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Trust, Reputation and Contracts

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TrustCoM

A trust and Contract Management framework enabling secure collaborative business processing in on-demand created, self-managed, scalable, and highly dynamic Virtual Organisations

SIXTH FRAMEWORK
PROGRAMME

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1 Executive Summary

1.1 Introduction

The overall mission of the TrustCoM project is to provide a trust and contract management framework enabling the definition and secure enactment of collaborative business processes within Virtual Organisations that are formed on-demand, are self-managed and evolve dynamically, sharing computation, data, information and knowledge across enterprise boundaries.

This document addresses the most fundamental questions related to socio-economic and business aspects of Trust and Reputation in Virtual Organization management. The document describes in depth the economic and social issues for VO (Virtual Organization) collaboration, interaction and sharing between businesses in order to provide better profitability, transaction efficiency and reduced costs. The report asserts that Business contracts with appropriate business models provide tremendous foundations for enabling trust and reputation between businesses in a VO environment. The document describes the foundation of trust from an economic sense and then illustrates the role of Business Contracts in enabling trust in VO supply chains.

The technologies and standards based implementations for Trust and Security in VO frameworks provide a technical foundation for building advanced collaborative environments for business processes within and across multiple organizations. This document brings out the business, social and economics foundations for Trust and Reputation, with an emphasis on a) Business Contracts; b) Contract Terms and Conditions; c) Business Metrics for monitoring performance driven by contract terms and d) Business models for trust establishment.

1.2 Primary objectives for WP8

- Explore economic models of competition for Trust and Reputation in VO management. This objective was to understand, expand or extend the competitive strategy driven models to include complex VO attributes for trust and reputation.
- Explore Business models for VO management and VO supply chains and trust enablement through intermediaries and third-party entities.
- Investigate Trust and Reputation models for VO lifecycle management using models of contracts between VO members. The contracts include one-to-one and one-to-many configurations.
- Explore Business models for Trust and Reputation in VO management with specific emphasis on the CE and AS scenarios.

- Provide recommendations on Trust and Reputation models and mechanisms to the rest of the TrustCom group activities.

1.3 Modified objectives for WP8

During the first half (first 7 months) of the project in 2004, competitive game models were applied for VO selection and trust enablement between two parties. The models developed were focussed on individual trust models when compared to the requirements of the complex VO lifecycle management, which involves complex relationships between the VO members (group level trust). The game model was applied on a few attributes of the members and deeper insights into VO management were not revealed. One of the primary reasons was that the VO management framework was in the design stage and not fully conceived. Based on the reviews done in April, 2005 the objectives were modified during November, 2005 towards models of Reputation, Business models for Trust and others. The final modified objectives are as follows:

- Explore advanced multi-tier Models of Business Contracts for VO Management
- Economics of Business Contracts and Terms and Conditions for Reputation
- Investigate models for Reputation based on metrics defined around contract terms and conditions. Investigate advanced scoring models for Reputation.
- Investigate Business Models for Trust and Interoperability between VO members and other VO organizations.
- Investigate Business models for Trust in third-party neutral or dominant group environments.

1.4 Interactions with other TrustCom Action Lines

- WP8 team worked closely with AL1 and AL2 sub-projects and teams on Business Contracts, Terms and Conditions, VO management and Business Metrics for Reputation and VO supply-chain models.
- WP8 Business Contracts has contributed knowledge and criteria to WP20-21, WP-28, WP 23 and WP35. Currently a working group has been established between the 4 partners (which include, SALFORD, SAP, BAE and others) to investigate role of Business Contracts in VO supply chains and in designing reputation mechanisms. WP8 intends to provide advanced knowledge, definitions and mechanisms around Business contracts, which will encompass the SLA work that is being done in WP22.

- WP8 has provided input on “Generic Reputation Service” which is an important part of the VO lifecycle management and Trust/Security Services. The input has been on supply-chain metrics and contract attributes and management for building an industry driven reputation system.
- WP8 has also provided input to VO management (on Reputation scoring) on reputation models and scoring functions for VO members in a VO environment.
- WP8 also interacts with WP13 and other AL4 initiatives on standards for business contracts, models for interoperability between cluster of projects in the eGovernment and eBusiness area.

1.5 Contributions from WP8

- Developed a model of Business contracts for enabling VO supply chain interactions based on terms and conditions between VO supply chain partners. This is described in section 3 of this document in great detail
- Novel reputation models based on Business Contracts and contract-specific terms and conditions. The reputation model is based on monitoring contract terms and conditions over a long-period of time in order to score and rate VO members.. The contracts signify the agreed upon terms, which if violated the conditions apply. Business rules can be set by the VO members on the violations to understand and select out the VO members.
- New models for scoring based on contract attributes and functions for VO member reputation. The attributes for reputation are based on rules applied to the terms and conditions. For example, in a VO supply chain if a VO member violated a specific term and condition 5 times then the scoring function will rate the VO member based on the type of term and condition. If multiple terms and conditions are violated the scoring function considers multiple attributes and weighting functions based on the semantics and criticality of the violations.
- Economics and business models for Interoperability were developed as a part of WP8 activities. The models for interoperability consider trusted third-party, trusted consortia and trusted group models. The business models were compared and contrasted around various degrees of trust and reputation (this study was presented at a cluster interoperability workshop).

1.6 Conclusions and Recommendations

Three major conclusions and contributions have been made through WP8.

- Economic models play a strong role in enabling trust mechanisms. The document describes the various economic and business models for enabling

trust in third-party environments. The game models for establishing trust and understanding trust dynamics is described in section 2. The major result is that trust between parties or players is better with more history of transactions.

- Contracts are the life-line of building trust in Business Environments and VO supply chains systems. Contract terms and conditions provide a tremendous foundation for Trust and Reputation management. The major result from the work is the design of a novel contract driven and attributes based reputation rating of partners in a VO supply chain. The reputation rating models consider attributes and criteria that are semantically driven. Section 4, 6 and 8 provide more details.
- Business Metrics based on contract terms and conditions are critical for evaluating the reputation of VO members, monitoring the contracts terms and ensuring the proper enforcement of the terms. These measurements provide feedback into the generic reputation system models (Workpackage 28) for performing rating of members and new VO creation.

1.7 Structure of Document

This document is structured into 3 major sections (starting from section 2). These sections address some very important questions on Trust and Reputation in TrustCoM. The main questions are as follows:

- Definition of Trust in Social, Economic and Business contexts
- Business Contract Models in VO Supply Chains
- Business Contract Structures for VO lifecycle management
- Business Metrics for Monitoring Terms and Conditions and for scoring
- Business models for Trust Establishment through third-party entities

The main document is 32 pages in length (till page number 38). The rest of the document content is captured in the appendix. In section 2, we begin by providing the Economic and social definitions and foundation of Trust. The economic and social definitions provide various view points on Trust and Reputation models.

In section 3, Business Contract Models are described in detail. In this section, three different models are described, but we also note that the models described here are abstractions. In section 6 (Appendix), we present information about beneficiaries of VO and the impact VO has on business processes. We also address the question of industry types, sizes of companies involved and introduce the VO lifecycle.

In section 4, Business Models for VO management with Trust are described in detail. We compare and contrast multiple models of interaction amongst businesses with trusted third-parties. From section 6 onwards (appendix) we describe some details of business contracts, CE VO contract attributes and scoring mechanisms.

2 Social and Economic Aspects of Trust

This section discusses the social issues of trust and cooperation in the TrustCoM framework. The mission of TrustCoM is to provide an integrated framework enabling secure collaborative business processes in on-demand created, self-managed, scalable and highly dynamic Virtual Organizations. A Virtual Organization (VO) is defined as a temporary or permanent coalition of geographically dispersed individuals, groups, organizational units or entire organizations that pool resources, capabilities and information to achieve common objectives. The parties that form a virtual organization are typically part of a larger enterprise network from which a selection of partners is made.

Trust is an important element of any interaction in society, be it in the family, an organization, a market, or across country boundaries like the European Union. For example, successful business-to-business collaborations require that partners trust one another to behave ethically. A company that shares internal data such as sales reports, production schedules, product designs and logistical details, with a supply-chain partner must trust the partner with that information. Obviously, this kind of trust is easier to establish with a long-term business partner who is known personally rather than a temporary business partner at the other end of the world.

We therefore argue that trust plays a crucial role in the performance of many VOs. When interactions are frequent and repeated, there are many opportunities to use threats, punishments or reputation building in order to promote cooperation even in the absence of trust. There are fewer such opportunities, though, when people interact infrequently and mainly with strangers. Because these tend to be the typical interactions in VOs, trust among their members will be essential for their performance. There are several ways to enhance trust in a VO. This can, for example, be by facilitation of communication among VO members, or by familiarity with the framework. Reputation management is a very powerful trust enhancer. We have seen the development of reputation systems in informal online markets where anonymous individuals may buy and sell a wide variety of goods and services in isolated trades. These systems, where trading parties get the opportunity to evaluate each other after a transaction, mitigate each party's risks related to cheating by the other party. eBay's feedback forum is the most widely known reputation system; it appears to be an important factor in eBay's success. They reported fraud less is less than 1 percent.

Note that in VOs security issues play another major role. For example, data might have to be shared with selective VO partners, which makes it important to control data access. These security issues are primarily of a technological nature, although the security technology used is likely to influence human behaviour. Also legal

issues arise, for example, with respect to the question of the ownership of data. We exclude security issues from consideration in this document. This section provides background information on behavioural aspects of trust and cooperation. Specific applications to the TrustCoM framework will be discussed in the second part. We define trust and related concepts. These definitions will be used throughout this document.

2.1 Trust definitions and Social Capital

Arrow (1972) has described trust as a lubricant without which many of the most essential everyday decisions would not be possible. Trust can help in solving problems caused by social uncertainty, which arises when we are not able to correctly determine the intentions of other people or organizations that have incentives to act against our best interest. Barber (1983) distinguishes between two types of trust, trust in another person's competence and trust in another person's goodwill. The former is the expectation of technically competent role performance from those involved with us in social relationships and systems, whereas the latter is the expectation that our interaction partners will carry their duties in certain situations to place our interests before their own. Following Yamagishi and Yamagishi (1994), we denote the expectation of competency as confidence. We define trust in an economic sense the expectation of other persons' goodwill and benign intent, implying that in certain situations those persons will place the interests of others before their own.

