

Deliverable

59

WP8-Business Models, Supplier Scoring and Reputation

WP8 Socio-Economics and Business of
Trust, Reputation and Contracts

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31/07/2005

V.2.0

ID: 6.1.3

PRE-FINAL VERSION

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

PRIORITY IST-2002-2.3.1.9



Deliverable datasheet

Project acronym: TrustCoM

Project full title: A trust and Contract Management framework enabling secure collaborative business processing in on-demand created, self-managed, scalable, and highly dynamic VO

Action Line: 6
Activity: 6.1
Work Package: 8
Task: 6.1.3

Document title: Business and Socio-Economics
Version: V.2.0
Document reference:
Official delivery date: 31/07/2005

Actual publication date:

File name: WP8
Type of document: Report
Nature: Public

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Version	Date	Sections Affected
V.0.1	16/6/05	All
V 0.5	18/7/05	2, 3, 4 and 5
V 1.0	25/5/06	3, 4, 5
V 2.0	10/7/06	2,3,4,5
V2.5	12/7/06	1,2,3,4 and 5

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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 business and socio-economic aspects of Trust and Reputation in Virtual Organization management. The document describes in depth business models, contracts and supplier (or member) selection methods for VO (Virtual Organization) collaboration, interaction and sharing between businesses in order to provide better transaction efficiency and better profitability. The report asserts that Business contracts with appropriate business models and member selection provide necessary foundations for enabling trust and reputation between businesses in a VO environment. In this document we also illustrate the importance of supplier (member) scoring and rating from practices in industry supply-chains, and how they can be applied for effective VO lifecycle management.

The technologies and standards based implementations for Trust and Security in VO frameworks provide a technical foundation for building secure 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 the following: a) Business Contracts; b) Business Metrics for monitoring performance driven by contract terms and c) Supplier Scoring 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 and Industry supply-chains. This objective was to understand, expand or extend the competitive strategy driven models to include complex VO attributes for trust and reputation.
- Investigate and recommend Business models for VO management and VO supply chains and trust enablement through intermediaries, supply-chains and third-party entities. In particular focus on CE scenario¹ in TrustCom.

¹ TrustCom CE Scenario focuses on Design collaboration with service providers.

- Investigate Trust and Reputation models for VO lifecycle management using models of business contracts and business metrics between VO members. The contracts include one-to-one and one-to-many configurations.
- Provide analysis and best practices from Industry Supply-chain models for Trust and Reputation in VO management with specific emphasis on the CE and AS scenarios.
- Provide recommendations and runtime system design for Member/Supplier scoring and Reputation for VO management, SLA management and SLA enforcement.

1.3 Modified objectives for WP8

During the first seven 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 and not entirely suited to the requirements of the complex VO lifecycle management, which involves complex relationships between the VO members (group level network level trust). The game model was applied on a few attributes of the members and deeper insights into VO management were not revealed. Based on the reviews done in April, 2005 the objectives were modified during November, 2005 towards models of Reputation, Member scoring methods, industry best-practices in supply-chains, Business models for Trust and others. The final modified objectives are as follows:

- Investigate and apply advanced multi-tier Models of Business Contracts and metrics for VO Management, and contribute the models to AL1 and AL2 (action lines).
- Investigate Business Models for Trust and Interoperability between VO members and other VO organizations. Explore third-party neutral or dominant group environments for VO management and CE scenarios (Design engineering scenario).
- Investigate and apply Business Contracts and corresponding Terms and Conditions from industry supply-chains to VO Trust, member selection and reputation. Contribute to AL1 and AL2 activities.
- Investigate models for Reputation based on metrics defined around contract terms and conditions. Investigate advanced scoring models based on Industry practices in supplier selection using multiple criteria (for new and existing supplier selection).
- Provide recommendations on contract models, business models, reputation methods, member selection and scoring to actions lines in TrustCom (AL1 and AL2).
- To enable flexibility in the selection of partners, guidance in the specification of contractual terms and conditions, and assurance as VOs are executed

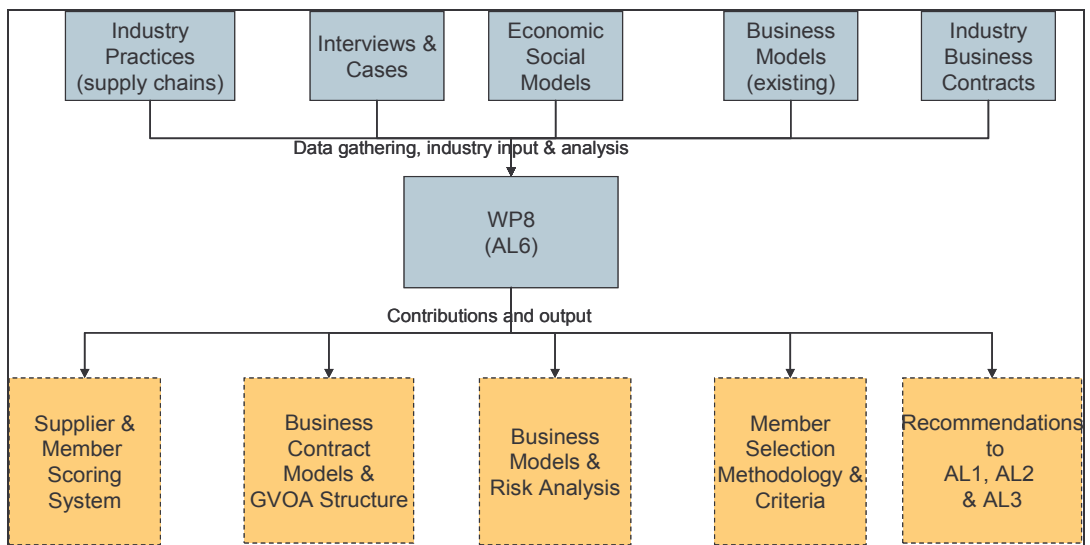
1.4 Interactions with other TrustCom Action Lines

- WP8 (including WP9) closely with AL1 and AL2 sub-projects and teams on Business Contracts, Terms and Conditions, VO management, Business Metrics for Reputation and VO supply-chain models.
- WP8 Business Contracts has contributed industry content and criteria to WP20-21, WP-28, WP 23 and WP35. Currently a working group has been established between multiple partners (KENT, SAP, BAE, NRCCL, BT, HLRS and others) to investigate role of Business Contracts in VO supply chains, VO and SLA management and in designing reputation mechanisms. WP8 intends to provide advanced knowledge, definitions and mechanisms around Business contracts to SLA and VO management (WP22).
- WP8 has provided input to the “Generic Reputation Service” which is an important part of the VO lifecycle management and Trust/Security Services. The input has been on Scoring methods, supply-chain metrics, contract based attributes and management for building an industry oriented reputation system.
- WP8 has also provided input to VO management (on Reputation scoring), 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 2 of this document in great detail
- Developed novel reputation structures based on industry supplier criteria, business contracts and contract-specific terms and conditions. In this document we refer to VO members as suppliers (and we interchange the terms often). In most cases the VO manager is trying to form a consortium of members (suppliers) for specific applications. 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.. Business rules can be set by the VO members on the violations to select the VO members.
- Industry driven 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. 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.
- Business models for Interoperability were developed as a part of WP8 activities (deliverable D14). The models for interoperability considered trusted third-party, trusted consortia and trusted group models. The models apply to CE and AS scenarios and the VO management scenarios.
- Conducted industry research into the role and application of reputation. Used this research to drive reputation models and contracts.

- Industry-based model and methodology for risk and criticality assessment, which can be applied to TrustCom Business models. Identified levels of criticality and risk tolerance to drive the criteria for supplier selection process, scoring, and management.
- Contributed to models, process, and methodology for supplier selection based on industry research and standards. Models includes supplier selection criteria at 3 levels of granularity, supplier, process, and product/ The methodology is applied to the TrustCoM business models. Industry-based supplier management model and metrics applied to TrustCom VO management and CE scenario. The data, input and contributions are presented in the figure below.



1.6 Conclusions and Recommendations

The major conclusions and contributions are as follows.

- Economic models play a strong role in enabling trust mechanisms. The document describes the various business models for enabling trust in third-party environments. The models were compared and contrasted based on risk, cost and other factors. The major result is that trust between parties or players is better with more history of transactions, metrics and assurances.
- Contracts are the life-line of building trust in Business Environments and VO supply chains systems. Design of contract structure based on industry knowledge for multiple service providers was the main contribution. The business terms and conditions in the contract and the contract content are the additional contributions.
- 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. The metrics are captured and provide input to the generic reputation system models (WP 28) for rating and scoring VO members/suppliers.

- Criticality and risk are required precursors to the supplier and partner selection process. Criticality and risk assessment models were developed for the purposes of measurement and communication of these values for TrustCoM VO members.
- The supplier selection process consists of six basic steps including the analysis of risk and criticality. A methodology to support this process has been developed with supporting tools that can be employed in a manual or automated fashion.
- Risk manifests itself differently in the various CE Business Models. The same models also apply to AS scenarios. Opportunities to pool and transfer risk in partnerships and consortia were identified. The supplier selection methodology is consistent across the CE Business Models.
- Products and services present unique characteristics; however, common criticality, risk, supplier selection, and management methodologies are applicable. Differences in product and service sourcing decision are reflected in the supplier selection criteria that have been developed and would be further developed through the presented methodologies.

1.7 Structure of Document

This document is structured into 3 major sections (starting from section 2). The main areas of research work in these sections are the following: a) Business models and corresponding contracts terms for TrustCom VO scenarios; b) Industry driven Supply-Chain Contract Models and best practices; c) Business Metrics for performance and scoring; d) Member and Supplier Scoring Criteria and scoring methodology; e) Business models for Trust Establishment through third-party entities; and f) Member and Supplier Scoring Criteria and scoring methods

The main part of the document is 34 pages in length. The rest of the document content is captured in the appendices. In section 2, we begin by providing Business models and contract structures for VO management and CE Scenario. The business models for the CE scenario provide a foundation throughout this document for modelling business contracts, supplier selection, supplier scoring, risk analysis and business metrics. The same models can also apply to AS scenario.

In section 3, Industry practices for supplier evaluation, risk and models are described in detail. The business models for CE are the basis for doing risk analysis, which is done to ensure the right criteria for supplier selection. The business practices described in this section include supply chain methods used in industries.

In section 4, Business and Supplier Selection criteria and models VO management with Trust are described in detail. Again the business models based on CE are used to describe the different kinds of criteria needed for supplier selection. We also compare and contrast multiple models of interaction amongst businesses with trusted third-parties. We conclude in section 5 with the contributions made to TrustCom through WP8 in terms of business contracts, scoring and supply-chains practices.

In the appendices we provide substantial detail on VO contract models applied to the CE scenario. We also provide details on the interview methodology, the scoring criteria, examples of risk calculation for scoring and others. We also provide details on metrics and scoring methods for Supplier scoring.

2 Business Aspects of Trust and Contracts

Business contracts play a strong role in creating a legal framework, and enabling trusted interaction and transactions. Having well-define contract terms and conditions provides a foundation for enabling flexibility in specifying the rules of interaction and operation for transactions, sharing information and computational resources. Before we begin to describe the contracts in detail for various kinds of providers, we first present a collection of business models for VO management in the context of the CE Scenario (which is based on Aerospace Design Validation and purchasing). In deliverable D45 (framework) a model of a generic VO contract is shown. We expand on this model to cover the business and IT terms and conditions for complex interactions in industry VOs. In this section, we then use the business models to describe the various business contracts for VO management.

2.1 Business models

Several business models based on trusted third-parties or consortia can be suggested and recommended to TrustCom VO structures and scenarios. In the previous WP8 deliverable (D14), multiple business models for TrustCom VO management were analyzed based diverse criteria. The models were applied to CE and AS scenarios. In this chapter will introduce three of those models (shown in figures 1 and 4) in order to drive the analysis and design. We selected the CE scenario to illustrate the business details. The models are as follows.

- Model A is a multi-tier supply-chain model, where there is a dependency on a Tier-1 service provider, who then depends on other service providers down the supply-chain for services.
- Model B is another supply-chain model with multiple Tier-1 suppliers and service providers. In this model, the VO manager assumes risk and management of interaction with the service providers.
- Model C is based on a consortium structure where multiple service providers are part of a consortium that transact collectively with the VO manager (the initiator of the VO).
- Model D is based on multiple consortia that contract with the VO manager for different kinds of services. Interacting with multiple consortia is becoming common in the current economies.

