must be punished or removed	○	○	○	○	○	○	○
Prevents / resolves conflict between members	○	○	○	○	○	○	○
Is impartial and does not favour certain members over others	○	○	○	○	○	○	○
Protects its members' rights	○	○	○	○	○	○	○

Q2. On this Platform ...

	Strongly agree (1)	Agree (2)	Somewhat agree (3)	Neither agree nor disagree (4)	Somewhat disagree (5)	Disagree (6)	Strongly disagree (7)
Transactions are properly validated	○	○	○	○	○	○	○
Transactions are processed as expected	○	○	○	○	○	○	○
Transactions are secure	○	○	○	○	○	○	○
Access to data is controlled	○	○	○	○	○	○	○
There is monitoring against suspicious activity	○	○	○	○	○	○	○

Q3. How much are you using Smart Contracts ...

	Very Often (1)	Often (2)	Sometimes (3)	Rarely (4)	Never (5)
Instead of written contracts	○	○	○	○	○
To automate business processes	○	○	○	○	○
To automate payment processes	○	○	○	○	○

Q4. Compared to before you joined the Platform, do your business relationships with other companies ...

	Strongly agree (1)	Agree (2)	Somewhat agree (3)	Neither agree nor disagree (4)	Somewhat disagree (5)	Disagree (6)	Strongly disagree (7)
Now rely less on trust?	○	○	○	○	○	○	○
Now are less guided by informal processes?	○	○	○	○	○	○	○
Now rely less on the promises of vendors?	○	○	○	○	○	○	○

Q5. Compared to before you joined the Platform, do you ...

	Strongly agree (1)	Agree (2)	Somewhat agree (3)	Neither agree nor disagree (4)	Somewhat disagree (5)	Disagree (6)	Strongly disagree (7)
Now rely less on written contracts?	○	○	○	○	○	○	○
Now rely less on formal written rules?	○	○	○	○	○	○	○
Now use less third-party intermediaries?	○	○	○	○	○	○	○

Q6. How long have you been a member of this Platform?

○ <1 year

○ 1 year

○ 2 years

○ 3 years

○ 4 years or more

Q7. Why did you join this Platform?

- ○ Requested by trading partners
- ○ Invited by Blockchain consortium
- ○ Part of management strategy
- ○ We were one of the originators of this Blockchain

Q8. What's your core business ?

- ○ Exporter
- ○ Importer
- ○ Importer & Exporter
- ○ Financial Institution
- ○ Logistics Provider
- ○ Government Agency
- ○ Inspection Company
- ○ Other

Q9. What's your company size ?

- <10 employees
- 10-49 employees
- 50-249 employees
- 250+ employees

Q10. What's your major business location ?

- Africa
- Asia
- Australia/Pacific
- Europe
- North America
- South America
- Worldwide

Q11. Please give any other feedback you'd like to mention

V. Case Study Key Interview Sources

This section lists key interview subjects who contributed to the case study within this thesis via video communication.

Please note that this list excludes those subjects who requested anonymity, and who contributed via email or messaging.

1. Consortium Representatives

Name	Agnès Joly
Title	Head of Innovation and Strategy Global Transaction Banking
Organization	Société Générale (France)
Role at we.trade	Chairperson of the Board - we.trade
Linkedin Profile	https://www.linkedin.com/in/agn%C3%A8s-joly-6002222b/

Name	Hubert Benoot
Title	(ex) Head of Trade Finance
Organization	KBC Bank (Belgium)
Role at we.trade	(ex) Chairperson of the Board - we.trade
Linkedin Profile	https://www.linkedin.com/in/hubert-benoot-83090928/

2. Bank Trade Finance Participants

Name		Tomas Perger
	Title	Senior Innovation Manager Export & Trade Finance
	Organization	Československá obchodní banka (Czech Republic)
	Role at we.trade	Provides financing products on we.trade and recruits buyers and sellers to the platform
	Linkedin Profile	https://www.linkedin.com/in/tom%C3%A1%C5%A1-perger-31788a23/
Name		Tomas Rak
	Title	Head of Trade Sales
	Organization	Komerční banka (Czech Republic)
	Role at we.trade	Provides financing products on we.trade and recruits buyers and sellers to the platform
	Linkedin Profile	https://www.linkedin.com/in/tomasrak/