From a sociological viewpoint, Francis Fukuyama (1995) argues, in his book *Trust: The Social Virtues and the Creation of Prosperity*, that trust creates social capital. Social capital has been defined by Coleman (1988) as the ability of people to work together for common purposes in groups and organizations. The social capital embedded in trusting relationships is present in communities of all sizes, ranging from families to corporations and nations. According to Fukuyama, the ability of a society to develop strong civic institutions and efficient organizations depends to a large degree on its social capital. He argues that social capital fuels a society's economic performance. Based on a historical analysis he demonstrates that low trust countries tend to show a lower overall economic performance than high trust countries.

Knack and Keefer (1997) provide empirical support for Fukuyama's thesis based on a measure of trust derived from answers to an attitudinal question on trust from the *World Values Survey* of the National Opinion Research Center. The question was, Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people? Knack and Keefer considered 29 countries with market economies in the 1981 and 1990-1991 World Values Survey. They took the percentage of respondents from each country who answered that people could be trusted as a measure of how trusting that country's populace was..

2.2 Trust substitutes

Yamagishi and Yamagishi (1994) distinguish trust from *assurance*, which they define as the expectation of benign behavior based on the knowledge of the incentive structure surrounding the relationship rather than the other person's goodwill. They give the example of a Mafia family member who can expect his trading partners will not cheat on him, not because they are benevolent but because they are aware of the consequences. In other words, the trading partners behave trustworthily because it is in their own interest. Assurance can thus complement or substitute for trust.

A related trust substitute is *commitment*. Maintaining long-term relationships with loyal partners rather than making deals with new partners is a kind of commitment where incentives for noncooperative behavior are reduced. In such relationships it is mutual assurance based on the nature of the relationship rather than trust that leads to cooperative behavior. This was demonstrated, for example, by Axelrod (1984), Selten, Mitzkewitz and Uhlich (1997) and Keser (2000); they examined human decision strategies in repeated "social dilemma situations," where the individual payoff-maximizing non-cooperative behavior leads to socially inefficient outcomes. They observe that people often actively attempt to establish and maintain mutual cooperation when they expect to repeatedly interact with each other.

In this attempt, participants signal in early interactions their willingness to cooperate and then use reciprocity—cooperate if the others have cooperated and defect from cooperation if the others have defected in the previous interaction—as an instrument to establish cooperation. Following such a strategy typically pays for an individual involved in repeated encounters with others. Keser and van Winden (2000) show that people who repeatedly interact with the same people in a social dilemma situation tend to use the reciprocity principle and manage to cooperate significantly more than those whose partners change randomly.

Another trust complement, or trust-enhancing factor, is *reputation*. Reputation may play two different roles in social interactions involving trust. The first role is informational. It makes a person trust more when given favorable information about the business partner. Trust has been defined earlier as the expectation that others will show goodwill in their dealings with us. Lacking perfect information about others' intentions, we thus evaluate their intentions from available information, such as their reputation. The second role that reputation may play is as a tool for disciplining or restraining, in order to control dishonest behavior. This aspect of reputation makes the targeted party act in a more trustworthy way. Thus, a reputation management system may enhance trust through the creation of assurance.

2.2.1 Trust in economic theory

Neo-classical economic theory, and in particular game theory, is based on the paradigm of self-interested behavior, or the egoistic maximization of one's individual utility. This is also called the paradigm of full rationality. As neo-classical economic theory considers a world of egoists, where each egoist, called *homo economicus*, knows that everybody else is also of the *homo economicus* type, this theory leaves no room for trustworthy behavior and trust, defined as the expectation that our interaction partners in certain situations will place our interest before their own. A very straightforward demonstration of the lack of trust and trustworthiness among self-interested agents and the resulting lack of interaction is given in the *trust game* (Berg, Dickhaut and McCabe 1996).

Demsetz (1983) criticizes the neo-classical theory of the firm, which attempts to understand how the price system coordinates the use of resources, because it contributes little to the understanding of the inner workings of real firms. Thus, it is the mission of the so-called *New Institutional or Transaction Cost Economics (TCE)* to analyze institutions and economic organizations. TCE is based on the assumption of people's cognitive limits to rationality (*bounded rationality*) and consequently the fact that contracts are unavoidably incomplete (complete contingent claim contracting is impossible). Together with the human condition of opportunism—which translates, again, into the profit or utility maximization assumption of the neo-classical theory—this leads to problems such as adverse selection, moral hazard, shirking, sub-goal pursuit, etc. (Williamson 2000).

Discussing the role of trust in the analysis of economic organizations, Williamson (1993) argues that the TCE approach is principally calculative. The awkwardness of including the notion of trust in calculative models leads him to reject trust as a computational concept. Williamson further argues that the notion of trust should be avoided when modeling economic interactions because it adds nothing new: well-known notions such as reliability, utility and risk are adequate and sufficient for that purpose. While TCE is based on ad hoc assumptions of bounded rationality (by armchair reasoning), *experimental economics* empirically analyzes boundedly rational behavior. This new economic subdiscipline laid its roots in the 1950s. One of the roots was in the disagreement of social psychologists with the negative predictions of economic theory due to the perfect rationality assumption¹.

¹ By now, experimental economics has become an established sub-discipline that significantly influences the development of economic theory. It has received official recognition as an important sub-discipline by the award of the Nobel Prize for Economics in 2002 to Vernon Smith *for having established laboratory experiments as a tool in empirical economic analysis, especially in the study of alternative market institutions*, together with

2.2.2 Individual versus group trust

The trust examined in the trust game by Berg, Dickhaut and McCabe is trust in individuals. It is not clear whether placing trust in individuals and placing trust in collective entities can be used interchangeably. More concretely, we have to ask whether trust exists at different levels (individual versus collective). If so, is trust across levels related and does trust at one level influence trust at the other? Furthermore, does trust at different levels affect economic performance in different ways? McEvily et al. (2003) address these questions in an experimental study based on the trust game. In particular, they examine whether someone who trusts an individual agent with whom he deals will necessarily be more inclined to trust that person's organization. Or is it possible to trust a collective entity, independent of the trust that one has for the individuals that comprise it? They observe that people transfer perceptions of trustworthiness to individuals based on previous experiences with members of that individual's group, even with a very minimal form of group membership. Note that not much work has been done to understand organizational behaviour under trusted mechanisms (e.g. business contracts).

The relationship between group boundaries and trust has also been explored by Buchan, Croson, and Dawes (2002) in trust experiments. There is evidence that groups make more rational decisions than individuals in the sense that they are more guided by the payoff-maximization principle.

2.2.3 Cooperation without trust

The assumption of neo-classical economic theory that human beings are purely self-interested leads in many situations to socially inefficient outcomes. The trust game is one example. Let us consider now another class of games, social dilemma games, in which individually rational, personal payoff-maximizing behavior leads to socially inefficient outcomes and in which players make simultaneous decisions (decision-making in the trust game is sequential). In experiments on voluntary contributions for the provision of a public good, for example, they observe that people are willing to punish uncooperative others even if punishing is costly.

2.3 Reputation systems

Daniel Kahneman for having integrated insights from psychological research into economic science, especially concerning judgment and decision making under uncertainty.

Trading on informal online markets evidently involves a great deal of trust and trustworthiness. In these markets individuals spread over the globe may buy and sell a wide variety of goods and services. Typically, single isolated trades take place between anonymous counterparts, and there may be no opportunity for inspection of the item to be traded. Each of the trading parties might be tempted to cheat.

As a buyer of PEZ™ dispensers at eBay (<http://www.eBay.com>), for example, a buyer faces some risk that sellers have not accurately described the condition of their PEZ dispensers, will not pack them properly for shipping, or will not deliver them in a timely fashion, if they will be delivered at all. If a seller chooses to deliver before receiving the payment, there are similar risks involved. To manage these risks several approaches have been proposed (see, for example, Kollock 1999, and Malaga 2001). Third-party escrow services could be used. They have the disadvantage, though, that they are time-consuming and costly.

EBay, for example, launched its Feedback Forum in February 1996 in order to promote safe trading, to alleviate the need to track user behavior or arbitrate disputes, and to have a permanent public record of complaint. In its initial version the Feedback Forum allowed that comments did not need to be based on a transaction. The reputation of a user could easily be destroyed without any transaction; in February 1999, eBay introduced transactional feedback, the option to make a comment linked to a specific sale or purchase and a response comment; and in March 2000, all feedback was limited to the participants in a transaction.

The current version of the Feedback Forum allows the participants in a transaction to rate each other by submitting a comment and a rating. The rating takes one of three values: “+1” for a positive comment, “-1” for a negative comment, or “0” for a neutral comment. All ratings that an eBay user receives from distinct other users are summed up into a Feedback Rating number. (The restriction to distinct users, which excludes counting of feedback from repeated interaction was introduced in 2000.) The Feedback Rating number is attached to each user ID, be it a seller or bidder. A user who accumulates 388 positive and no negative comments has a Feedback Rating of 388. However, a user with 459 positive and 71 negative comments has the same Feedback Rating. A user whose Feedback Rating drops to -4 is suspended from further participation. The Feedback Rating is part of the user’s Feedback Profile, which can be obtained by clicking on the user’s Feedback Rating. It provides the full list of textual comments for that user, the distribution of all previous ratings received from distinct other users, the percentage of positive ratings, as well as the distribution of recently received ratings over the past seven days, past month, and past six months.

2.3.1 Reputation Results

The results of empirical eBay studies suggest that buyers are willing to pay more for goods coming from a highly rated seller. Kalyanam and McIntyre (2001) examined auctions of Palm Pilot personal digital assistants, Houser and Wooders (2000) examined auctions of Pentium III processors, Lucking-Reiley et al. (2000) examined collectible coin auctions. Resnick et al. (2002) conducted a field experiment in which they sold matched pairs of items (batches of vintage postcards). Selling one half of a matched pair under the extremely high reputation of an established eBay auctioneer and the other half under newcomer identities with little reputation, they observed that the established identity fared better than the newcomer identity. They also compared sales under newcomer identities with and without negative feedback. Among the newcomers, one or two negative feedbacks appeared to show no price effects.