Model	Description	Supply-chain model with profit sharing	Third-Party
VO Model A	VO initiates through third-party	Multi-Tier model of VO creation	Third-party assumes risk
VO Model B	VO initiates and manages the relationship	Single Tier (Tier-1)	VO manager assumes risk
VO Model C	VO initiates through supplier consortium	Single Tier consortium	Third-party assumes risk

VO Model D	VO initiates through multiple consortia	Multiple consortia	VO manager assume risk
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Each of these models assumes a certain risk for the VO manager and relationships in terms of Trust and reputation have to be established right. Through out this document, we will refer to the CE VO business models (A, B and C) and present the contracts, risk models, supplier selection, scoring and others based on these models. These models provide flexibility in partner selection, guidance in specifying contractual terms and conditions“ and “assurance with during the execution of VOs.

2.2 Business Contracts

In this chapter we present models of the business contracts and reputation based on the terms and conditions. The contracts are multi-tier and enable VO supply chains to form and leverage the trust and assurance that are designed in the contracts. In the next section, we present some details of business contracts and we position the contracts in the CE scenario context.

In TrustCom, the main contract model is the EN contract, which is a single contract for all VO members. During our interviews with experts and companies, the main contract model that seems more practical is the supply chain model with one-on-one contracts. The experts indicated that EN contracts in general are complex to build and enforce for complex industry supply-chains (example shown in the figure below, Figure 1). In general, industry focuses on project level contracts which are based on individual one-to-one contracts in a supply-chain configuration. Though both EN and Supply-Chain contracts are important for TrustCom’s applications, we will focus on the Supply-chain contract models, which are quite general and the norm in most industries. In figure 3a, we show a generic GVOA contract model, and discuss the applicability of such a model for the CE scenario in the following sections.

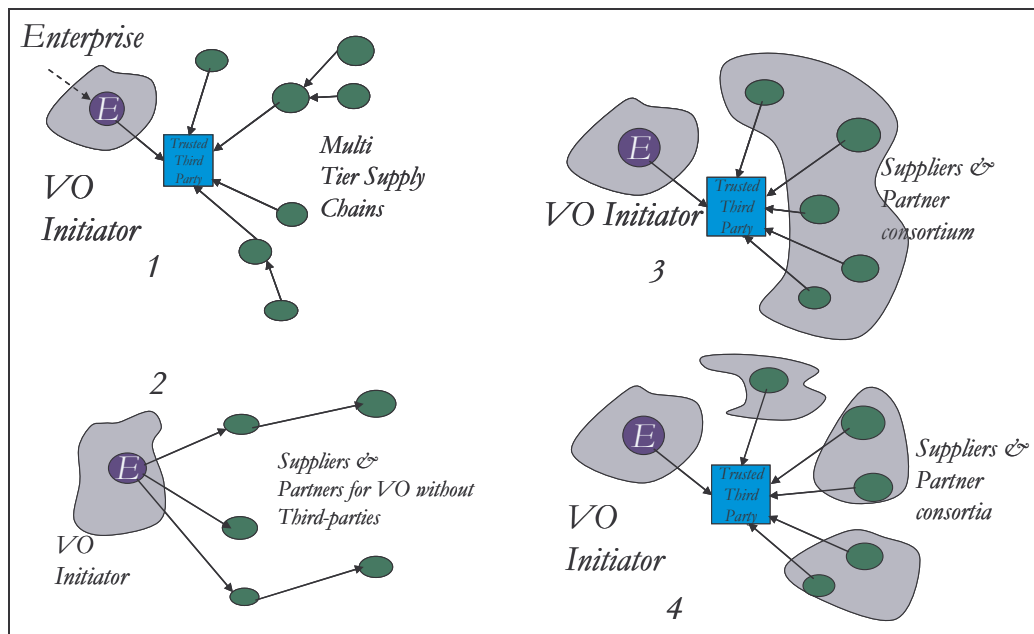


Figure 1: VO Supply Chain Models with trusted third-parties.

2.3 VO Business Structure (CE scenario)

This section defines the terms and conditions that are included in the contracts between partners in the CE scenario. The terms and conditions of a contract provide a foundation for monitoring and measuring specific violations of the contracts. The CE scenario is illustrated in the figure below (Figure 2). The CE VO contracts out the design analysis and validation to an Analysis VO (TC-ConsEng), which is a consulting firm specializing in Aircraft design analysis, validation and testing. The business structure consists of 4 major players. CE VO is the main customer for TrustCom.

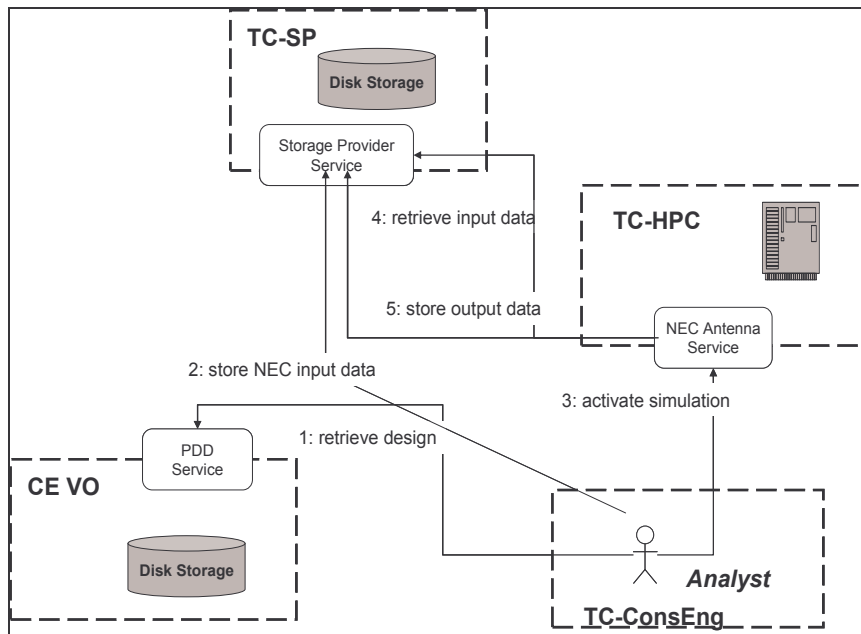


Figure 2: CE Scenario and Roles

2.3.1 VO Contract Model and CE Contracts

The business contract models (GVOA) is shown in the figure below. The contracts have multiple types of terms and conditions. The main types discussed in this document are the Business and IT terms and conditions. The legal terms and conditions are discussed in WP9 (Legal Issue) of the TrustCom project. In general, the contracts can be one-to-many or one-to-one. In the figure below, we show a generic contract model for businesses, where access control, terms and condition, policies and actions are defined in the contract. A sample contract is given in Appendix A for TC-ConsEng. The contract is modelled in XML for enabling contract management and enforcement (see appendix A).

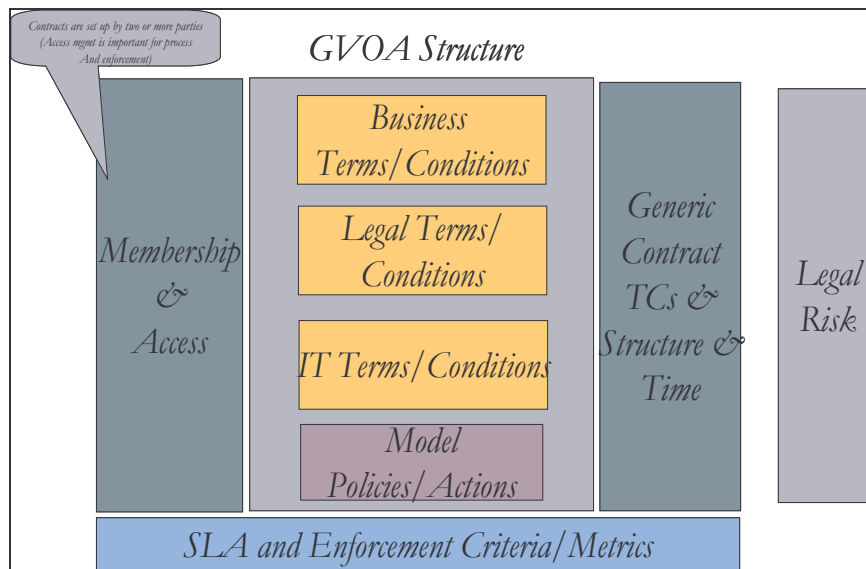


Figure 3a: GVOA contract structure

There are several contract models to consider in the TrustCom CE Scenario. There are four kinds of contracts that can be derived from the TrustCom CE scenario, of which we present in two of them in some detail. In Figure 3a, we illustrate three types of Terms and Conditions (TCs) as forming the contract basis. In addition, the contract model has generic terms and criteria for access and change management. The four kinds of contracts in the CE scenario are as follows:

1. CE VO and AirVO
2. CE VO and Analysis VO (TC-ConsEng – Consulting Engineering Firm)
3. TC-ConsEng and TC-HPC
4. TC-ConsEng and TC-SP

The contract models are described in detail in the Appendix B. Three of the models are illustrated in detail in Figure 4a. The contracts terms and conditions are captured in XML format (XML schema). Sample contract schema and XML are defined in the appendix A. The contract structure provided input to TrustCom GVOA models (done in WP35).

The CE scenario illustrates both product and service sourcing decisions ranging from aircraft components to engineering, IT and storage services. The CE scenario also allows for multiple VO business models including various levels of partnership and n-tier supplier participation. The content of this document is applicable to and addresses these business models as well as multi-tier supplier relationships. In Figure 4a, 3 models for the CE scenario are illustrated. We use these three models throughout chapters 2,3 and 4.

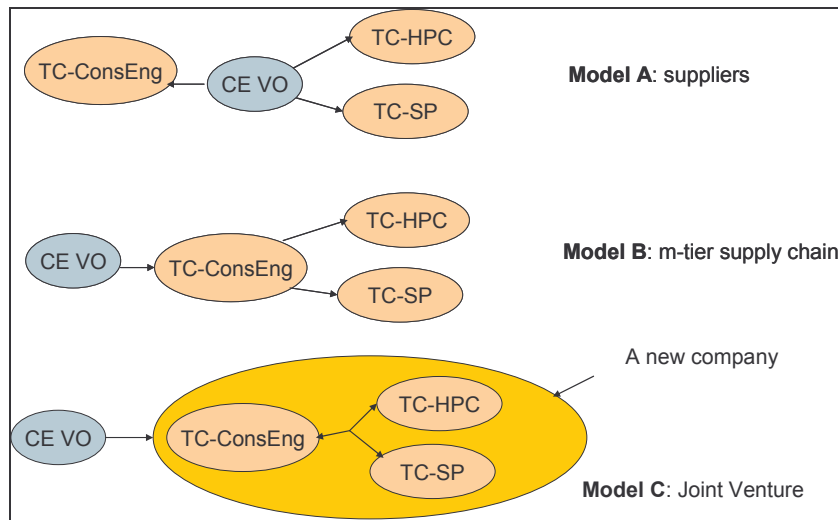


Figure 4a: VO Business Models applied to CE Scenario

In figure 4b, we illustrate in more detail Model A, which contains a strong supply-chain of suppliers offering specialized services through established contracts. In Figure 4b model A is elaborated. There is a strong dependency on TC-ConsEng to ensure that business transactions and consulting jobs are accurately done.