3. Bank Technology Participants

Name		Selim Yüksel
	Title	VP, Innovation
	Organization	Akbank
	Role at we.trade	Designs the bank's platform to provide financing products on we.trade
	Linkedin Profile	https://www.linkedin.com/in/selimyuksel/
Name		Osman Emre Geredeli
	Title	Innovation Center Manager
	Organization	Akbank
	Role at we.trade	Designs the bank's platform to provide financing products on we.trade
	Linkedin Profile	https://www.linkedin.com/in/osman-emre-geredeli-828a709a/

4. we.trade Representatives

Name	Mark Cudden
Title	Chief Technology Officer
Organization	we.trade
Role at we.trade	Major participant in the design and the operation of the we.trade platform and application processes
Linkedin Profile	https://www.linkedin.com/in/mark-cudden/
Name	Danny Fitzgerald
Title	Chief Operating Officer
Organization	we.trade
Role at we.trade	Responsible for the commercial development of the we.trade platform
Linkedin Profile	https://www.linkedin.com/in/daniel-fitzgerald-9475a166/

Name	Gilbert Cordier
Title	Head of Sales
Organization	we.trade
Role at we.trade	Responsible for the commercial development of the we.trade platform, working in Société Générale, and in we.trade
Linkedin Profile	https://www.linkedin.com/in/gilbert-cordier-032ba866/

5. Buyers & Sellers

Name		Michaël LOPEZ
	Title	Responsable Administratif et Financier
	Organization	EKOÏ
	Role at we.trade	A we.trade buyer of products from we.trade sellers
	Linkedin Profile	https://www.linkedin.com/in/michael-lopez-02888a91/

Name		Patrice SCHWARTZ
	Title	Administrative and Financial Director
	Organization	w41tb
	Role at we.trade	A we.trade seller of products to we.trade sellers
	Linkedin Profile	https://www.linkedin.com/in/schwartz-patrice-6656b9aa/

6. Platform Provider

Name		Parm Sangha
	Title	EMEA Blockchain Practice Leader
	Organization	IBM
	Role at we.trade	Major participant in the design and the operation of the we.trade platform on the IBM blockchain platform
	Linkedin Profile	https://www.linkedin.com/in/parm-sangha-65a3464/

Direction de la **recherche**
et de la **valorisation**
Collège **doctoral**
Université de Strasbourg

Résumé en français suivi des mots-clés en français

Insérer votre résumé en français suivi des mots-clés en français

Cette thèse sur papiers intègre d'abord la blockchain dans la théorie actuelle de la gouvernance des échanges inter-organisationnels au sein des réseaux d'entreprises, et développe ensuite un cadre et un modèle de structure de gouvernance de la blockchain comprenant des mécanismes administratifs, de plateforme et d'application qui peuvent remplir les fonctions de coordination et de protection des transactions et qui peuvent ainsi se substituer aux mécanismes traditionnels de gouvernance contractuelle et relationnelle. Enfin, cette thèse teste la structure de gouvernance de la blockchain à l'aide d'une observation empirique du réseau we.trade pour le financement du commerce. Les acheteurs et vendeurs participants, ainsi que leurs banques, font confiance au réseau blockchain, remplaçant ainsi le besoin de mécanismes traditionnels de gouvernance. Cette thèse confirme les hypothèses selon lesquelles, sur un tel réseau, se trouve une structure de gouvernance blockchain dont les niveaux administratifs, d'infrastructure et d'application assurent le traitement et la protection des transactions.

Mots clés :
blockchain, gouvernance, échanges inter-organisationnels, réseaux d'entreprises

Résumé en anglais suivi des mots-clés en anglais

Insérer votre résumé en anglais suivi des mots-clés en anglais

This paper-based thesis first integrates blockchain into current theory on the governance of inter-organizational exchanges within business networks, and second develops a blockchain governance structure framework and model comprised of administrative, platform, and application level mechanisms which can perform the functions of transaction coordination and safeguarding and thus can substitute for the traditional contractual and relational mechanisms of governance. Third, this thesis tests the blockchain governance structure against empirical observation of the we.trade network for trade finance. Participant buyers, sellers, and their banks place their trust in the blockchain network itself, replacing the need for the traditional mechanisms of governance. This thesis finds true the hypotheses that present on such a network is a blockchain governance structure whose administrative, infrastructure, and application levels deliver the required processing and safeguarding of transactions.

Keywords :
blockchain, governance, inter-organizational exchanges, business networks