There are several issues in a reputation system that might be worth consideration. For example, a rating received for a higher-priced item might be valued more heavily in the user-feedback rating number than a rating received for a lower-priced item. One might also be interested in the performance of the positive-neutral-negative rating system relative to the one-to-five-star rating system used by Amazon. People might feel uncomfortable giving a negative rating even for the poor performance of a trading partner, whereas giving just one star out of five might give less discomfort.

We observe, indeed, relatively few negative ratings at eBay. This could be due to the discomfort in giving a negative evaluation or a high trustworthiness, but it could also simply be caused by a fear of retaliation. Both parties involved in a transaction are asked to rate each other mutually. Thus, it would be easy for a negatively rated seller to retaliate by giving a negative evaluation to the buyer. The problem could be solved by simultaneous ratings that will become visible only after both ratings have been submitted or the time period for evaluation has been closed. This could have other negative implications, though, as the information about a seller who does not deliver will be disseminated too late.

Reputation management systems are likely to become more important in the future as the Internet develops as a marketplace. They clearly are a contributing factor to success, as we can see at sites such as eBay. Their existence and performance can make a big difference in buyers' satisfaction or firms' profit and thus in their reliance on online markets. Similarly, reputation management systems should be part of the TrustCoM framework.

3 Business Aspects of Contracts and Reputation

TrustCoM addresses new requirements for scalability, responsiveness and adaptability that necessitate the on-demand creation and self-management of dynamically evolving virtual organisations (VO) spanning national and enterprise borders, where the participating entities (enterprises or individuals) pool resources, information and knowledge in order to achieve common objectives.

This section switches gears from a social and economic view of Trust and Reputation (as described in Section 2) to the business definitions of trust and reputation. The section keeps a focus on foundations of trust between businesses which is based on contracts and terms/conditions for enabling streamlined transactions. In this section, we focus more on the real-life models of collaboration between businesses, where contracts and specific terms and conditions play a strong role in enabling efficient business interactions.

3.1 Scope

In WP8, Business Contracts scope is limited to understanding the role of contracts in VO supply chains and VO management. A VO supply chain is a collection of VO members who are connected in a supply chain form to provide business functions and services to one-another. In the TrustCoM case, a VO initiator, VO member, VO moderator, VO supplier and others form a VO supply chain. Business contracts play a strong role in world-wide economics as we currently witness it. Businesses have long established mechanisms of trust based on contract terms and conditions. With a legal system in place, the contracts violations are monitored and legally resolved in courts. We recognise that most of the consortium partners already have considerable expertise concerning the purely technical issues relating to the VO and trust frameworks that they are tasked with developing. In addition, the project has already submitted a deliverable on the state of the art in technological requirements for a VO². The fundamental questions within the scope of this section are as follows:

- What Business Contract models are appropriate for Virtual Organizations (as envisioned by TrustCoM) for enabling trusted and secure business collaboration over the Internet in Europe and elsewhere?

² WP10, State of the Art

- Will Business Contract models enable better collaboration, interaction and sharing between businesses and provide better profitability, efficiency and reduced costs?
- What are the key recommendations for TrustCoM on Business Contract Models in order to enable Reputation and Trust? What are the business metrics associated with Business Contract terms and conditions?
- How are the business metrics monitored and fed back into Quality and Reputation System? What are key attributes from the terms and conditions which need to be monitored and provided to the Reputation system?

3.2 Relationship between Contracts and Reputation

In this document we assume that there is a strong relationship between Business Contracts, Performance monitoring and Reputation. The figure below illustrates in a simple way the relationship.

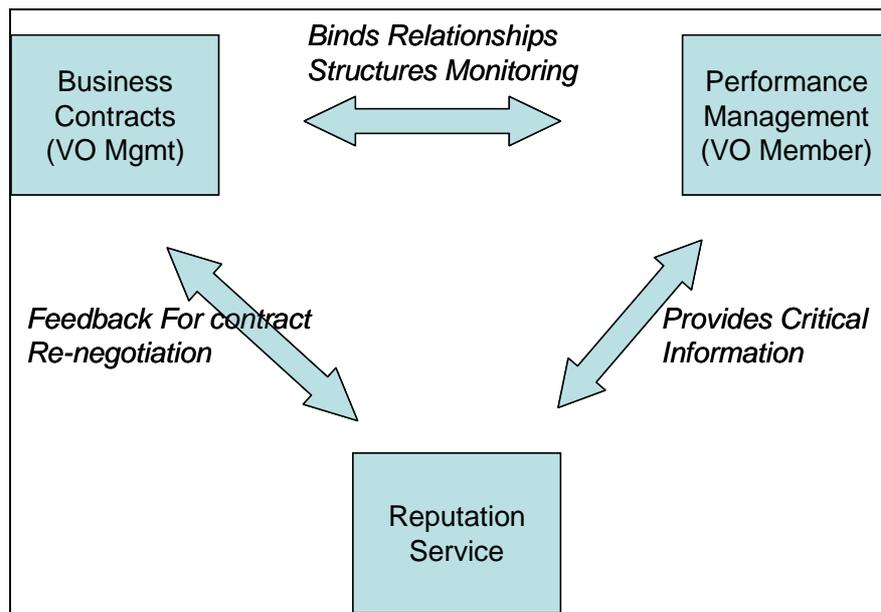


Figure 1: Relationships between Business Contracts, Reputation and Member performance management

In this section, Business Contract Models are described in detail. Three different models are described, but we note that the models described here are abstractions of the general implementations done in real economies.

In sections we present we present the VO CE case study and contracts for VO CE supply-chain and design collaboration. The case studies presented here will provide important guidelines, references, technology values and exploitation plans for reputation mechanisms in TrustCom project.

3.3 Business Contracts and Reputation

The relationship between Business Contracts, Reputation and VO management is shown in the figure below. Business Contracts will provide a set of guidelines for interaction between the VO members. For each of the interactions between the workpackages, the inputs and outputs are clearly defined. For example, the input from WP8 into WP23 reputation is very clearly stated, and the input back from WP23 into WP8 on the structure of rating model is also clearly provided. WP8 provides a higher level notion of Business contracts when compared to the computational terms and conditions in the SLA models (WP22).

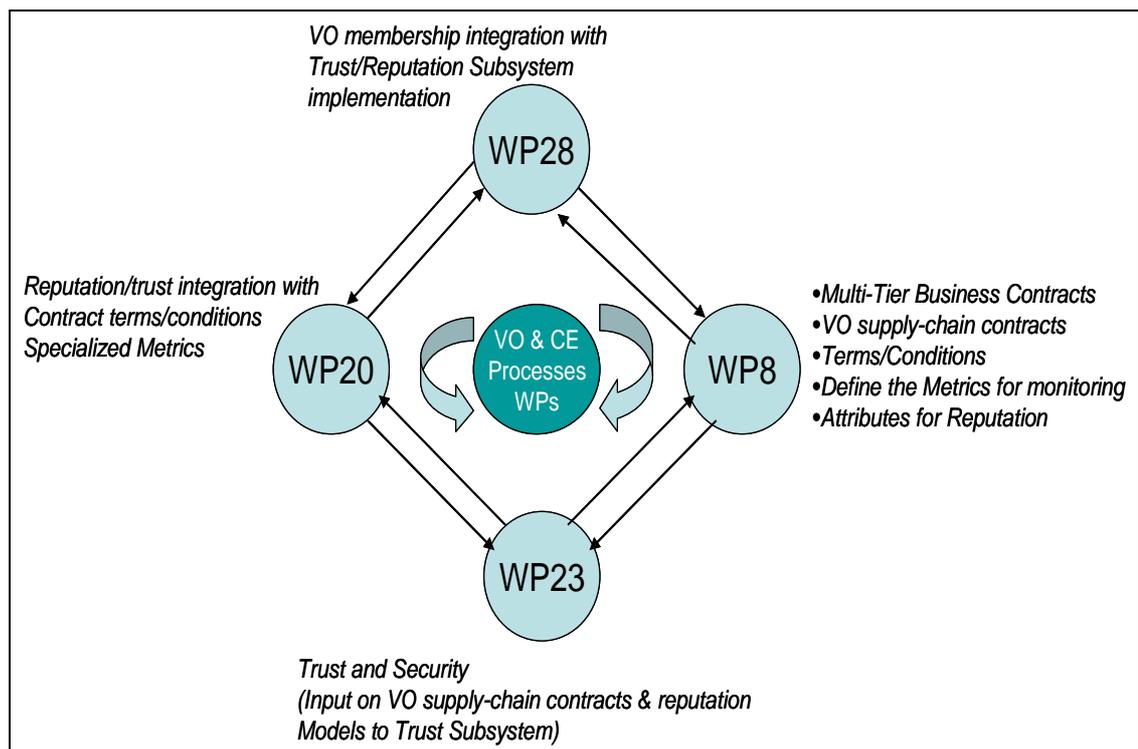


Figure 2: Relationship between Business Contracts and Reputation. WP20 and WP21 play a role in VO management and business process enactment. Business contracts form the foundations for VO formation with multiple VO members.

3.4 Business Contracts

In this section we present models of business contracts for TrustCom VO management. The business contracts capture more information and terms/conditions between businesses in a VO. The contract terms and conditions include attributes that specify the expected transactional behaviour between the businesses. The business contracts contain the following sub-components.

- Partner specific contracts
 - Short or long-term
 - On Delivery, fulfillment, termination, risk and others
- Terms and Conditions
 - Terms provide specific metric
 - Conditions capture the violation process for the metric
- Metrics for monitoring/enforcement
 - Specific metrics for terms and conditions
 - Metrics monitored by third-parties or by each VO
- Business Policies
 - Business policy management
 - Policy mapped to actions and decision-flows
- Business Actions
 - Actions taken once the Terms/Conditions are not met
 - Actions could kick-off workflow and processes

3.4.1 Models of Contracts

Between the businesses, there are several models of contracts that can be established as listed below:

- Bi-lateral contracts between VO members
- Multi-tier contracts with some linkage between VO members
- Multi-lateral contracts amongst the VO members

The contracts are initiated typically between two businesses, but for a business activity to be performed (such as purchasing or design sharing) between more than two businesses, then multi-tier and multi-lateral contracts need to be established for the members of the VO to share certain common terms and conditions.