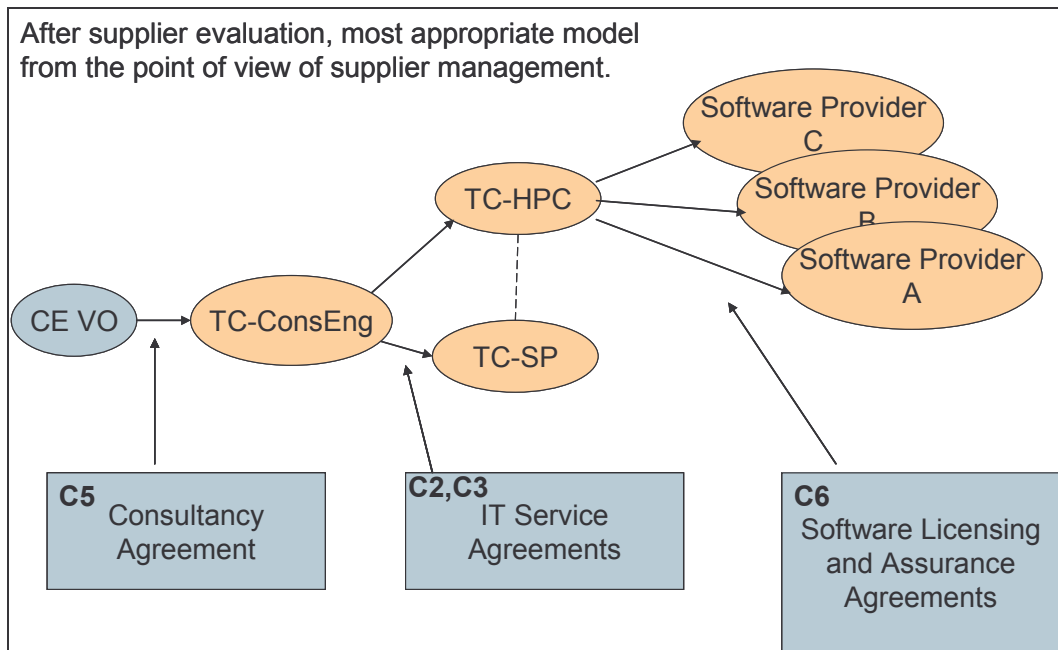


Figure 4b: CE Supply-Chain Contracts – Model A

2.3.2 CE VO and TC-ConsEng Contract

CE VO negotiates with consulting service providers to perform design, validation, testing and approval of aircraft design. During the negotiation the CE VO might have to disclose aspects of its operations data to TC-ConsEng (see figures 4a and 4b). It may take this decision if it feels that the benefits from the CE VO 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 Internal business information- internal processes, current product configurations etc, and The strategic direction of the company. 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 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. Delayed proposals and customer reviews and delays in delivery and access to internal business systems can also be covered. The consequences of these may be loss of time and campaign funds for the CE VO. Therefore, the agreement between the two would essentially be a non-disclosure agreement with an additional item about IPR. A contract between the CE VO and TC-ConsEng is described below.

Contract Items	Type of TC (Terms and Conditions)	Description of TC	Values for the contract item
Owners	Member	One or more owners of the contracts	TC-ConsEng and CE VO Contract analysts
Roles	Member Role	One or more role supported by the contract	CE VO marketing and project manager, VO Managers, CE VO Design manager, AirVO operations manager, AirVO negotiator
General TCs	General Terms for contracts	General terms such as change, approvals, expiry, owning group and renewal.	Business Policy
Duration TC	Time or Date	Duration of contract which is a generic part of the contract	Duration in date or time
Change Owner TC	General Business TC	Change of contract primary owner	Change rule and policy
Change Contract TC	General Business TC	Contract owners can change the contract based on agreed upon business rules	Change policy
NDA TC	Business Rule and TC	NDA must be observed by all subsidiaries and sub-contractors	Business Policy on non-disclosure of information
Security TC	IT Rule and TC	All information provided by CE VO should be encrypted	IT and Business Policy on Security of data

Confidentiality TC	Business Rule and TC	All data from CE VO is confidential, secure classification, digitally signed and a non-disclosure	Business Policy on Confidentiality
Information Loss TC	Business TC	All data must be duplicated and backed up twice a day (24 hour system and 7 days a week)	Backup policy (Multiple times per day of critical information)
Non-Disclosure	Legal and Business TC	The same as Confidentiality TC, but persists beyond the project duration.	Business Policy

Similar to the above contract structure and content, the CE VO can have multiple contracts, one with each service provider. The business model for the CE scenario is described in Figure 4 (section 3). The business (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. Detailed TC-HPC and TC-SP (Storage provider) contracts are described in the appendix.

In the next chapter details of the Industry best practices for supplier scoring and selection are described. In addition, some of the best practices are recommended for TrustCom VO management and CE VO scenario implementation. In the appendix B, additional contracts (tables) are defined for the various interactions between the service providers.

3 Industry Practices Models and Risk

The objective of this section is to provide a view of the current state of Criticality and Risk in industry. The role of criticality and risk are significant in their contribution to the supplier selection and management process. Both are precursors to the development of supplier selection models and management metrics. In a higher risk and higher criticality environment, trust must be assured thoroughly and in a structured manner. Historical performance metrics and reputation play an important role in high criticality and high risk environments.

After criticality and risk are examined in this chapter, chapter 4 will illustrate the supplier selection and management process from beginning to end. Beginning with criticality and trust and ending in supplier management and monitoring.

3.1 Scope

VO members are part of a VO supply chain wherein their interactions are governed by trust and reputation and assured by contracts. These interactions include the selection of VO members or VO suppliers and the ongoing tracking of performance to set objectives and expectations specified in contractual agreements. In this section we focus on actual practices and methodologies that are employed in various industries. Interviews were conducted across multiple industries to document and apply industry practices to the TrustCoM framework. The questions this section will address are specifically: a) What are the drivers behind the supplier selection and scoring mechanism development?; b) How do risk and strategic business criticality play a role in the development of trust and reputation?; c) Within industry how are product and service sourcing unique?; d) How does industry consider and apply reputation?; and e) How can this be applied to TrustCoM?

3.2 Information Gathering Process and Methodology

The process for gathering information for this document chapter included interviews with industry professionals across industries and TrustCoM consortium members. The consortium member companies from which feedback was collected include:

- BAE Systems
- British Telecom
- IBM

The first sets of interviews conducted were with IBM and comprised the majority of dedicated interview time. Subsequent interviews with BAE and British Telecom strongly validated the information assembled from IBM interviews and industry expertise. Additionally, a great deal of supply chain expertise in industrial and automotive sectors was leveraged through consortium member contributions.

The information gathering process was facilitated through structured interviews based on a questionnaire included in appendix B of this document. The questionnaire was designed to elicit responses from interview subjects around the following six subject matter areas:

1. Supplier selection and de-selection processes
2. Supplier selection criteria
3. Metrics and KPIs
4. Reporting
5. Supplier Relationship Management
6. Tools, Systems, and Automation

The results of these interviews provided a significant source of information to the development of this document chapter and the next. Additionally, publications and journals were consulted for additional information. Significant to note, among these publications were corporate websites where major corporations often publish basic supplier selection guidelines. Some of these guidelines are included in document Appendix D.

3.3 Product and Service Sourcing Differentiation

Although there are many similarities between product providers and Service providers within a VO context, there are some unique points of differentiation that should be recognized. Among the key drivers of differentiation is the subjective nature of many services. It can be difficult to measure how effectively services are delivered as compared to products. Product quality can typically be measured with objective comparisons to specified requirements. But service quality is often subject to human perception of a service level. It is possible to measure many service metrics with simple objective evaluations such as issue response time or issue resolution time; however, many metrics are not as straightforward. Note: Criticality, Risk, Selection processes, and Supplier Management are all explored in further detail in subsequent sections of this document. The CE scenario illustrates both product and service sourcing decisions ranging from aircraft components to engineering, IT and storage services.

3.3.1 Overview of Product and Service Differentiation

The table below illustrates the distinctions between purchased products and purchased services where relevant for this study on Business, Reputation, and Social Aspects of Trust. Distinctions are made by the following dimensions:

- Defining Characteristics
- Criticality
- Risk
- Supplier Selection
- Supplier Management

Prod / Service	Defining Characteristics	Criticality	Risk	Supplier Selection	Supplier Management
Product	Refers to physical goods that are procured by a company (The VO Initiator).	Criticality in the provision of products is similar to that of services. The measurement of criticality may vary, however, at times being closely related to sequential activities in a product design or manufacturing process.	Risk tolerance in product delivery may be related to product specification requirements and allowable deviations in addition to delivery and availability requirements.	Supplier selection for product providers may include detailed evaluations of product spec such as measurements, weight, performance testing, etc.	Supplier management for products often includes a great deal of automation where measurement of product specifications and delivery are involved. Automation allows for the generation of large volumes of data that can easily be applied to data analysis-based process optimization exercises.
Service	Refers to work executed by people (or combinations of people and machines) benefiting a company (VO Initiator). The work may result in the provision of products or other services.	Service criticality is driven by the same needs and requirements as product criticality – to provide requirement to a customer – however, the heavy reliance on human capital in the service sectors at times change the evaluation and measurement of criticality.	Risk tolerance will be primarily related to service delivery requirements and service performance.	Service-based supplier selection may involve criteria that are more heuristic in nature when measuring the suitability of the specific service to customer requirements.	Supplier management in a services delivery environment involves more subjective metrics of quality and delivery. To capture and quantitatively evaluate data of this nature requires quantification methods such as ordinal ranking where precision may be lost.

Figure 5: Product and Service Differentiation

3.3.2 Comparison of VO Business Models within the CE VO

The three business models within the CE VO present unique attributes and considerations. Specifically with respect to responsibility, risk, contracts, and selection criteria there are notable differences.

The chart below summarizes these differences and examples in the subsequent sections illustrate how they manifest themselves in real circumstances.

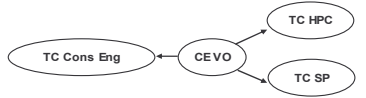

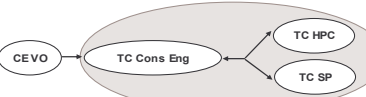
	<i>Responsibility</i>	<i>Risk</i>	<i>Contracts</i>	<i>Criteria for Selection</i>	<i>Structure</i>
Model A	CE VO owns relationships with all members	CE VO assumes all risk	CE VO establishes 1:1 contracts with members	Selection criteria are developed and monitored by CE VO	
Model B	CE VO leverages TC Cons Eng's relationships with HPC and SP providers	TC Cons Eng assumes some risk associated with HPC and SP delivery - risk transference from CE VO to TC Cons Eng	Multi level supply chain contracts exist between CE VO, TC Cons Eng and subsequent suppliers	Selection criteria for HPC and Sp services are developed and administered by TC Cons Eng	
Model C	Consortium / Joint Venture owns delivery responsibility and accountability to CE VO	Risk pooling through consortium where consortium assumes risk and CE Vo transfers some risk	1:1 contracts between CE CO and Consortium	Selection criteria for TC Cons Eng are administered by CE VO. Consortium determined and administers selection criteria for all members	

Figure 6: Business Model Differentiation within the CE Scenario

3.3.3 Examples of Product and Service Differentiation

We consider two examples to illustrate the unique considerations of products and services. One is based on the TrustCoM CE Scenario the second is a purchased industrial component for a commercial airliner.

3.3.3.1 Example – CE Scenario TrustCoM (Consulting Engineering) Design Validation

In this sample scenario a TrustCoM Consulting Engineering firm provides analysis reports of designs created by the CE VO. This example is explicitly service-oriented. Unique differentiators associated with this example due to its service nature are as follows:

- Typical metrics to measure validation and analysis reporting services include: Report delivery time, processing and development durations, etc. These are measurable and their measurement can be easily automated. Quality metrics, however, are much more difficult to capture. For example, how well are the specified reporting requirements met? Is the analysis and validation at the appropriate level of detail? Does the Consulting Engineering firm have the capability to identify abnormalities or issues in the analysis? How well are their validation results integrated with VO processes? In the case of a product quality can be measured quantitatively. With an engineering service there are no discreet

measures that can be applied to measure customer satisfaction without applying a great deal of interpretation and losing some sensitivity.

- Criticality and Risk associated with engineering validation operations are often high because they may provide analysis of safety-impacting and performance variables. In some cases, however, to measure and mitigate risk a corporation must interpret heuristic subjective data.
- Supplier selection and management is not as easily automated because actual human performance and interaction must be measured and tracked for the TC Cons Eng.

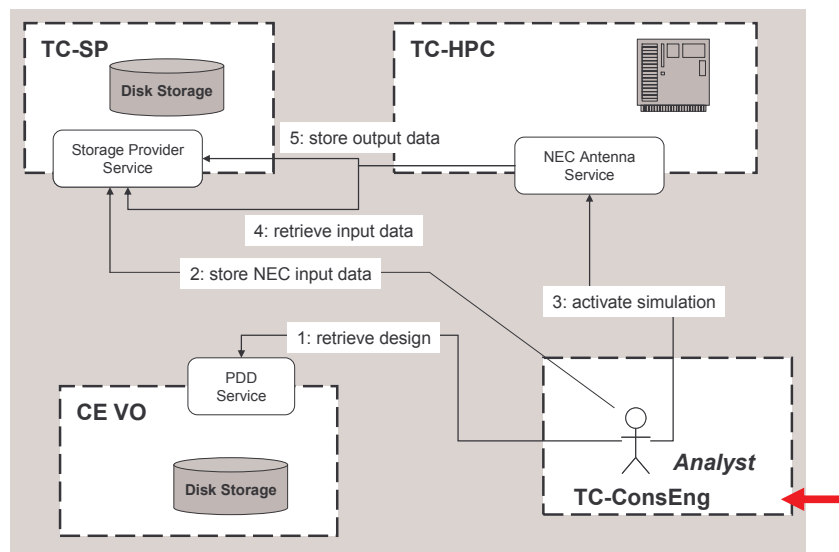


Figure 7: VO CE Scenario Service Providers

3.3.3.2 Example – Purchased Industrial Components, Airliner Seatbelts

In this sample scenario a corporation is selecting a supplier to provide seatbelts to be included in airliner assembly. The supplier will ship the seatbelt subassemblies to the corporation, they will not do installations. This example is explicitly product-oriented. Unique differentiators associated with this example due to its product nature are as follows:

- The production process is automated and can be evaluated by the VO initiator corporation for process quality. Six Sigma and other quality methods can be easily applied to the manufacturing process and tracked by the VO initiator.
- The VO initiator can use detailed quality metrics as a method of selection and monitoring of the supplier.
- Adherence to standards and delivery success are evident and easily measured by qualitative objective methods. These metrics can then be used for data mining and analysis for process improvement initiatives.

- Criticality and Risk associated with these products are very high due to their impact on passenger safety. Risk management and mitigation planning is implemented through production and logistics control mechanisms that are well-established and understood throughout industry.

3.4 The Role and Impact of Criticality

In this section we present the concept of criticality and methodology for assessment of members/suppliers. In the TrustCoM business and selection models, whether applied to a product or service purchase, criticality plays a role. We present through examples and cases the concept of criticality for assessment of suppliers in a VO environment (selection and operations).

The significance of criticality lies in its applied definition within industry. Criticality is often referred to by other names such as:

- Strategic business importance
- Significance
- Precedence

As criticality increases so too does the role of trust and assurance. Trust as a function of reputation indicative of delivery or performance quality and assurance as a guarantor of trust. The following sections define criticality through examples and position it within the context of the TrustCoM framework.

3.4.1 Criticality Evaluation

Practically, criticality is initially driven by the business intent of a product or service and how critical the part or service is to intended business objectives. We propose the following steps towards the evaluation of criticality:

- Criticality analysis
 - Determination of the impact of non-delivery or low quality delivery
 - Employ a list of questions to guide evaluation. An example list is below.

Questions to Guide Criticality Evaluation

1. Is the product or service to be purchased a critical differentiator for our business?
2. Is the product or service associated with any health or safety requirements?
3. Is the cost of this product or service relatively high?
4. Is the contribution margin of this product or service relatively high?
5. How much does this product or service contribute to corporate reputation?
6. How much does this product or service contribute to brand image?

Figure 8: Criticality Questionnaire

- Assignment of a qualitative (*i.e.* high, medium, low) or quantitative metric of criticality to the part or service to be purchased. The criticality metric will be considered relative to the criticality of other parts and services.

After the criticality analysis and assignment of a representative criticality metric the metric and results of the analysis are used to determine the best method and required precisions for conducting the supplier evaluation and scoring exercise. The criticality analysis will bring to light attributes of the product or service to be purchased that are sensitive and will ensure that they have been assessed before the scoring system is developed.

Criticality of Product and Process Information

The criticality of the product and process information also influences the terms and conditions that must appear in contracts, as well as the way in which the system is configured in order to support the business objectives. The following procedure for the evaluation of product and process information criticality is proposed:

- Determine the level of sensitivity of the information and who should have authorized access to the information it:
 - *Public*: the information is not highly sensitive and must be disseminated in order to find suitable partners.
 - *Potential Members*: the information is required for usage in negotiation of price, quality, reliability, risk aversion and other contractual terms.
 - *Selected members*: the information must be disclosed to members that have been selected and agreed to be part of the VO.
 - *Trust Third Parties*: the information must be disclosed to trusted third parties for functional or legal purposes.
 - *Product Integrators*: members involved in integrating components with the product may need access to product information for purposes of standard-compliance, testing and documentation.
 - *Product Owners*: only owners of the product should have access to the product information, with the assumption that they are also owners of the product information.
- Will withholding the information impede the business process or its quality and performance assessment? Derived from the principle of least privileges, if there is no anticipated or proven disruption of the business process, due to withholding information, then information disclosure should be avoided.
- Is it technically feasible to enforce the limiting of information to authorized parties? Does the cost of information loss outweigh the information protection costs? In some cases the decision to ignore the desired scope within which information is disclosed is necessary, as the effort and costs associated with delimiting this scope are impractical.

- Is it possible to detect critical information leakage within reasonable costs? Therein, is it possible to specify and include compensation procedures and mechanisms should leakage be detected? These compensation procedures should be included in the terms and conditions of the contracts. Secondly, there must be assurance provided that the infrastructure will have the available mechanisms in order to detect the critical information leakage. Although such issues are beyond the scope of TrustCoM, these must still be noted for VOs and collaborative business processes in a broader context.
- Is the disclosure of the information obligatory for compliance reasons, scoring or reputation rating? In such cases it may not be possible to withhold information due to legal obligations, such that the priority of legal compliance may outweigh the cost of protecting information.

Having done the criticality analysis of product-related information, it is then possible to include finer details in the contractual terms concerning the handling of information. Moreover, the results of the analysis can be transformed into security policies that are used to configure the underlying ICT infrastructure that supports the processes.

3.4.2 Examples of the Impact of Criticality

In order to better understand the impact of criticality we will provide two very localized example. Note, that an assessment of criticality without risk has limited meaning, however, these examples are provided for the sake of furthering conceptual understanding.

3.4.2.1 Example – Corporate Communications to Customers

In this example a hypothetical corporation is outsourcing the creation and dissemination of communications to their customers. The content of these communications will be directed by the corporation, however, the design, development, printing, and distribution (assume the communications are printed communications distributed to customers to simplify the example) will be conducted by the selected supplier. The communication is not related to the ordering or purchase of products or services, but consists of one-way bullets issued to customers. The bulletins are not related to any safety, health, or recall information.

If we apply the steps of the criticality analysis we see the following:

1. Impact of non-delivery or Low Quality Delivery – **Low**
2. Criticality Evaluation Questions
 - a. Is the product or service to be purchased a critical differentiator for our business? **No**
 - b. Is the product or service associated with any health or safety requirements? **No**
 - c. Is the cost of this product or service relatively high? **No**
 - d. Is the contribution margin of this product or service relatively high? **No – This is not a profit-yielding product**
 - e. How much does this product or service contribute to corporate reputation? **Low**
 - f. How much does this product or service contribute to brand image? **None**
3. Assigned Qualitative level of Criticality - **Low**

Figure 9: Corporate Communications Criticality Assessment

Given the low level of criticality, the effort and precision applied to the sourcing strategy and criteria would be appropriately low. For a low – to –non-critical supplier decision, a corporation will not typically commit a great deal of funds and time to evaluate and track suppliers.

Note that this analysis was done in the absence of a risk assessment. A subsequent risk assessment may require some specific risk mitigation planning in the sourcing methodology and criteria.

3.4.2.2 Example – Collaborative Engineering Scenario

This involves TC-ConsEng using providers of engineering services, which in this particular case are TC-HPC and TC-SP, for the analysis of design data. The assessment of the design relies on the simulation of the performance of the digital design of the product by TC-HPC and the storage of results on the TC-SP service. The simulation could be, for example, the simulation of the plane in along some specific trans-Atlantic route where satellite reception needs to be judged. The satellite reception data would be stored (along with other results) within the TC-SP service at the end of the simulation. These results are then used for making assessments of the antenna performance to be reported to CE VO.

We assume that the analysis process is organised such that these simulations are scheduled for overnight runs. This allows the engineer to process them during the following working day; this is also the opportunity for submitting revised simulations. Therefore, the services are relied upon to deliver the results at the start of the next working day.

The human bottleneck therefore puts limits on the required performance of the TC-HPC and TC-SP suppliers. If an alternative service delivered results more quickly than TC-HPC, but applied a higher charge for its services, then it would not be considered suitable for this particular project.³

On the whole, a good deal of effort needs to be spent in the selection of suppliers of engineering services such as TC-HPC due to their criticality to TC-ConsEng's performance.

³ We assume that the number of personnel in TC-ConsEng is fixed and cannot increase capacity if suppliers that have higher performance than TC-HPC and TC-SP are found.

<p>1. Impact of non-delivery or Low Quality Delivery – High</p> <p>2. Criticality Evaluation Questions</p> <p>a. Is the product or service to be purchased a critical differentiator for our business? Yes</p> <p>b. Is the product or service associated with any health or safety requirements? No</p> <p>c. Is the cost of this product or service relatively high? Yes</p> <p>d. Is the contribution margin of this product or service relatively high? Yes since the overall performance of the consultancy, ie, delivery of reports, is critically dependent on the performance of these suppliers.</p> <p>e. How much does this product or service contribute to corporate reputation? Low</p> <p>f. How much does this product or service contribute to brand image? None</p> <p>3. Assigned Qualitative level of Criticality - High</p>
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Figure 10: CE Criticality Assessment

3.5 Assessment and Impact of Risk Tolerance

Risk tolerance is a required precursor to the application of a supplier selection methodology. It is applied consistently across industry and drives not only sourcing decisions but staffing decision, operational decisions and many others.

One of the reasons risk is relevant to TrustCoM is in its role throughout the VO lifecycle. In TrustCoM the VO lifecycle includes multiple phases:

- Discovery
- Formation
- Operation
- Termination/Dissolution

In the first three phases there are risks around selecting and adding suppliers to the VO and subsequently monitoring them. The multiple types of risk include:

- Strategic Risk – Refers to a risk that would impact the strategic business direction or intent of a corporation. Corporate strategies can take many forms and encompass any subject matter and strategic risk addresses them specifically. With respect to suppliers or VO models, a supplier or VO member may pose strategic risk when their products or services impact the corporate strategy of the initiator or when their strategy or business practices interfere or conflict with the initiator’s.
- Financial Risk – Refers to risks that can directly or indirectly impact a corporation’s solvency or financial position. With respect to suppliers or VO models financial risk becomes an issue if there is a high cost or investment required of the VO initiator corporation or when there is a potential loss of profit or revenue opportunity due to a sourcing decision.

- Operational Risk – Refers to risks that address a corporation’s regular operations. Whether operations are manufacturing, distribution, consulting, product engineering, or etc, any potential disruption to these operations is considered operational risk. With respect to suppliers or VO models, operational risk takes place when a supplier or VO member is not able to integrate well into the corporation’s operations. Issues such as delivery timing or quality will pose a strong operational risk.

The concepts of risk assessment in industry have long been in existence, however, were formalized at Shell Oil⁴ over thirty years ago. Shell Oil developed and applied a scenario-based planning approach wherein risk and likelihood play a key role. This approach and many derivatives are used throughout industry today.

Note: as part of the Legal Risk Analysis (WP9) exercise legal risk assessment is detailed, however, in this chapter we are addressing forms of business risk.

3.5.1 Risk Transference to Suppliers and Within the VO

The concept of risk transference has been applied frequently in recent years as large corporations are transitioning increasing responsibility to their suppliers for certain operations including inventory management, quality assurance, manufacturing, product development and others. Close partnerships allow corporations to outsource critical and non-critical functions in such a manner that they have to rely less on their ability to maintain high levels of competency in certain areas while providing products and services that benefit from the high levels of competency provided by their suppliers.

In a VO as the number of members grows depending on the VO structure and management style so too can the risks. However, through risk transference and the consolidated management of VO members this risk can be pooled and reduced. The benefits of risk absorption on the supplier side are increased opportunities to grow thorough their relationship with key customers.

Examples of risk transfer are evident in automotive and some large retail industries where inventory is supplier managed as is the quality and delivery of the supplier-managed inventory. The VO models present many potential opportunities for Vo initiator risk transference.

3.5.2 Risk in the CE Scenario Business Models: One-on-one, One-to-many, and Trusted Consortia

The following section refers to CE scenario business models developed as part of the WP8 D14 previously developed.

In the Figure 11 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. 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. In model 1 the VO Manager is able to transfer risk

⁴ Well known reference in the Industry benchmarks.

to individual suppliers. In model 2 the supplier can transfer risk to individual suppliers or to the trusted third-party. During the discovery and formation phases of the VO lifecycle risk tolerance would be considered as would opportunities for risk pooling.