In the next subsection, we discuss the contract models for VO supply chains. We explicitly selected the CE scenario to help motivate the general models.

3.5 Contract Model in VO Supply Chains

The VO supply chain model with contract system (shown below) is responsible for managing the contracts and monitoring the metrics defined on the terms and conditions. The reputation provider gets feedback from the contract monitor to provide a rating on performance of the VO members with respect to the contracts.

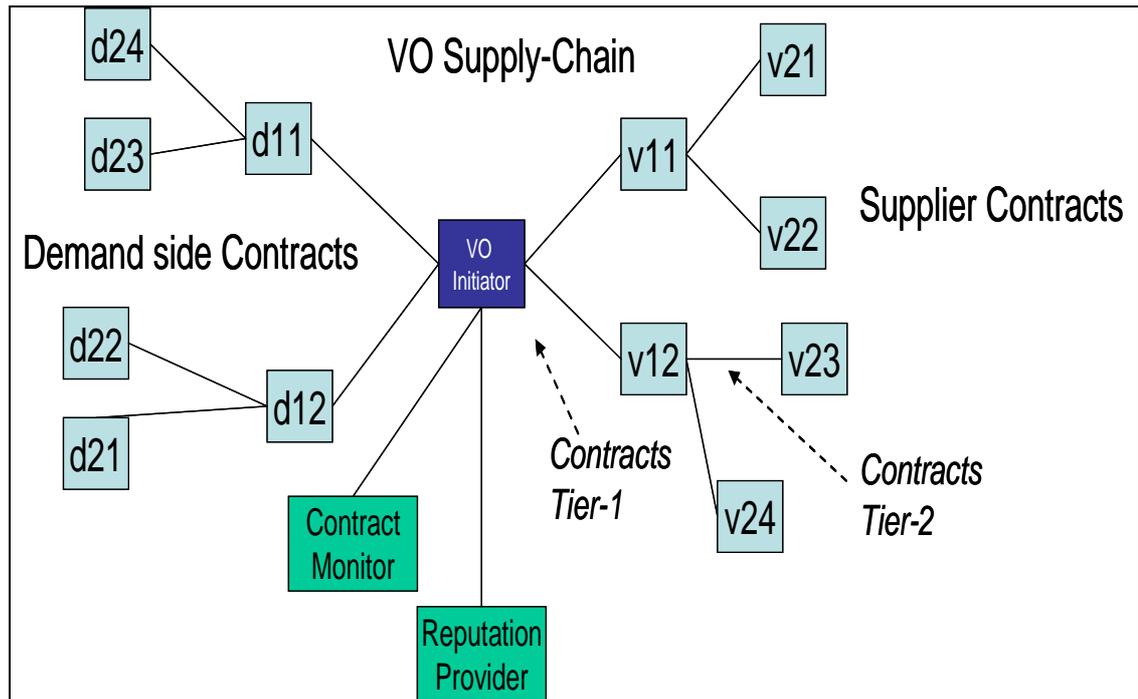


Figure 3: VO Supply Chain Model with Contract System and Reputation Provider. The blue central node is the VO initiator.

The figure above illustrates the various parts of the VO supply chain network. The VO configuration is as follows:

- VO dominant player (e.g CE VO)
- VO Initiator (e.g. AirVO)
- VO Supplier network (e.g. AVO)
- VO Demand network (e.g. AirVO)

The Contracts get established between the following:

- VO contracts between Demand side players and VO initiator
- VO contracts between supply side players and VO initiator

The Contract Terms/Conditions include the following:

- VO Terms for participation
- VO Terms for price, discount-model, delivery, shipment, fulfilment, quality per specification and others
- VO Terms for termination, closure, risk, legal and others

The Metrics for Reputation include the measures based on Contract terms and conditions. The typical measures include the Fulfilment Failure as a % of the Transactions. The metrics are monitored in a metric monitoring system, which can generate the following:

- Reports on Transactions
- Audits on Transactions
- Metric calculations and Measurement

3.6 VO Supply Chain Model

In this subsection, we once again define a Virtual Organization for the sake of clarity in defining the business contracts. A Virtual Organization is a federated collection of businesses bound together by business contracts in order to enable interaction, communication and collaboration to enable the sharing and creation of value for the consumers. A VO supply chain is a collection of businesses organized in a typical supply chain fashion, where VOs establish one or more contracts amongst themselves (in a multi-tier fashion) to enable trusted collaboration and transactions.

3.6.1 Detailed Model

In the supply chain model (figure below), a key dominator (VO creator and manager) will play a role in managing and initiating the interactions between the supply chain. The VO (in blue) will have supplier contracts with one or more VO consortia. Likewise, the VO will have demand side contracts with one or more VO consortia for sales of the finished goods or services.

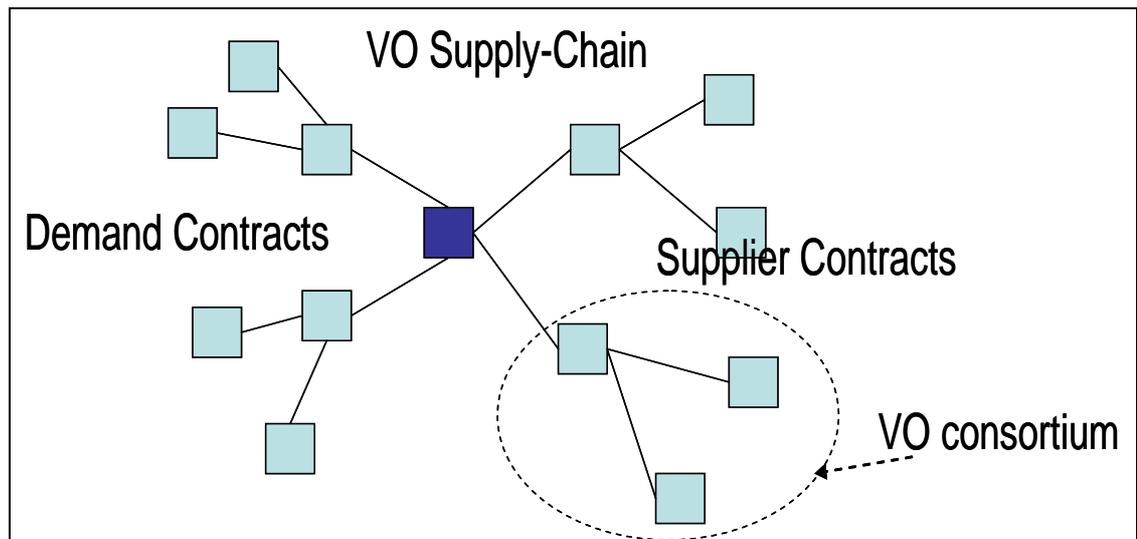


Figure 4: VO Supply Chain Model with the dark blue (dark node) as the VO coordinator. The rest are VO members including a VO consortium acting as a joint member. The VO coordinator initiates the VO formation and establishes the business contracts.

3.7 CE Scenario

The Collaborative Engineering scenario involves an engineering consortium, the CE VO, who develops and produces a range of passenger jets presenting a number of business proposals to a major air line, the AirVO. The proposals are to upgrade a particular part of the fleet to include an inflight Internet and entertainment system. The proposals must take into account existing plane configurations, minimise risks and present an attractive price and upgrade plan to the customer.

Once an acceptable proposal is made the customer agrees to proceed with the negotiation of the upgrade contract and the goal is achieved. The participants in the CE scenario include the following:

- **The CE VO** is a VO that comprises a number of different engineering companies that are responsible for the sub-systems of a passenger aircraft. It is looking for new opportunities and identifies the need for a new capability- inflight Internet service provision for passengers.
- **The AirVO** is a VO that comprises an airline carrier and a number of engineering support teams. It negotiates a requirements specification with the CE VO and reviews the initial design specifications provided by the CE VO in a customer review process. Once the proposed design meets the customer's criteria, a formal proposal is made and a contract is awarded.
- **The AVO** is a consortium of engineering consultancies that collectively provides design and design-analysis services over many different engineering sectors-

automotive, aerospace and construction. It is an SME that relies on the reliable provision of High Performance Computing resources from a HPC provider

- The HPC provider has a supplier relationship with the AVO. It is required to deliver reliable access to fast computing resources within a secure facility.
- **The CE VO** handles the coordination of the design specification, design review, requirements analysis and design analysis between the internal teams and the AVO. The AVO has a strict business relationship with the CE VO- the AVO is paid for its services has no stake in the products owned by the CE VO- that could be described as client/supplier. However, the AVO has access to sensitive design data and participates in the most important design/engineering decisions in the CE VO. In a sense, the relationship is also highly collaborative. However, the CE VO retains rights to any improvements to the design as a result of using the services of the AVO. Marketing Team within the CE VO- this is a team that looks for new opportunities for the CE VO and interfaces to the customer in this particular scenario. Design Team within the CE VO- aggregates design expertise across many departments in different organizations.
- **AVO extracts** the business metrics from the design specification and performs an analysis of the metrics to identify if the design meets performance specifications and criteria.