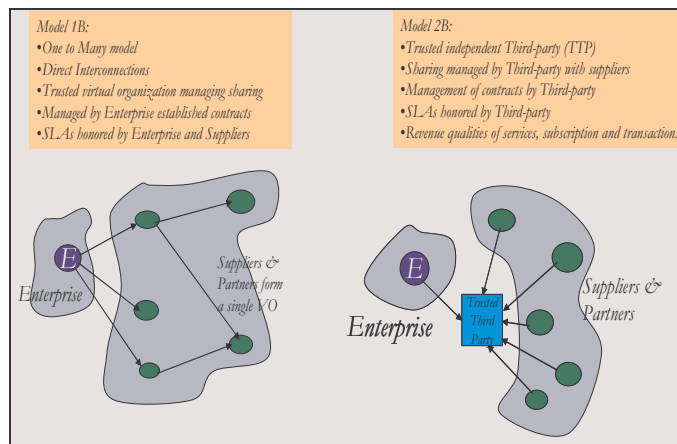


Figure 11: VO Business Models 1 and 2

Figure 12 illustrates 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 there are opportunities for risk pooling and transference through the Trusted Third-party. Model 4 also allows for centralized risk transference and risk pooling while also providing an additional advantage to suppliers through their opportunities to access multiple VO initiators through a single Trusted Third-party. As a result the suppliers may experience opportunities to take advantage of economies of scale associated with assuming additional risk. Where Trusted Third-parties are involved risk in the discovery and formation phases of the VO lifecycle are often lower due to the existing reputation and knowledge associated with the TTP. For example, Dunn and Bradstreet may act as a TTP in that they present objective validated information that can be applied in supplier selection decisions and thus reduce associated risk.

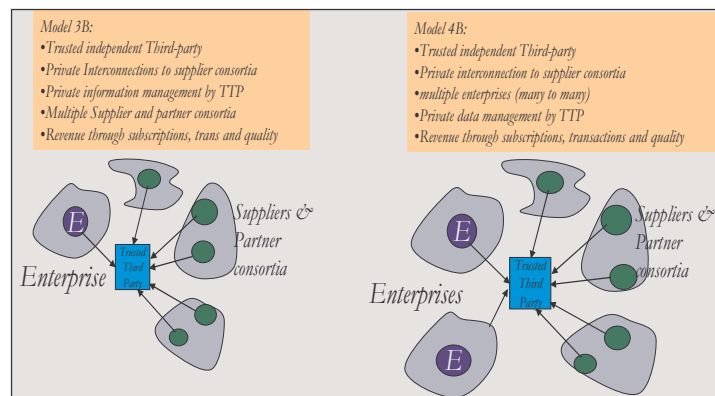


Figure 12: VO Business Models 3 and 4

In the Figure 13 below, 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. Figures 5 and 6 allow for more sophistication and standardization across the risk management activity. The collaborative environments allow for standardization of practices and expectations that lend themselves to better management of risk. Again, collaboration in these business models alleviates risk early in the VO lifecycle.

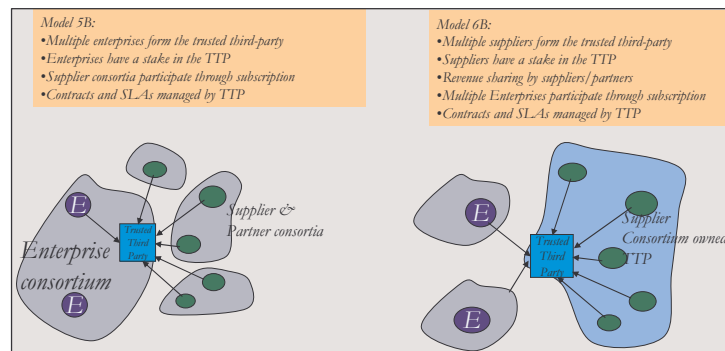


Figure 13: VO Business Models 5 and 6

3.5.3 Risk Evaluation

The three types of risk were addressed in the beginning of section 3.5. In addition to the three types of risk, when a risk evaluation is being conducted risk tolerance must be evaluated at three levels:

- Supplier Level – based on decision sensitivity to supplier stability and corporate reputation.
- Process Level – Based on part or service sensitivity to process maturity and consistency.
- Product Level – Based on part or service specific sensitivity to risk. The impact of variability of part or service specifics.

In the subsequent chapter of this document we will define these distinctions and the role they play in supplier selection and management.

Risk tolerance is evaluated through a method known as risk mapping. Risk mapping allows for the identification of specific risks that must be addressed. The following figure presents a risk mapping framework. At each level (supplier, process, and product) risks are identified by subject matter experts familiar with the purchase decision and mapped onto the framework based on their likelihood and impact. Tolerance is based on where within the quadrants the risk falls.

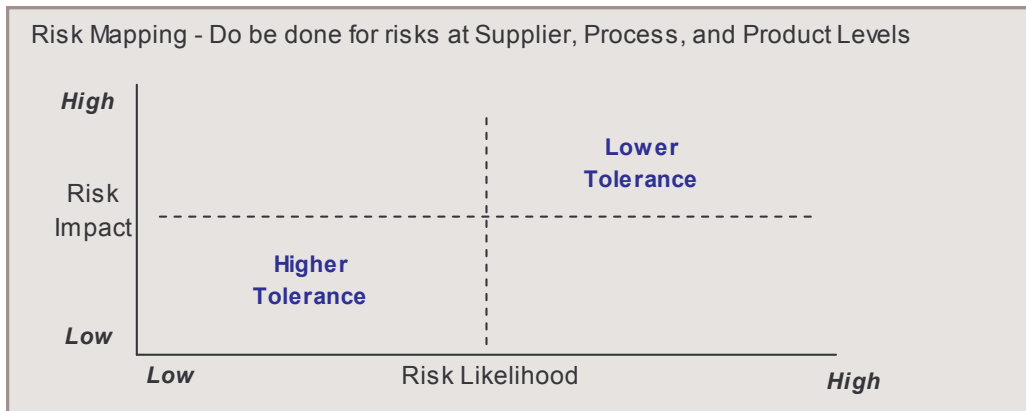


Figure 14: Risk Mapping Model

We have included a risk mapping example in Appendix D, Section 10.3. It is based on the CE Scenario for a subset for TC-SP (Service Provider) risks.

3.6 The Role of Reputation in Industry

Reputation forms the basis of supplier selection and management metric in industry practice with varying degrees of consistency and objectivity. In the event that thorough data is available the supplier selection process will include historical performance metrics as a measure of reputation in their evaluation and selection process. When that data is not available, however, other less formal reputation metrics are applied. Informal reputation metrics may include but are not exclusive to:

- Word of mouth that decision makers may obtain through various industry contacts – this feedback is typically subjective and difficult to document although it may prove to be of significant impact.
- Professional organizations and affiliations with which decision makers are involved may provide insight into supplier capability and reputation through conferences, presentations, and materials.
- Journals and other publications conduct benchmarks and case studies that contribute to the reputation throughout industry circles.
- Media reports and news regarding supplier innovations, issues, successes, and failures have a major impact on perception and reputation and prove difficult to modify over time.
- Past experience that an individual or entity had with a supplier.

Formal application of reputation is done through selection criteria such as “historical performance” or “competitive position.” Informal application of a negative reputation to the selection and management process may manifest itself through lower rankings on unrelated selection criteria or lower prioritization among other suppliers. Informal application of positive reputation may manifest itself similarly.

4 Supplier Selection

Chapter 2 of this document focused on the business aspect of trust and the role of contracts. Chapter 3 documented industry practices in the evaluation and application or criticality and risk to supplier selection, management, and reputation. This chapter includes industry practices in supplier scoring, selection, and management. The analysis is conducted with respect to actual business practices and presented within the context of the virtual organization (VO) as defined in the Market Study (WP15). This chapter addresses the supplier selection process including scoring. It places within context the criticality and risk analysis introduced in chapter 3 and also address supplier management and its relationship to trust and business contracts. Throughout this chapter concepts that are currently applied in traditional supplier relationships that are also applicable in virtual organizations are highlighted and echo the work in WP20 VO Management.

4.1 Scope

The supplier selection section of this document exists with twofold intent; to preset the results of research on industry practices and to provide input into the development of supplier selection, evaluation, and management processes and tools for TrustCoM.

The following are the objectives of Chapter 4, Supplier Selection, of this document:

1. Preset supplier selection best practices and industry findings
2. Illustrate the role of criticality and risk to the supplier selection and management process
3. Demonstrate the relationships between trust and reputation enables including: criticality and risk assessment, supplier selection methods and criteria, contracts, reputation, and supplier management
4. List commonly employed supplier evaluation criteria at three levels of granularity: Supplier, Process, and Product/Service
5. Demonstrate the relationship of cost and quality as well as the concept of total cost of ownership as it applies to supplier selection and management
6. Provide recommendations on scoring criteria and process development based on industry practices and the TrustCoM models
7. Present supplier management processes and their applicability within the TrustCoM VO business models
8. Provide recommendations and input to supplier or VO member scoring system implementation

4.2 Selection Process Overview

The supplier selection process can be summarily expressed in six steps from product requirements definition through the development of a scoring system. The overall selection process is consistent across both product and service supplier selection decisions.

Our investigation also highlighted the unique classifications that organizations applied to their supplier base. It is a common industry practice to classify suppliers based on the intended nature of their relationships with the initiator organizations. The significance of these classifications is demonstrated through the contract terms and conditions, service level agreements, and supplier management metrics and processes. Some example classifications include:

- Strategic Partner
- Preferred Vendor
- Premier Vendor
- Premium Plus Partner
- Collaborative Development Partner

The figure below illustrates the selection process including all six steps. The following six subsections of 4.2 will provide detailed information on the selection process.

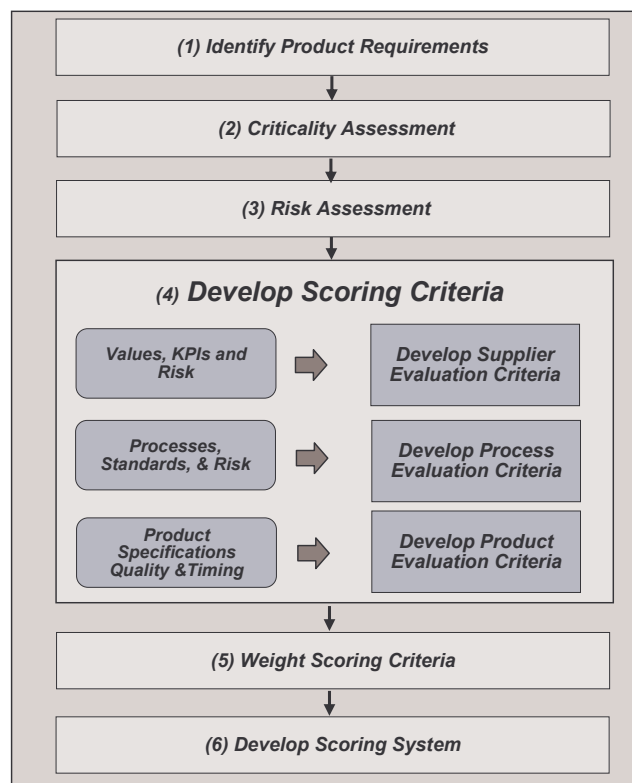


Figure 15: Supplier Selection Process

4.2.1 Step 1 - Identify Product Requirements

Step one Identify Product Requirements occurs during the product (or service) definition. Product requirements such as cost, quality, timing, quantity, and delivery frequency are among the requirements that are identified when product requirements are determined. Additionally, any technical specifications including size, weight, durability, and others are specified during product requirements definition. Product or service CTQs are documented as part of requirements definition. CTQ stands for “Critical to Quality” and represent required product characteristics and expectations. CTQ is a term often associated with Design for Six Sigma.

4.2.2 Step 2 – Criticality Assessment

Step two, the criticality assessment, is conducted as described in 3.4.1. After the product or service requirements and CTQ’s are determined in Step One, the criticality is evaluated based on the product/service contribution to business objectives. In some situations criticality assessment is conducted in a more formalized manner while in some cases it is informal. The result of the criticality assessment is a quantitative or qualitative representation of product or service business criticality.