3.8 CE Scenario Contracts

For enabling the transactions, contracts can be established between the various VOs in the CE scenario is as follows (Figure 5 illustrates the various VO members):

- CE VO
 - An NDA with the AirVO. Contracts with internal members with specific contract terms and conditions.
 - Business policies for each of the terms and conditions are established for ensuring smooth business transactions. Metrics/Attributes for monitoring the terms and conditions
 - Personalized reputation to enable the CE VO to decide on future participation with the AirVO and AVO.
 - A third-party reputation is also feasible for enabling CE VO to make decisions on member performance and rating.
- AirVO
 - Contracts with CE VO. Contract terms and conditions are on on design sharing, analysis quality and design requirements.
 - Business policies for taking actions on breach of terms and conditions
 - Personalized Reputation model to enable AirVO to decide on participating with the CE VO or the AVO in future transactions
- AVO
 - Agreements between individual SMEs within the AVO that agree to coordinate their activities in their overall delivery of the service to the customer

- Contracts with CE VO
- Business Policies
- Metrics/Attributes for monitoring

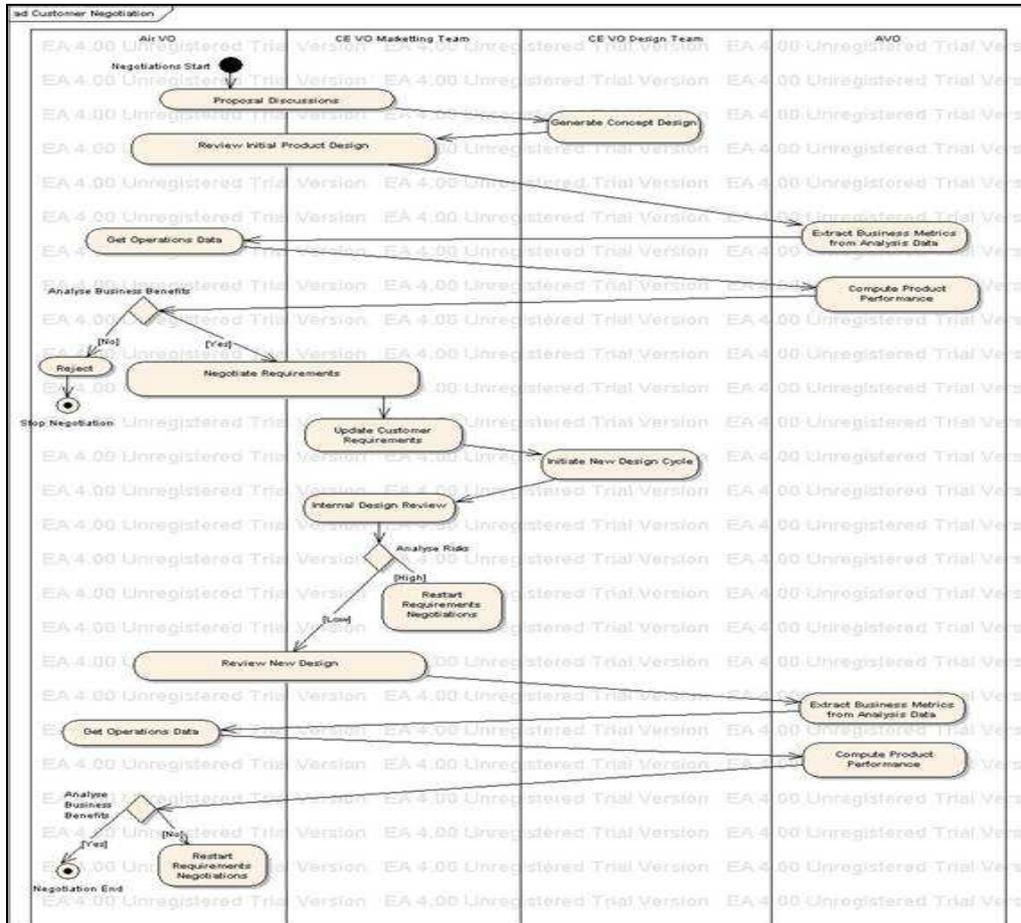


Figure 5 An activity diagram showing the negotiation process for design collaboration in the CE scenario.

In Appendix A (CE VO Contracts), we present a details on the generic Business contracts between AVO and CE VO Markeing Team, and contracts between CE VO Design team and the AirVO member. The contracts terms and conditions specify the details of the expected interaction between the business members on design engineering collaboration and delivery of critical projects tasks based on schedule and quality of service.

3.8.1 Example of a VO Contract

Therefore, the agreement between the two would essentially be a non-disclosure agreement with an additional item about IPR. For the AirVO and CE VO the terms and conditions are as follows:

Owners of Contract

- Air VO contracts officer
- CE VO contracts officer

Roles

- CE VO marketing and project manager
- VO Managers
- CE VO Design manager
- AirVO operations manager
- AirVO negotiator

Expiry Date

Terms and Conditions

- Contract duration: 2 years. AirVO reserves right to extend NDA.
- Contract owner may be changed only by mutual agreement.
- AirVO reserves right to renegotiate contract, eg, duration of NDA
- AirVO reserves right to modify terms and conditions of NDA
- NDA must be observed by all subsidiaries and sub-contractors of the CE VO
- All information provided by the AirVO to the CE VO to be encrypted, given security classifications and be digitally signed
- All information provided by the CE VO to the AirVO to be encrypted, given security classifications and be digitally signed
- All proposal information given by the CE VO, including concept designs and proposed costs, to be in strict confidence and not to be disclosed to other parties.
- The negotiation should be held in confidence by both the CE VO and AirVO and should not be disclosed to other parties without mutual consent.
- The CE VO has all rights to pre-existing and new IPR generated in the course of the negotiation with the potential customer.

3.9 Models for Evaluation and Reputation Rating

This subsection describes the evaluation models and reputation rating of VO members in a VO supply chain based on contract terms and conditions. We first present the models for VO management for reputation and then we present the criteria for ranking and evaluation.

3.9.1 Models for VO management and Reputation

Not all models here are necessarily suitable for VOs. This is primarily because existing organisations may be used to working in a particular model that may not be suitable for new VO type ventures, therefore a sound understanding of the distinguishing factors would be useful.

(1) Traditional supply chain model: this can be seen as the traditional linear relationship (that is typically non transitive). Business processes are internal to the company performing them, although at any or all steps of the chain, the company is reliant on suppliers to provide components, raw materials. The relationships to these other organisations are typically order/supply/pay (although there may be elements of design, specification and so on). It should be noted that there are different models associated with Virtual Organisations – e.g. the market report talks about value networks and dynamic markets – both of these could be applicable here. But the evaluative results will be quite different between these two models. The dynamic market model also has more than one sub-model. For example, who manages the market?

(2) The second model (VO1 in our previous business model and Study) requires a new legal entity to be formed by the member companies – the member companies are therefore the shareholders of a newly founded VO. The VO is a legal entity and can employ staff. The key requirements for a VO of this form are outlined in the technical annex of the TrustCom proposal. This model could be seen as similar to an organisation owned by corporate ownership (e.g. many companies are entirely owned by corporate shareholdings and pension funds). But they are very different. *The annex states a number of conditions (which ones are necessary and which sufficient isn't made clear) for a VO organisation. The VO organisation conforms to the TrustCom lifecycle. So a VO organisation is typically created to meet an important need and dissolved once that need is met. In practice, the creation of a new legal entity may be easy and fast (particularly when law firms offer pre-registered limited societies, like they do in many countries. However, the dissolution of the legal entity is more difficult and cumbersome. Unlike the consortium, this legal entity is itself bound by legal obligations (in the consortium, only the members, not the VO are bound by e.g. contractual and statutory obligations).*

(3) A third model is where people and organisations outsource major parts of their business processes to external organisations – the organisations then mesh together rather tightly. But in this model, control resides with the “parent” company.

3.9.2 Reputation Evaluation based on attributes

- (1) Can include: Costs, stability, scalability, value
- (2) Revenue models
- (3) We should also consider adaptation capabilities (what you get with such networked phenomena). How will the model being considered lead to emergent changes within the whole community of organisations and within individual organisations themselves.
- (4) We should also consider capabilities for innovation. – Such networked organisations typically provide conditions for innovation (part of the dynamic nature of networked organisations and the serendipity involved in contacts with different organisational members). But different models will incur different types of innovation opportunity (and the subject is important given that innovation is one major reason for VO formation) and we should not lose sight of the fact that innovation can come from the very opposite of a network.
- (5) Another one on Interoperability – actually, this criteria is related to 3 and 4 – but maybe we can consider this to do with the changing relations of power and competitive advantage of the members through the process of interaction. Maybe this one is also related to stability and scalability (listed in point 1 above). Either way, we need to understand the dynamics of the model in terms of changing power and competitive relationships between the members.

3.9.3 Scoring Models

There are a number of different approaches to evaluating each of the models with the evaluation criteria. For example, we could use deterministic or heuristic models to simulate the economic, stability, scalability etc. implications of a particular model. We could use standard game theory, evolutionary game theory, social complexity theory, post modern, modern, structuralist approaches and many more. Even within a given perspective (say an engineering type design perspective) there will be a number of different evaluative models to select.

We consider simple weighted models for scoring or complex exponential forms for scoring. The appendix C describes some of the scoring functions based on multiple criteria. The **exponential and linear weighted** functions for scoring based on criteria are described in section 8.1

4 Business Models

The first 3 chapters in this document focussed on the definition of Trust (economic and social view) and the role of Contracts and third-party in enabling a robust trusted environment for businesses. Chapter 5 addresses the following questions: What are the appropriate business and revenue models for enabling Virtual Organization (as envisioned by TrustCoM) frameworks for secure business collaboration over the Internet in Europe and elsewhere? What are the appropriate VO models of execution for enabling collaboration, interaction and sharing between businesses provide better profitability, efficiency and reduced costs? What is the role of business models in enabling Trust and Reliability?

4.1 Scope

The business models document considers TrustCom's two major business scenarios for analysis and investigation. We consider business criteria and perspectives in order to evaluate the models based upon interaction, trust establishment, revenue generation and cost management. The following are the goals of the business models research:

1. Recommend and evaluate business models based on cost, revenue and execution for the CE³ and AC⁴ (Ad-hoc Collaboration) business scenarios
2. Identify and use critical business and technical criteria for evaluating the business models
3. Perform analysis of the business models for the CE and AC scenarios
4. Compare and contrast the various business models based on revenue, cost, efficiency, and others
5. Provide recommendations on enabling cost efficient interoperability, enforcement and monitoring requires standards and tight integration
6. Recommend profitable TrustCom models which are needed for social and business reasons
7. Perform Economic/cost modeling of trust and security in VOs for Returns on investment and assets.

³ Collaborative Engineering Scenario

⁴ Ad-hoc Aggregated services Scenario

4.2 Approach and Methodology

The following is the approach and methodology taken for the business models study on enabling cost effective and streamlined management of Virtual Organizations:

- Defining the main criteria
- Define the business metrics for criteria
- Design and develop business models for the CE and AS scenarios
- Compare the business models
 - Private versus public third-party
 - Private one-on-one interconnections
 - Buyer and seller controlled third-party
 - Investigate Game models for business interoperability
- Evaluate the revenue and cost structure for each of the models.

4.3 Recommendations and Contributions

In this document we present the main business criteria for comparison of the business models for the CE and AS scenarios. We present 6 models for the CE scenario and 2 models for the AS scenario. We compared and contrasted the models for each of the scenarios based on several criteria. The main recommendations are as follows:

- Models based on one-to-many (VO managed by the initiator) tend to have higher costs (e.g. transaction monitoring), complex interconnection, less flexibility and lower revenue when compared to third-party driven interoperation, integration and trust.
- Models based on third-party tend to have higher flexibility and better cost management in VO formation in the CE and AS scenarios. Third-parties focus on trust building based on reputation mechanisms, contracts and enforcement of contracts. The revenue models and costs are dependent on transaction volume, subscription rates and interoperation costs.

In the following sections, we present the main criteria and metrics for evaluation of the business models for the CE and AS scenarios. In section 5.6 (and onwards), we describe in detail the business models, and we compare and contrast them based on the criteria.

4.4 Business Models Criteria

The main criteria for evaluating business models are defined in the table below. The criteria were used to evaluate 8 business models for the CE⁵ scenario and 2 business models for the AS⁶ (eLearning) scenario.

Criteria Group	Metrics	Application to CE	Application to AS
Financial	Revenue, ROI, Costs, Assets, ROA, Intellectual Capital, Maintenance, Labor costs	Yes	Yes (except for social, non-profit interaction between businesses)
Organization	Market Share, Stability, Scalability, Adaptation, innovation capabilities, power and efficiency	Yes	Yes
Trust and Security	Risk , Trust level, member satisfaction index, security levels and privacy index	Yes	Yes
Technology	Interoperation standards, Process Integration, Security, contracts and Service agreements (SLAs)	Yes	Yes

⁵ Collaborative Engineering Scenario

⁶ Aggregated Ad-hoc Scenario

Business Process Metrics	Process efficiency, flexibility in changes, automation costs, transaction rate, number of transactions, monetary value	Yes	Yes, (except for social non-profit interaction)
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The metrics and criteria for comparison and evaluation of the models are described in some detail in the following subsections. The main metrics and criteria include the financial, the technology constraints (interoperation) and the business process performance.

4.5 Financial and other business scorecard information

- **Revenue models** (e.g. from new markets, increased customer base etc and implications for ROI,)
- **Cost Models** (e.g. infrastructure, transactions and others)
- **Asset base** (e.g. capital investment)
- **Intellectual capital** (various forms of opportunity to increase IC – e.g. access to R&D)

4.6 Organisation

- **Market share** – implications for increase, balance etc.
- **Stability** – Is the whole stable, does the whole produce instabilities in the individual organisations, impact of integrating technology
- **Scalability** – Related to stability – how big can it get before it gets instable. Implications of technology to scalability – i.e. will it get too complex to enable interoperability of business processes.
- **Adaptation capabilities** What emergent capabilities will the model have on the organisations in the VO and the VO as a whole?
- **Innovation capabilities** To what extent does the model provide enablers and barriers for innovation capabilities? (Warning that very rigid and hierarchical business models and power leadership models can be very good for innovation)
- **Power relationships** – who controls power but more importantly for the study, do the dynamics of the VO model have implications for shifts in power balance through time.
- **Efficiency** – How does the model implicate efficiency of business operations

4.7 Trust and Security

- **Risks** (e.g. organisational, client/customer, contractual etc. Complexity for automation of contractual relationships)
- **Trust** (implications on contractual, ease of forming, etc.)

4.8 Technical

- **Security** – as above in trust and security, but capability of technology to support security.
- **Process Integration** – A key criterion – how can technology support the organisational model, what technology will be required and therefore implications for successful technology provision. (maybe some additional criteria from the VO technology document, the State of the Art Evaluation.) As part of this, we would include sub-sub criteria as transaction efficiency.
- **Contractual Support** – Supporting the VO to form contracts – implications of the model for this.

4.9 Business Models and Analysis

In this section, we present the business models for the CE⁷ scenario. We compare and contrast the models based on the criteria and metrics defined in section 2.

4.10 Business Models for CE Scenario

In this section, we present the business models evaluation for the CE Scenario.

4.10.1 One-to-One and One-to-Many Models

In the Figure 6 below, we illustrate two models of interoperation and integration between the VOs and the VO initiator or manager for the CE scenario. The first model (1 or 1B) is a one-to-one interaction between the Enterprise (VO manager) and the partners. The partners for example include suppliers, dealers and other networked businesses. In Model 2 (or 2B), the interaction is done through a Trusted Third-party with all the partners grouped into one consortium and managed as a single entity.

⁷ Collaborative Engineering Scenario

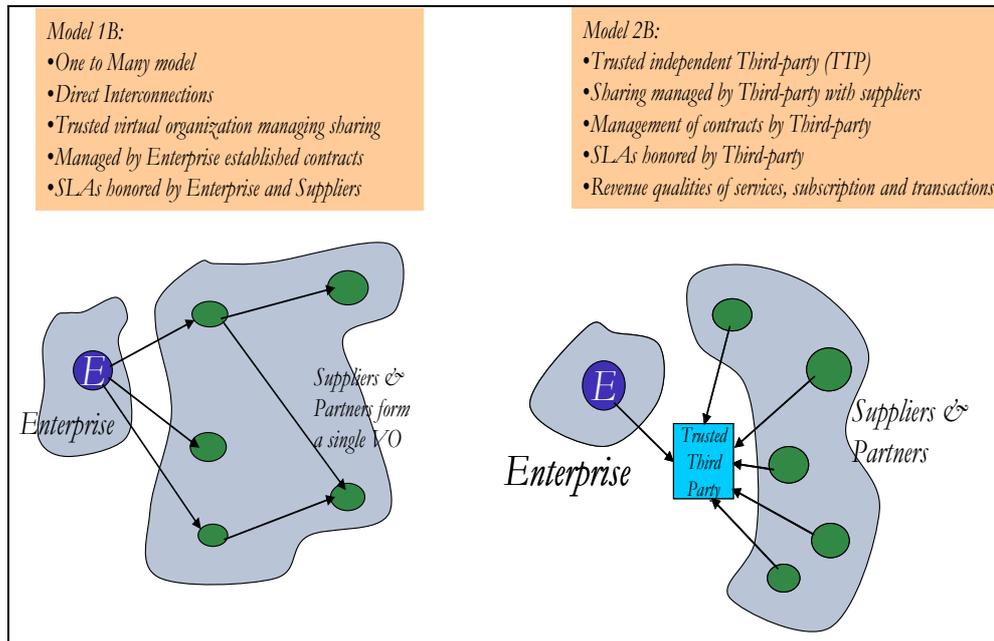


Figure 6: Models 1 and 2

4.10.2 Trusted-Third-Party Consortia Models

In the Figure 7 below, we illustrate two models (3 and 4) of interoperation and integration through a trusted third-party and multiple consortia. The third-party provides mechanisms for transactions, reputation, integration between multiple VO managers and trusted consortia. In model 3, we consider a single VO manager (or initiator) and multiple partner consortia. The VO manager can have a stake in the trusted third-party to enable the transactions and interoperation. In model 4, multiple VO managers interact with various partner consortia through the Trust-Third party.

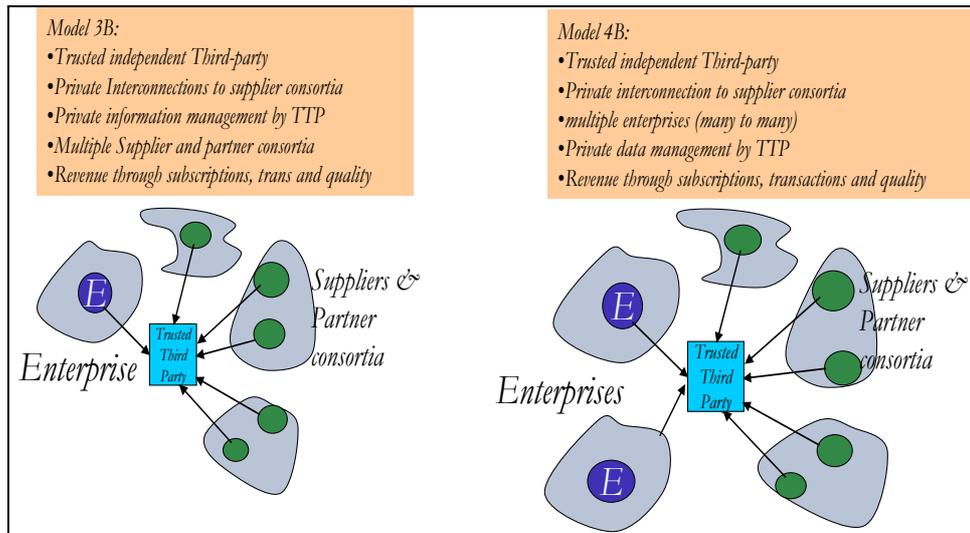


Figure 7: Models 3 and 4

4.10.3 Partner Managed Consortia

In the Figure 8 below, we present two more models for TrustCom CE scenario. In the first model (5) buyer consortia form and invest in a trusted third-party to manage the interactions with other partner virtual organizations. The second model (6) considers supplier consortia that manage the trusted third-party for interaction.