4.2.3 Step 3 – Risk Assessment

Step three, the risk assessment, is conducted as described in 3.5.3. The risk assessment is another precursor to supplier selection. It is used to understand risk tolerance and generate a risk tolerance variable. The risk tolerance serves as input to the development of supplier evaluation criteria and selection process. Lower risk tolerance sourcing decisions necessitate increased time and resources dedicated to a more robust decision process and subsequent supplier management metrics.

4.2.4 Step 4 – Develop Scoring Criteria

Scoring criteria are developed at three levels: Supplier, Process, and Product. These three levels, their detailed definitions, and roles will be detailed further in sections 4.4, 4.5, and 4.6. The inputs used to develop the scoring criteria are as follows:

- Supplier Criteria – The development of supplier scoring criteria are based on corporate values, corporate and functional KPIs (Key Performance Indicators), strategic and financial risk tolerance.
- Process Criteria – Process-level scoring criteria are derived from process and standards employed and required by the initiator. Operational risk tolerance is also a contributor to process-level scoring criteria.
- Product/Service Criteria – The development of scoring criteria that are specific to the product or service to be purchased are based on product specifications, quality requirements, frequency, and timing of delivery. At this level, the risk tolerance variable will be used to reflect the product level variation allowed.

4.2.5 Step 5 – Weight Scoring Criteria

Scoring systems are almost always based on some weighted measurement of multiple values. In some cases where decisions are simplistic and risk and criticality relatively low an explicit

scoring system may not be developed and weights may not be assigned. Even under these circumstances, however, some level of weighting is done. Perhaps cost is the most heavily weighted variable, perhaps quality or availability. Scoring systems are designed in such a manner as to allow for flexibility in the degree of importance that varying selection criteria will exercise. The weighting of variables enables a total assessment where each variable is treated with an appropriate degree of relative significance.

The assignment of weights is commonly done through the following process:

1. All relevant scoring criteria are documented
2. Marginally contributing elements are removed
3. Non-negotiable (must-have) elements are identified and removed (these represent a binary yes or no decision and can be removed from the weighted criteria and considered before weighting and scoring takes place to extract non-qualified suppliers from the process)
4. Remaining criteria are ranked in order of importance
5. Ranking by multiple interested parties or stakeholders will yield a better decision set
6. Weights are applied based on rankings and justifications

4.2.6 Step 6 – Develop Scoring System

There are many types of scoring systems currently that have been developed and are in use in academia and industry and vary in complexity. Some include:

- Weighted linear sum method
- Weighted exponential method
- Utility function (general non-linear models – Cobb-Douglass)
- Total Cost of Ownership Models

In addition to these existing methods companies often chose to develop their own scoring systems based on their typical scoring process requirements or specific product or service selection needs. Often scoring methods are very simple and represent basic weighted averages of criteria. In some very structured environments scoring systems are complex, represented by algorithms designed by the initiator, and automated through IT systems. Additional information on scoring systems is included in Appendix D.

4.3 Application of Criticality and Risk to the Selection Process

Throughout section 3 we discussed Criticality and Risk. How they are calculated as well as their significance to the supplier selection and management processes. At this point, having been introduced to the selection process as a whole, we revisit the subject of how criticality and risk apply to the selection process.

The selection of scoring criteria at three levels, the subsequent weighting of these criteria and development of a scoring system can be time consuming. Industry practice employs criticality and risk to drive the activities associated with the supplier selection process. Where criticality is low and risk tolerance high, selection processes proceed with reduced

robustness. Selection criteria are not as thoroughly developed and stakeholders are not as deeply engaged. Ultimately, companies limit the spend of time and resources on sourcing decisions that are not highly critical or risky.

4.4 Supplier Evaluation Criteria

The primary objective of the supplier evaluation segment of the supplier selection process is to narrow the potential supplier list with which the initiator would care to do business. Among potential candidates, the supplier evaluation will select the top candidate(s) with whom they would do business. The criteria at this level are based significantly on corporate values and high level capability. The figure below illustrates the sequential nature of the three evaluation levels, the first of which is supplier-level. Note that at the supplier level high level capability evaluations are conducted and this is the stage at which RFIs and RFQs are often released.

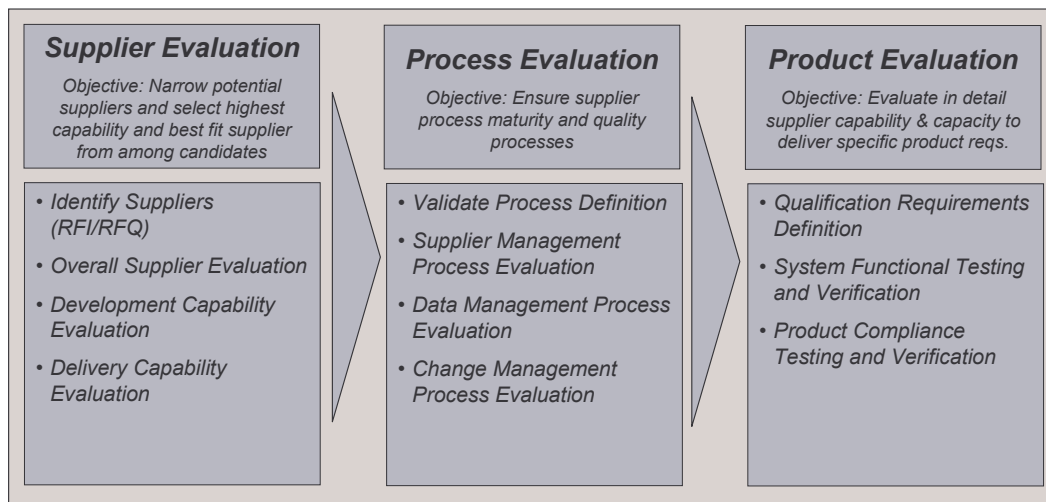


Figure 16: Supplier, process, and Product Evaluation Overview

The supplier evaluation level of the supplier selection process in the context of the TrustCoM virtual organizations would serve as a first level determinant of eligibility to supplier partnerships and consortia.

A significant industry trend exists around multi-sourcing where a large company may select multiple suppliers with which to do business and have a partner in the supplier base conduct the integration and coordination services.

4.5 Process Evaluation Criteria

The process-level evaluation serves to ensure maturity of processes where required and applicable. Refer to the figure in section 4.4 to understand the process evaluation criteria in context. Consistency of process definitions may be required as in the cases of quality monitoring, logistics, and service delivery operations. Processes ensuring the security of facilities and information including data management processes may be of significance to supplier evaluations due to audit and control requirements.

In addition to process consistency process maturity may drive a sourcing decision. Decision criteria sometimes serve to evaluate process maturity in relevant process areas where processes are closely tied with quality and ability to deliver. The CMMI (Capability Maturity Model) framework is an industry standard measure of process maturity applied to product and service industries including Information Technology. Quality process maturity is often represented in industry and service sectors through the ISO 9000 or ISO 14000 certifications.

4.6 Product Evaluation Criteria

Product-level evaluation exists to screen supplier capability to deliver to the specific requirements of the product or service and to do so at the appropriate chronological frequencies. In the case of product evaluations generally, the more complex the product or service, the more effort is required at this level of evaluation. The list of criteria will be lengthier in order to accommodate all of the product or service specifications to be evaluated and potential scoring systems may be more complex as they account for the increase in variables being evaluated. The product evaluation criteria are developed based almost entirely on the intent of the product or service being purchased. Safety or health affiliated products or services will demonstrate product evaluation criteria that address these needs as high priority criteria.

Cost is an additional variable that is evaluated often at the product level. Because costs are typically associated with delivery of unit or aggregate products or services the evaluation is done at this level. Cost variations are driven largely in part by product specifications and volume requirements. Cost will be discussed further in section 4.7.

The execution of product-level evaluation is very consistent across current industry best practices and the future-state TrustCoM VO business models. The consistency arises from the need to evaluate individual part or service purchase decisions on a unique and individual basis irrespective of existing supplier relationships whether as part of a one-to-one or one-to-many model. Refer to the figure in section 4.4 for an understanding of product-level evaluation in context.

4.7 Cost

With few exceptions, cost plays a significant role in the supplier selection decision. As organizations face competitive and financial pressure, cost sensitivity becomes even more acute. A significant role of many purchasing groups within large organizations includes the management and containment of costs with respect to purchase decisions. Long term supplier relationships include mutually agreed-to costs for repeatedly purchased service

and product types. Short term purchase agreements always include cost specifications. Cost is the one element that exists in every supplier contract without fail.

There are multiple ways to measure cost and it is generally inversely proportional to quality. In the following sections we present the concepts of cost versus quality and total cost of ownership.

4.7.1 Cost versus Quality

Low cost and high quality are competing objectives in the sourcing decision. In every sourcing decision, however, the objective is not necessarily to acquire the highest quality product or service, but rather the most appropriate level of quality per product or service requirements. Value refers to the highest quality that can be achieved at a given price point. While in some cases a company's objective is to purchase a product or service at the highest level of quality in some cases the objective is the highest value. Product-level cost and quality details are particularly important in the Formation and Operation phases of the VO lifecycle.

On annual basis world-wide governments (large governments in the EU, Japan, Russia, US, China and others) spend massive amounts of money through varieties of purchasing relationships and present many opportunities to study supplier selection and management. A notable statement from "Improving the Sourcing Decisions of the Government" from the US Government's Report of the Commercial Activities Panel (April 2002) expresses the cost-quality trade-off that industry and public sector organizations face very well:

"In making source selection decisions in public-private competitions, cost must always be considered . . . but the government should not buy whatever services are least expensive regardless of quality. Instead, public-private competitions should be structured to take into account the government's need for high-quality, reliable, and sustained performance, as well as cost efficiencies."

4.7.2 Total Cost of Ownership

The concept of total cost of ownership is used to describe both direct and indirect costs associated with any purchase decision. The concept has gained popularity, in part, through its application in the financing and costing of IT applications because of the dual sets of costs associated with the initial development and implementation and later the ongoing application support.

Total cost of ownership measures exists to capture an accurate reflection of the product or service throughout its complete lifecycle. It is a metric that industry employs frequently in when making investment decisions. Total cost of ownership takes into account the following:

- Gross Purchase price of product or service before taxes
- Taxes

- Maintenance costs
- Repair costs
- Facilities costs
- Telecom and infrastructure costs
- Product or service support costs
- Licensing costs
- Support and service costs

4.8 Supplier Scoring

We have demonstrated the supplier selection process and the three levels of criteria that the selection processes addresses. We have also presented the concepts of criticality and risk and how they are employed to drive the supplier selection process from criteria development through scoring. In this section we will discuss typical scoring criteria for the three levels of the supplier selection decision: Supplier, Process, and Product/Service. We will also place the scoring process within the context of the VO lifecycle.

4.8.1 Scoring Criteria Development

As we discussed in section 3 of the document, criticality and risk are key drivers in the development of scoring criteria and scoring systems. Criticality of the sourcing decision directs the amount of effort and detail that is included in the sourcing criteria and the sourcing system. Risk tolerance is used to determine the specific criteria that must be developed in order to mitigate risk where tolerance is low as well as to determine how to weight criteria.

In section 4.3 we discussed the application of criticality and risk to the selection process in more detail. In sections 4.4 through 4.6 we present the three levels of evaluation: Supplier, Process, and Product/Service. Each level is tasked with unique objectives in the supplier evaluation and selection process. We have also noted that the supplier evaluation and selection process is tightly coupled with the VO lifecycle in that it enables its discovery, formation, and operation.

4.8.2 Typical Scoring Criteria

Scoring criteria are often reused within companies in the course of supplier selection activities. Specifically, the farther away from the product or service, the more scoring criteria reuse is observed. In other words, a company may apply very consistent supplier-level scoring criteria across all supplier selection decisions as part of an effort to maintain a minimum common standard to which their suppliers must adhere. At the process level, there may be less consistency across process-level scoring criteria than there are the supplier level, however, common process requirements within an organization will drive a certain degree of consistency.

The product or service-level supplier scoring criteria present the most variation from decision-to-decision within a company or organization. This is a result of the unique nature of products and services being purchased. It is a common practice in organizations, as illustrated by our research and interviews, to create groups of purchasing agents and specialists who focus on specific product or service types. These groups bring together focused product and service level competencies that can be reused across supplier selection decisions for similar products and services. One of the advantages this model brings to the scoring process is that it enables the reuse of product and service-level scoring criteria where applicable in circumstances of similar product or service requirements.

The following figure contains some example supplier-level scoring criteria. These criteria are representative of typically employed supplier-level scoring criteria employed in industry and the companies interviewed in the research of this document. Note, however, that the actual scoring criteria are sensitive and cannot be made public.

The supplier-level scoring criteria include criteria that are relevant to and addressed in the legal risk management activity of TrustCoM WP9. Additionally the criteria applied at the supplier evaluation phase are applicable in the TrustCoM VO lifecycle in the Discovery and Formation phases as these are criteria used to determine at a high level if companies are qualified to become members of the VO community.

<i>Criteria</i>	<i>Detail</i>
Supplier competitive position *	Illustrative of the supplier's overall capability and very meaningful within a long-term relationship consideration
Supplier Stability *	A representative quantitative measure indicative of the supplier's stability and likelihood of business continuity
Supplier financial position *	Indication of supplier financial strength illustrative of potential risk that the initiator is willing to undertake.
Management Philosophy	Consistency with VO Initiator's philosophy is in some cases significant
Supplier Development Capability	Includes development technology, development systems, and development environment.
Supplier Quality	Supplier quality plans, processes, and systems are scored at a high level.
Supplier Delivery Capability *	Capability criteria may include capacity measures, manufacturing and service systems maturity, automation, and testing.

* Indicates relevance to legal risk management activity WP9

Figure 17: Representative Supplier-level Scoring Criteria

Process-level scoring criteria exist with the objective of ensuring supplier process compliance and process maturity where applicable and relevant to the purchase decision. We have found that there are two sets of process standards applied throughout industries. The first refers to required standard processes and process capability. An example of this type of standard would be when a company requires ISO certification as a prerequisite for engaging with another. The second type refers to processes that are specific to the development or delivery of the product or service. An example of this type of process requirement would be a specific assembly process requirement for an industrial component.

Some process level criteria are also relevant to and addressed in the legal risk management activity of TrustCoM WP9.

The table below lists some example process-level scoring criteria. These criteria represent typical criteria examined during supplier selection across various industries.

<i>Criteria</i>	<i>Detail</i>
Quality Process Maturity	Score representing a detailed analysis of quality processes such as failure analysis, SPC, skills training, certification, and others
Audit and Control Processes *	Discipline and compliance through the existence of thorough audit and control processes
Supplier Management and Incoming Quality Control	Including the supplier's supplier selection, supplier quality management, and supplier audit processes
Outgoing Quality Control and Quality Containment	An indicator of the suppliers ability to contain outgoing quality issues and maintain a minimal product failure rate
Data Management	Existence and maturity of quality reporting, product traceability, failure analysis and corrective action, and records retention
Personnel Mgmt	Personnel Management, Expertise and Training
Security Processes *	Control of facility, data, communications, and systems security.
Change Management	Ability to respond to VO initiator process changes, engineering changes, and part changes.

* Indicates relevance to legal risk management activity WP9

Figure 18: Representative Process-level Scoring Criteria

Product or service-level scoring criteria are very specifically intended to reflect the requirements and expectations of the product or service to be purchased. They are developed with product specifications in mind and exist to measure conformance to these specifications. In many cases the product or service-level evaluation includes on-site visits and assessments of supplier facilities and capability, testing of product or service performance.

Product level specifications can assume any number of levels of detail. Sourcing decisions that represent high criticality and where risk tolerance is low may entail significantly more detail and thus more scoring criteria. Sourcing decisions that are less sensitive can be made with a reduced number of product-level selection criteria. The more complex the product requirements, the greater the number of product-level requirements to be developed and evaluated in order to make a decision.

Product or Service integration is another variable that is taken into consideration during the supplier selection process. When the product or service to be purchased is tightly integrated with a finished good to be delivered, there are additional levels of complexity that the product or service-level evaluation must consider. In cases such as this integration testing may also become a requirement.

<i>Criteria</i>	<i>Detail</i>
Product Compliance	Compliance with requirements specifications and standards including weights, measures, performance requirements, etc
Warranty and Reliability (and Service)	Historical and projected data compared to warranty contract terms and conditions. Includes maintenance and service.
Product Quality	Including supplier outgoing quality and VO Initiator's measure of incoming quality
Manufacturing and Delivery Lead Time	Shorter manufacturing lead times result in reduced risk, specifically on unique single-sourced products.
Integration Testing	Integration testing to ensure compatibility, interoperability, and intended performance within the holistic environment.
Functional Testing	Testing with varying degrees of environmental and conditional simulation to validate function and performance.

Figure 19: Representative Product-level Scoring Criteria

In Appendix D Section 10.4 we have included example scoring criteria at the Supplier, Process, and Product level for the TC-SP service provider in the CE VO to better illustrate the concepts we have presented around scoring criteria.

4.8.3 Scoring Process

After the scoring criteria are developed the execution of the scoring activity takes place. At each of the three levels: Supplier, Process, and Product/Service, a scoring exercise is conducted. The objective of the scoring is to provide a relative comparison of the available suppliers across all of the required dimensions. Each supplier is evaluated individually based on their capability on each of the various scoring criteria. Some criteria may require minimum performance levels and in these situations suppliers who do not demonstrate those levels of performance will be removed from the assessment pool. A more extensive description of scoring processes is included in Appendix D Section 10.5

4.9 VO Supplier Management

We will conclude section four with a discussion of supplier management. Although often functionally disintegrated from supplier evaluation, scoring, and selection, supplier management is strongly correlated to all of the above. Supplier management is based on the monitoring and performance to specified metrics that are closely correlated to the initial supplier selection criteria. All of the supplier, process, and product/service-level selection criteria were developed and evaluated due to their requirement for the product or service in question. It is imperative that these same criteria be monitored over time to ensure consistent high quality delivery of the required and agreed-upon products or services. Supplier evaluation criteria form the foundation of supplier management metrics. Performance to these metrics is explicitly stated and agreed-upon in the negotiation and establishment of contracts. Contract terms and conditions are derived from product or service requirements and the need to minimize risk, for all intents and purposes, the same principles as selection criteria.

The figure below illustrates the relationships between supplier selection, the three levels of evaluation, and supplier management. Supplier management is conducted as an ongoing metrics-driven process. Quality is closely monitored and managed based on contract terms and conditions that specify performance and delivery requirements. Service level agreements may be used supplemental to purchase contracts terms and conditions to ensure the appropriate supplier response to customer situations. Service level agreements include metrics that are also driven by product and service requirements and are monitored

as part of the supplier management activity. Service level agreements vary in their content and intensity. Higher levels of service are offered at a higher cost.

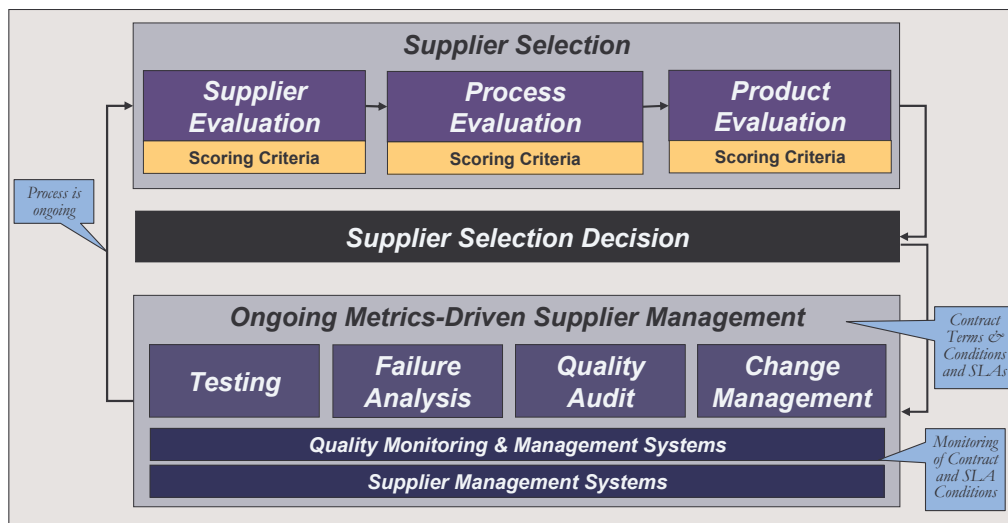


Figure 20: Supplier Selection and Management

4.9.1 Trust and Contracts in Supplier Relationship Management

Both contracts and trust have a role in supplier management and supplier relationship management. Contracts exist to enumerate and detail the expectations and requirements of the supplier for the scope and duration of their relationship with the VO initiator company. Contracts provide assurance that commitments will be met and they specify measures in the event that commitments are not met.

Trust exists at multiple levels in the supplier relationship. There is trust that contract terms and conditions will not be violated unless under the most extreme circumstances. There is trust that service level agreements will be honoured as promised and funded. There is trust that delivery requirements will be met. Naturally, contracts are always in place despite trust, however, in almost every foreseeable circumstance, non-delivery or non-performance of committed activities will have a negative impact on the initiator company and subsequently on the supplier as well. Therefore, despite the existence of contracts as a mechanism of assurance companies also seek out and depend on trust with their suppliers. The existence of trust is driven by many different variables as discussed in **TrustCoM WPXX** including reputation.

4.9.2 Supplier Quality Management

Quality monitoring is a major component of supplier management and bears mention in this document. Quality management is an extremely significant function within companies across industries. Supplier quality is at times a large subset of total quality (see figure 20). It is not uncommon in large companies to have an executive-level presence and reporting organization with sole responsibility for supplier quality management.

Supplier quality can be very broad in scope due to the changing nature of supplier relationships in industry. In examples such as the CE scenario where collaborative engineering among multiple parties occurs quality refers to far more than basic incoming product quality as one would observe in more traditional industrial manufacturing models. Collaborative engineering requires high quality delivery of complex services. The VO members delivering these services specialize in the services and in those roles may pose far more in-depth competence than the initiator companies. In this and similar scenarios quality must be managed and monitored very carefully so that it accommodates the gap between subject matter expertise between VO members and initiators.

4.9.3 Example Supplier Management Metrics

Supplier management metrics are based on the specific requirements of the product or service to be purchased. They are developed as mentioned in section 4.9 through input from the selection criteria.

The following list provides a representation of typical supplier management metrics employed in the ongoing supplier management process. In addition to monitoring these metrics also serve as input into supplier evaluation or reevaluation.

Cost	
<ul style="list-style-type: none"> Price Variance over Time Comparing Quote and Actual 	<ul style="list-style-type: none"> Discount Rates Payment Delays Credit Increases
Quality	
<ul style="list-style-type: none"> Comparing Target and Actual Incoming Quality 	<ul style="list-style-type: none"> Quality Containment Metrics
Delivery Metrics	
<ul style="list-style-type: none"> On-Time Delivery (%) Delivery Failure (%) Quantity MisMatch (%) 	<ul style="list-style-type: none"> Fulfillment Failure (%) Shipment Delays (%) Specification Failure (%)
Analysis Metrics and Procedures	
<ul style="list-style-type: none"> Statistical Process Control Defect Analysis 	<ul style="list-style-type: none"> Failure Distribution
Management	
<ul style="list-style-type: none"> Supplier Management Adherence to Contract Terms & Conditions Change Management 	<ul style="list-style-type: none"> Engineering Change Control Process Change Control People Management

Figure 21: Supplier Management Metrics

5 Summary and Conclusions

In this section we summarize the contributions made by WP8 to Trustcom through business contracts, industry practices for reputation in supply-chains, supplier scoring methods, and business models.

Business contracts play a significant role in enabling Trust and Assurance between multiple business partners in a VO environment. In this Workpackage (WP8) illustrate various kinds of business contracts for enabling VOs with diverse providers. We identified 4 types of service providers: consulting service, computational service, high-performance service, direct material providers and others. For each of the interactions we define and identify the contract terms and conditions using industry knowledge and best practices. For applying TrustCom to industry solutions and industry VO management, we strongly recommend that Industry specific contracts based on service provider services are required for TrustCom VO management, GVOA and reputation models.

Based on the Business contracts we defined and established a collection of business metrics that need to be monitored for various kinds of service providers. The business metrics will enable Supplier/member evaluation when selecting a new VO or adding members to a VO based on historical trends and behavior. We strongly believe that in addition to SLA (IT level) metrics, business metrics will be needed for VO management and reputation in TrustCom.

We modeled a simple but heterogeneous CE supply-chain which has consulting and IT service providers for Design validation. We presented the Product and Service sourcing through industry practices. We presented differences in some characteristics and execution, but easily able to apply the same methodologies and framework for evaluating risk, criticality, supplier scoring, and management. We also illustrated the role and Impact of Criticality – Criticality drives the required models for trust and assurance. It also serves to determine the depth and complexity of the supplier selection process, scoring criteria, and management metrics. We presented a common industry model for risk assessment based on likelihood and impact. We Illuminated how the concept of reputation is commonly applied in industry – through both objective (quantitative and qualitative) and subjective criteria.