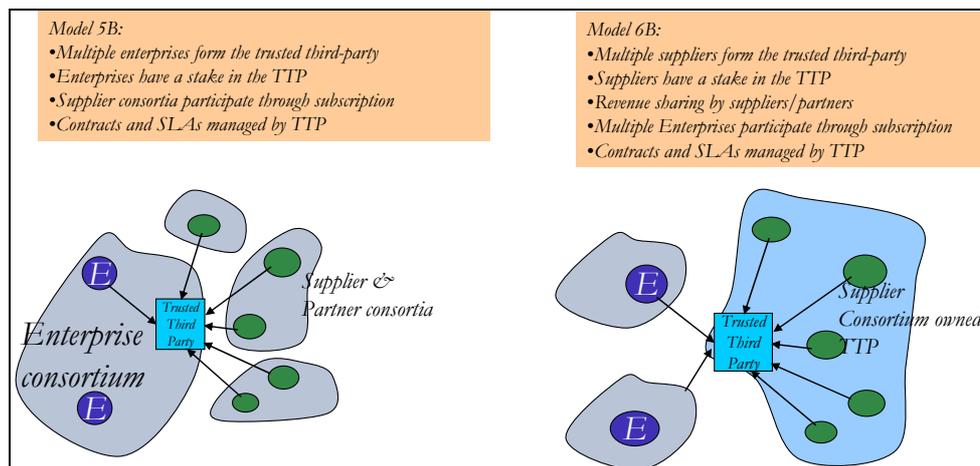


Figure 8: Buyer and Seller Managed Third-Party Models

4.10.4 Comparison of the Models for the CE Scenario

Criteria/ Model	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Financial Revenue Costs Assets RoI and RoA	Subscription revenue Interconn and monitoring costs RoI and RoA driven by Enterprise efficiency	TTP Revenue based on Transaction, subscription and QoS Partner managed their own RoI/RoA	TTP revenue based on Trans, subscription and QoS Partner managed RoI and RoA	TTP revenue on trans, subscription and QoS Partner managed RoI and RoA	TTP revenue on subscription. Enterprises have stake in TTP Partner managed RoI and RoA	TTP revenue on subscription. Suppliers and partners have stake in TTP Partner managed RoI and RoA
Organization	Enterprise managed Long contracts Supplier monitoring	TTP managed Contracts and SLAs through negotiation Monitoring by TTP	TTP managed Multiple consortia Multiple VOs Complex mgmt	Many-to-many TTP managed Multiple VOs Complex mgmt	Private Many-to-many TTP managed Multiple VOs Complex mgmt	Private Many-to-many TTP managed Multiple VOs Complex mgmt
Trust and Security	Enforced by Enterprise Enforced by partners Enforcement is complex	TTP enforcement of trust and security Monitoring done by TTP Enforcement is less complex	Enforced by TTP Enforced by partners Monitoring by TTP			
Technology	Contracts establishment SLA mgmt Web Services interconnection	Private information store, confidentiality Policy driven interconnection Web Services interconnection	Private information store, confidentiality Policy driven interconnection Web Services interconnection	Private information store, confidentiality Policy driven interconnection Web Services interconnection	Private information store, confidentiality Policy driven interconnection	Private information store, confidentiality Policy driven interconnection
Business Process Metrics	Not efficient Substantial monitoring costs Enforcement costs High costs process management Semi-automation for processes is feasible	Processes managed by TTP Monitoring by TTP and partners High costs for process management Semi automation for processes is feasible	TTP managed processes High costs for process management and monitoring Semi automation for processes is feasible	TTP managed processes High costs for process management and monitoring Semi automation for processes is feasible	TTP managed processes High costs for process management and monitoring Semi automation for processes is feasible	TTP managed processes High costs for process management and monitoring Semi automation for processes is feasible

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6 Appendix A: CE VO Business Contracts

In this section we describe the various Business Contract models for VO management and lifecycle control. Business contracts have over many years and are still playing a strong role in enabling trusted interaction and transactions. The contract terms and conditions have become the foundation for enabling the flexibility in specifying the rules of interaction and operation for transactions, sharing information and computational resources.

In this chapter we present models of the business contracts and the economic models of reputation based on the terms and conditions. The models of contracts are for VO management and control in the VO lifecycle. The contracts are multi-tier and enable VO supply chains to form and leverage the trust that is built based on the contracts. In this section, we discuss the details of the business contracts which is one of the crucial.

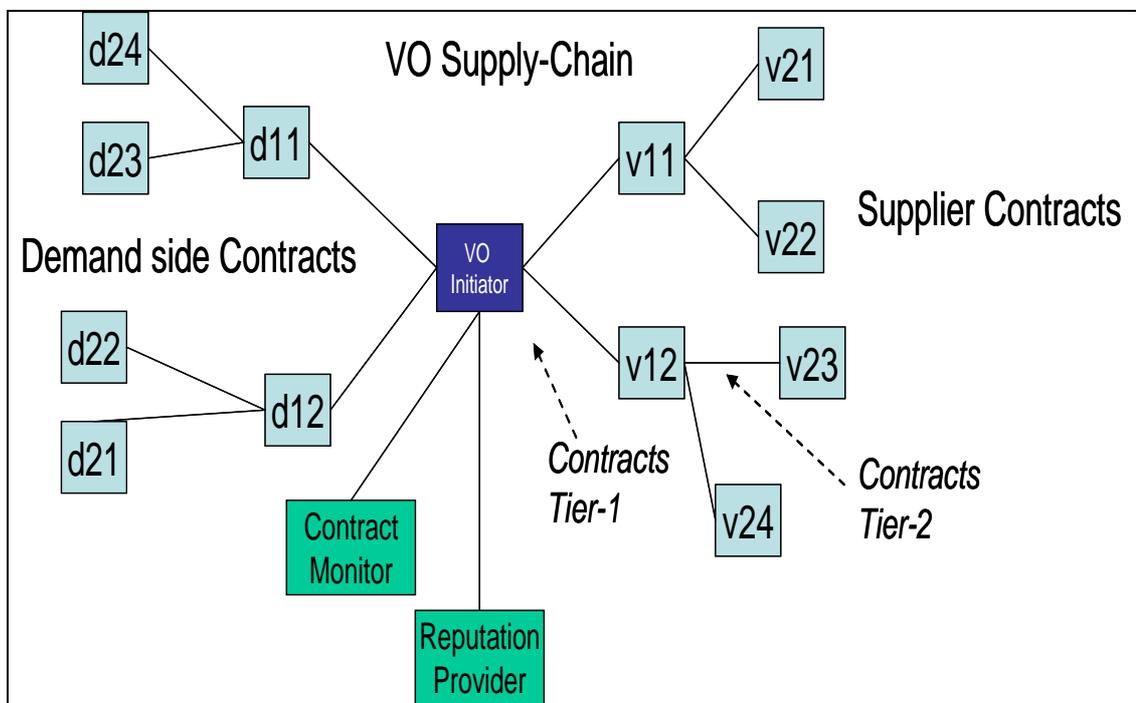


Figure 9: VO Supply Chain Model with Contract System and Reputation Provider

6.1 VO Contract Terms and Conditions

This section defines the terms and conditions that are included in the contracts between the collaborators that have been identified so far. Contracts play a crucial role in enabling trust between the VO members. The terms and conditions of a contract provide a foundation for monitoring and measuring specific violations of the contracts. Other interested parties include air safety bodies, environmental standards bodies and product re-cycling standards bodies. Their interests will be considered in the final proposal but are not involved in the contracts described here.

6.1.1 AirVO and CE VO Contract

During the negotiation the AirVO might have to disclose aspects of its operations data to the CE VO. It may take this decision if it feels that the benefits from the CE VO's proposal are worth the risk from sharing this data. The operations data has no associated IPR but may be of value to competitors as it may give an insight into:

- 1) Internal business information- internal processes, current product configurations etc, and
- 2) The strategic direction of the company.

In addition to this, the negotiation between the AirVO and CE VO might have to be conducted in confidence in order for the AirVO not to disclose its intentions to its competitors. A similar remark could be made for the CE VO- if it feels the proposal has novel aspects then it would prefer to keep the negotiation process confidential as well. Any IPR generated in the process of negotiations with the customer should be retained by the CE VO.

It should be pointed out that the negotiations do not commit either party to delivery dates for proposals and AirVO business information. Therefore, the agreement does not cover aspects of this (possibly temporary) relationship that could say anything about the professional competencies of either party. For example, delayed proposals and customer reviews and delays in delivery and access to internal business systems are not covered. The consequences of these may be loss of time and campaign funds for the CE VO with very little impact on the AirVO.

Therefore, the agreement between the two would essentially be a non-disclosure agreement with an additional item about IPR.

For the AirVO and CE VO the terms and conditions are as follows:

Owners

- Air VO contracts officer
- CE VO contracts officer

Roles

- CE VO marketing and project manager
- VO Managers
- CE VO Design manager
- AirVO operations manager
- AirVO negotiator

Expiry Date

Terms and Conditions

- Contract duration: 2 years. AirVO reserves right to extend NDA.
- Contract owner may be changed only by mutual agreement.
- AirVO reserves right to renegotiate contract, eg, duration of NDA
- AirVO reserves right to modify terms and conditions of NDA
- NDA must be observed by all subsidiaries and sub-contractors of the CE VO
- All information provided by the AirVO to the CE VO to be encrypted, given security classifications and be digitally signed
- All information provided by the CE VO to the AirVO to be encrypted, given security classifications and be digitally signed
- All proposal information given by the CE VO, including concept designs and proposed costs, to be in strict confidence and not to be disclosed to other parties.
- The negotiation should be held in confidence by both the CE VO and AirVO and should not be disclosed to other parties without mutual consent.
- The CE VO has all rights to pre-existing and new IPR generated in the course of the negotiation with the potential customer.

6.1.2 CE VO and AVO Contract

The goal of the CE VO is to win a major upgrade order with a major customer through negotiations based around upgrade proposals. This negotiation process involves a number of risks to the CE VO:

- 1) Failure from achieving the contract due to inability to formulate a convincing proposal to the customer
- 2) Failure from not achieving the goal within time constraints defined by the negotiation process, e.g., for customer reviews.
- 3) Risks from disclosure of important IPR with temporary collaborators who help to formulate the proposals.

Therefore, the CE VO requires a good turnover of designs and reliable analysis data to avoid these risks. It also needs to have a reliable collaborator who it trusts not to disclose its design data.

From the point of view of the AVO, it needs to be sure that the CE VO agrees to a fair delivery and payment schedule. It also needs to ensure that its technical assessments will not hold it responsible for product reliability and safety.

Owners

- CE VO Contracts Manager
- AVO Contracts manager

Roles

- CE VO design manager
- CE VO Project Manager
- AVO Project Manager

Expiry Date

- Either completion of 1000 transactions or June 1st 20<XY>.

Terms and Conditions

For the CE VO and AVO the terms and conditions are as follows:

- The CE VO reserves the right to change the duration of the contract. The AVO forfeits the right to change the duration of the contract without prior consent of the CE VO.
- The CE VO has the right to change the delivery schedule, but only after consultation with the AVO.
- Both parties have the right to renegotiate the contract in the event of a) poor performance of AVO and b) late payments by the CE VO
- Contract is fulfilled subject to final customer review by CE VO. This reviews the performance of the AVO in delivering reports to time and expected standard over the duration of the contract.
- Payment schedule: payment based on performance review of the AVO by the CE VO every X months.
- ∴ AVO must deliver analysis reports and data within X days of changes to design.
- CE VO must encrypt and sign any data it discloses to the AVO

- AVO must encrypt and sign any data it transmit to the CE VO
- CE VO must grant access to PDD to the AVO. The PDD must provide the following information: sub-systems <x, y,z...>
- If it wishes to access other information, the AVO must submit a request to the CE VO.
- AVO must not attempt to gain unauthorized entry to other parts of the PDD by whatever route without the consent of the CE VO
- Analysis reports to be delivered as XML documents using industry agreed schemas. Data is to be available in agreed format.
-
- Proposals and technical specifications presented by the CE VO to be held in strict confidence and not to be disclosed to other parties.
- Liabilities: the AVO accepts no liability through loss of life, revenue or property through the use of its prediction data.

6.2 Metrics

AirVo and CEVO Metrics for Monitoring and Reputation

The agreement is an NDA. Monitoring this requires detecting unauthorized disclosure of all data defined by the agreement.

- SecurityBreach metric(?)
 - % unencrypted messages, missing digital signatures and missing confidentiality markings
 - % message and document violations- detected message modifications and message leaks

Other metrics NOT covered by the NDA but which would inform the measure of trustworthiness include:

- QualityMismatch
 - % Inappropriate or irrelevant business documents from AirVO
 - % Incomplete specifications from AirVO
- LateDelivery and DeliveryFailure Metrics
 - Number of delayed/failed customer reviews?
 - Number of delayed/failed deliveries of business information by AirVO
- SpecificationFailure
 - Poorly specified customer requirements by AirVO

AVO and CE VO Metrics for Monitoring and Reputation

- DeliveryFailure Metric
 - % number of failures over Total number of Transactions
- PaymentDelays Metric
 - Delays in days over 30,60,90 days

- CreditIncreases Metric
 - Credit changes % over Total Transactions
- FulfillmentFailure
 - Fulfillment failure % over Total Transactions
 - Departures from agreed XML schemas and document standards by AVO
- ShipmentDelays
 - Document shipment delays % over Transactions
- SpecificationFailure% over Transactions
 - Incomplete specifications by CE VO
- QuantityMismatch% over Transactions
- SecurityBreachMetric

AVO and HPC Provider

- FulfillmentFailure Metric
 - % number of failed job transactions (defined above)
 - % number of failed data transfers from HPC provider to client's storage provider
- DeliveryDelay Metric
 - % number of delayed job completions- violations of QoS
 - % number of data corruptions
- SystemAvailabilityMetric
 - % number of system downtimes- violations of QoS
- PaymentDelays Metric
 - % number of payment delays by AVO
- ContractModifications Metric
 - Number of changes to contract over the lifetime of relationship

6.3 Models for Evaluation and Reputation Rating

This subsection describes the evaluation models and reputation rating of VO members in a VO supply chain based on contract terms and conditions. We first present the models for VO management for reputation and then we present the criteria for ranking and evaluation.

7 Appendix B: Social Aspects of Reputation

7.1 Reputation and Feedback

Amazon.com uses a different feedback system to rate sellers at Amazon Auctions and zShops. Any time a buyer makes a purchase the buyer is encouraged to leave a short comment and rate the seller's performance on a sale from one to five stars, with five stars being the best. The average rating accompanies the seller's name in product listings. Also half.com, before it was bought by eBay, used a scale from one (poor) to five (excellent) and characterized each user by the average rating. Auctions at Yahoo.com, use the same rating scale and the same feedback-rating number as eBay but present the user's profile in a different way: the feedback rating is presented as the number of positive comments minus the number of negative comments. In addition to providing the full list of textual comments, it allows to click below the number of positive comments and retrieve a list of all individual positive comments or below the number of negative comments and retrieve a list of all negative comments.

All of the existing systems are relatively recent and some of them have been subject to several modifications during their short existence. Currently, there is no standard reputation system or set of rules on how to design efficient reputation systems. Rigorous research on reputation management started only a few years ago in various disciplines such as economics, marketing, sociology, psychology, computer sciences, and law.

7.2 Cooperation without Trust

Ostrom (1990) examined conditions under which real-world common-pool-resource problems (fisheries, communal tenure in mountain meadows and forests, irrigation communities) have been satisfactorily solved in self-organized communities. The sword to over-exploiters was one of them. Ostrom et al. (1992, 1994) also confirm this observation in the experimental economics laboratory.

Selten, Mitzkewith and Uhlich (1997) discovered a measure-for-measure principle in people's strategies for playing a repeated asymmetric social dilemma game: a typical strategy aims at a cooperative goal, which is individually specified based on equity considerations. The strategy reacts to the other player's deviation from

this goal in a reciprocating way. Thus, the typical strategy actively attempts to cooperate. A major problem that can arise in the asymmetric situation is that the individual specifications of a cooperative goal might not be compatible. Obviously, symmetry makes it easier to find a joint cooperative goal. Thus, it will be easier to achieve cooperation in symmetric situations than in asymmetric situations (see also Keser 2002, and Keser and Montmarquette 2004).

7.3 Individual versus group trust

The result by McEvily et al. reinforces the finding by Zaheer, McEvily and Perrone (1998) that individual and collective trust are related but distinct. McEvily et al. make the following statement:

... this suggests not only that it is meaningful to conceptualize the placement of trust in a collective entity, but also that collective trust may influence economic activity over and above individual trust. Consequently, it is important to carefully consider which level of analysis is most relevant when theorizing about the role of trust in the organization and coordination of economic activity. Further, recognizing that collective trust has a basis in group identification (Kramer, Brewer and Hanna 1996) is essential.

More concretely, Insko and Schopler (1987) and Schoper and Insko (1992) document that in two-person prisoners' dilemma games, groups tend to play more competitively than individuals. Furthermore, groups demand more but are willing to accept less in ultimatum-bargaining-game experiments (Bornstein and Yaniv 1998), and they terminate the increasing-sum centipede game earlier than individuals (Bornstein, Kugler and Ziegelmeyer 2004).

The prisoners' dilemma situation is the simplest example of a social dilemma situation. Its game-theoretical prediction of an inefficient outcome has motivated many experimental investigations by social psychologists, sociologists, and experimental economists. Very similar issues arise and have been investigated in, for example, games on common-pool resources, voluntary contributions to finance public goods, and team effort. Many other studies document that human behavior is driven by the reciprocity principle. Reciprocity is used as an instrument to achieve cooperative outcomes (e.g., Selten, Mitzkewitz and Uhlich 1997, Keser 2002, Keser and van Winden 2000). Fehr and Gächter in a series of papers (summarized, for example, in Fehr and Gächter 2000) point out the tendency for *negative reciprocity*.

8 Appendix C: Contracts and Scoring Functions

8.1 Scoring Functions

This section presents a family of ranking functions based on contract attributes. The ranking function combines information about quality of services, costs of service, delivery failures, violations in total, failure of products delivered (e.g. including digital documents) and others.

8.1.1 Ranking functions

We present 2 ranking functions based on important criteria (as described in section 4) from the contract terms and conditions. The ranking function is based on knowledge model that correlates business metrics to the raw attributes in data. The functions take the form of utility functions.

Knowledge model: We use a knowledge model to organize the factors that determine the importance of a part, engine, or model. The factors include

Form of ranking function: Our ranking function takes two forms: weighted sum and weighted exponential functions. The following equations show the two forms:

$$\text{Weighted sum method: } S = \frac{\sum_i (W_i \cdot V_i^{n_i})}{\sum_i W_i}$$

$$\text{Weighted exponential method: } S = \sum_i (e^{a_i W_i} - 1) \cdot e^{a_i V_i}$$

Where $a = 2$

In the above equations, the meaning and weight of each value are defined as follows. The criteria can be many depending on the reputation service.

Dimension	V_1	V_2	V_3	V_4	V_5
Meaning	Quality of Service costs	Number of violations	Number of delayed deliveries	Average failure rate of product deliveries	Computational & Security and other violations
Calculation	1) Take sum of cost-related attributes in each contract 2) Sum of all records regarding quality of service	Sum of labor hour attribute in all warranty records regarding the part	Count the number of delayed deliveries	Average of importance of failure rate. This includes document delivery	Average of importance of computational violations (e.g. SLA driven).
Weight	3	1	2	3	1

8.2 Sample Contracts

The business contracts from real-life hosting and supply chains are given below. The contracts terms and conditions also specify the behaviour that is needed from the supply chain in terms of production of the goods and services.

8.2.1 Procurement Supplier Terms and Conditions, and Performance Evaluation:

Criteria for evaluation

- Technology
- Quality
- Flexibility and Terms & Conditions
- Performance against Commitment
- Communication

Purchase-order terms and conditions.

- Prices/Tax
- Terms of payment and acceptance
- Termination
- Imports
- Packages/Transportation
- Late shipments
- Warranties
- Intellectual property
- Other indemnifications
- Limitation of liability
- Assignment
- Exchange of information
- Applicable laws

Industry Code of Conduct with the categories:

- Labor
- Health and Safety
- Environmental
- Management System
- Ethics

Supplier Conduct Principles:

- Forced or involuntary labour
- Child labour
- Wages and benefits
- Working hours
- Non-discrimination
- Respect and dignity
- Freedom of association
- Health and safety
- Protection of the environment
- Laws
- Ethical dealings
- Communications

Monitoring/Record Keeping