Supplier classification practices were presented within the scope of TrustCom and industry practices. We showed the application of criticality and risk to the selection process – weighting based on risk and criticality and limiting the amount of effort and resources dedicated to supplier selection based on criticality and risk. Supplier evaluation criteria were done at 3 levels: Supplier, process, and product in order to capture the diverse needs of the sourcing and partnership decisions. Supplier scoring was discussed in depth (using industry methods). The scoring model considers using risk and criticality coupled with requirements to drive the development of scoring criteria. An example of scoring criteria developed for the three VO service providers in the CE scenario. In addition, supplier management process and metrics were presented including supplier quality management and the role of trust and contracts.

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7 Appendix A: CE 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. We also 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.

7.1 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.

7.1.1 CE VO and AVO (TC-ConsEng) 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

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.

7.1.2 TC-ConsEng and TC-HPC

Contract Items	Type of TC	Description of TC	Value
Owners	Member	One or more owners of the contracts	TC-HPC and TC-ConsEng Contract analysts
Roles	Member Role	One or more role supported by the contract	CE VO marketing and project manager, VO Managers, CE VO Design manager, AirVO operations manager, AirVO negotiator
General TCs	General Terms for contracts	General terms such as change, approvals, expiry,	Business Policy

		owning group and renewal.	
Duration	Time or Date	Duration of contract	Duration in date or time
Change Owner TC	General Business TC	Change of contract primary owner	Change rule and policy
Change Contract TC	General Business TC	Contract owners can change the contract based on agreed upon business rules	Change policy
NDA TC	Business Rule and TC	NDA must be observed by all subsidiaries and sub-contractors	Business Policy on non-disclosure of information
Security TC	IT Rule and TC	All information provided by CE VO (through TC-ConsEng) should be encrypted	IT and Business Policy on Security of data
Confidentiality TC	Business Rule and TC	All data from CE VO is confidential, secure classification, digitally signed and a non-disclosure	Business Policy on Confidentiality
Performance Delivery of Jobs TC	IT TC	Performance and Quality of delivery of computation design jobs. Thresholds on the delivery.	Backup policy (Multiple times per day of critical information)
Uptime TC	IT TC	Uptime of the HPC service within limits to avoid system risk.	Business Policy

7.1.3 TC-ConsEng and TC-SP

Contract Items	Type of TC	Description of TC	Value
Owners	Member	One or more owners of the contracts	TC-ConsEng and TC-SP Contract analysts
Roles	Member Role	One or more role supported by the contract	CE VO marketing and project manager, VO Managers, CE VO Design manager, AirVO operations manager, AirVO negotiator
General TCs	General Terms for contracts	General terms such as change, approvals, expiry, owning group and renewal.	Business Policy
Duration	Time or Date	Duration of contract	Duration in date or time
Change Owner TC	General Business TC	Change of contract primary owner	Change rule and policy
Change Contract TC	General Business TC	Contract owners can change the contract based on agreed upon business rules	Change policy

NDA TC	Business Rule and TC	NDA must be observed by all subsidiaries and sub-contractors	Business Policy on non-disclosure of information
Security TC	IT Rule and TC	All information provided by CE VO (through TC-ConsEng) should be encrypted	IT and Business Policy on Security of data
Confidentiality TC	Business Rule and TC	All data from CE VO is confidential, secure classification, digitally signed and a non-disclosure	Business Policy on Confidentiality
Quality of Service	IT TC	Quality of Service in delivery of SP services	Backup policy (Multiple times per day of critical information)
Uptime TC	IT TC	The uptime TC for enabling better reliability of SP service.	Business Policy

7.2 Contract Driven 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 (TC-ConsEng) 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

7.3 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.

7.4 GVOA Contract Model in XML

We modelled the contract using XML structures. The UML model of the contract objects is shown in the figure below. A typical contract consists of generic two-party terms and conditions. The contract Terms and Conditions (TCs) are grouped into 3 main categories,

which are: a) Business Terms and Conditions; b) Legal Terms and Conditions and ; c) IT Terms and Conditions. This categorization applies to generic product and service providers in the supply-chain. The contract will also contain generic terms and conditions as such as change management, updates, ownership and expiry dates and others.

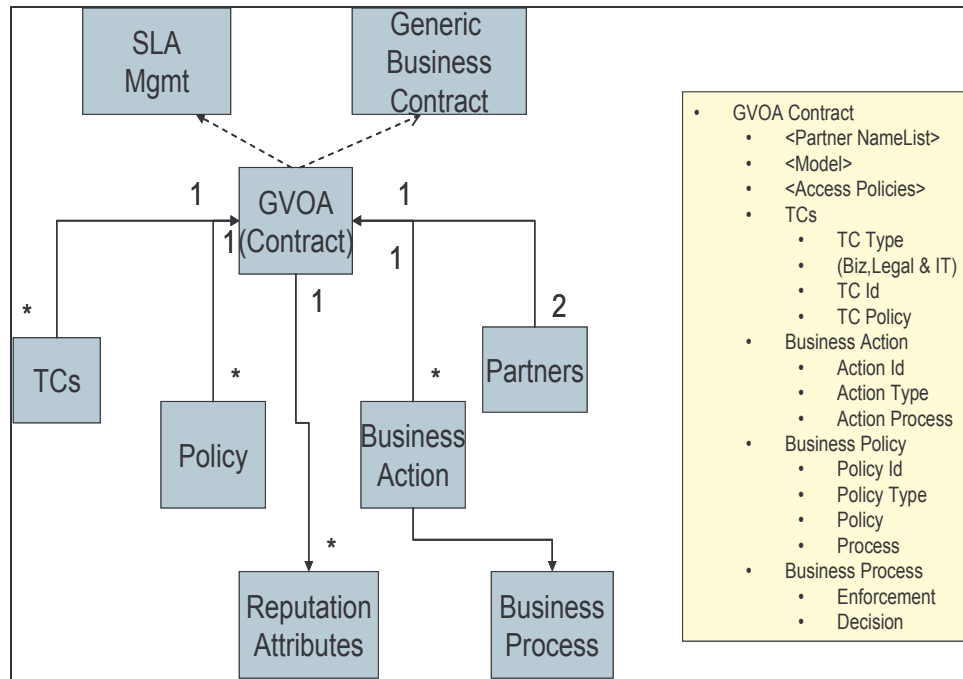


Figure 3: GVOA Structure with Policies, a and TCS

The implementation model (in XML) is as follows:

- <!-- ***** -->
- <!-- Licensed Materials - Property of Company --->
- <!-- ***** -->
- <?xml version="1.0" encoding="UTF-8"?>
- <Business Contract-GVOA>
 - <Initiator></Initiator> <!-- Name >
 - <OwnerList></OwnerList> <!-- List of suppliers or partner -->
 - <TCList>
 - <TC name="DeliveryRate" ></TC>
 - <Tctype name="BusinessTC"> </Tctype>
 - <TCValue name="DeliveryTime" value = "30 days"> </TCValue>
 - <TCPolicy name="DeliveryPolicy"></TCPolicy>
 - <TC name="IPropertyRules" ></TC>
 - <Tctype name="LegalTC"> </Tctype>

- <TCValue name="LegalTerms" value = "LegalDoc345.doc"> </TCValue>
- <TCPolicy name="DeliveryPolicy"></TCPolicy>
- <TC name="SecurityLevel"></TC>
 - <TCType name="ITTC"> </TCType>
 - <TCValue name="SecurityLevel" value = "Level-1"> </TCValue>
 - <TCPolicy name="DeliveryPolicy"></TCPolicy>
- </TCList>
- <AccessList></AccessList>
- <DateModifiedList> </DateModifiedList>
- <GeneralTC List></GeneralTC List>
- <DefaultPolicyList></DefaultPolicyList>
- <ExpiryDate> </ExpiryDate>
- <ContractType></ContractType>
- <DefaultProcessList></DefaultProcessList>
- </Business Contract-GVOA>

8 Appendix B: Supplier Reputation Questionnaire

The data collection methodology that was employed in the research for this document involved a questionnaire-based interview approach. The questionnaire content was designed to capture all facets of the supplier selection and management process including risk, criticality, selection criteria, and management metrics. There are elements of the supplier selection and management process that may sometimes be subjective and the questionnaire captures indicators of subjective criteria as well as objectively measured criteria.

SUPPLIER SELECTION AND QUALITY DATA COLLECTION QUESTIONNAIRE	
Version 0.1 - Copyright IBM - IP (IBM Confidential) 17-Feb-06	
Document Objective: This document will be used to facilitate analysis for the supplier selection and quality study. It will be used in discussions with various manufacturers to understand their supplier selection criteria and supplier quality metrics.	
Question Topic Area	
Question	
1 Supplier Selection and De-selection Process	
	Supplier selection process and methodology - how many suppliers exist in Tier-1
	How are suppliers initially identified before Sourcing?
	How are new suppliers identified during or after sourcing
	How are requirements developed (product or service requirements to be delivered by supplier)?
	How are supplier selection criteria developed?
	How are supplier selection criteria weighted?
	What is the bidding/negotiation process?
	What is the average duration from requirements identification to supplier selection?
	What are the roles and responsibilities associated with the supplier selection process?
	Are the same set (or subset) of supplier selection criteria used consistently?
	Is an onsite supplier review conducted?
	Who makes the final supplier selection decision?
	Is the supplier rating and selection process common across the organization?
	Does the level of effort involved in supplier rating and selection vary depending on business impact and size of supply base?
2 Supplier Selection Criteria	
	What are the supplier selection criteria? Some typical criteria topics are listed below:
	<i>NOTE: The actual supplier selection criteria will be much more detailed and specific to the OEM requirements and product</i>
	Capability / Fit to product requirements
	Fit to product specifications
	Flexibility to accommodate product variation over time
	Does supplier provide a competitive advantage to the OEM?
	Capacity Criteria
	Max capacity rates
	Customer base and competitive capacity requirements
	Capacity flexibility
	Supplier Quality Criteria
	Quality processes
	Quality systems
	Quality history
	Supplier's supplier selection process and quality requirements
	Regulatory and environmental standards performance
	Customer services history

Timing	Engineering and development lead time
	Production lead time
	Delivery lead time
	On-time delivery
Management and Personnel-related criteria	Management philosophy and consistency with OEM philosophy
	Personnel and resource sufficiency
Facilities and location Criteria	Physical location(s)
	Manufacturing facilities
	Equipment
	Safety record and measures
Cost Criteria	Competitive cost
	Contract structure
	Total cost of ownership analysis
Technology Criteria (tools, systems, and automation relating to production)	Tool and system capability
	Equipment
	Innovation history and commitment
Data and Information Technology Criteria	Use of info systems vs. manual controls
	Sophistication of info systems
	Data availability (engineering, production, scheduling, quality, sales, etc.)
	Data and/or system integration between supplier and OEM
Physical and information security criteria	Location security measures
	Data security
	Information and facilities access control
	Secure communications
3 Metrics and KPIs	
	What are the primary metrics and KPIs included in high level executive reporting?
	What are the overall supplier selection metrics and KPIs?
	What is the process to determine and revise supplier metrics and KPIs that are tracked?
	What supplier metrics and KPIs are tracked?
	Quality metrics
	Performance metrics
	Cost metrics
	Responsiveness
	Management metrics
	What are the processes to regularly measure metrics and KPIs?
	To what extent are metrics and KPI tracking automated?
	What is the relative importance of the metrics and KPIs?
	What is the relationship between supplier metrics/KPIs and other corporate metrics and KPIs?
	How do supplier selection criteria relate to metrics and KPIs?
	Who is responsible for tracking supplier metrics and KPIs?
	How is statistical process control used to track supplier quality metrics?
4 Reporting	
	What supplier quality and performance reports are used?
	What is the reporting frequency?
	What metrics are included in the various reports?
	Who are the audiences for the various supplier quality and performance reports?
	What are the supplier's reporting requirements to the OEM?
	What metrics are included in the various reports?
	How much reporting history is maintained?
	To what extent does automated reporting and metrics tracking occur?

5 Supplier Relationship Management

- What is the supplier quality and performance monitoring process?
- How frequently is monitoring conducted?
- What is the change management process relating to product engineering, systems and tools, distribution network, etc?
- Are periodic on-site reviews conducted? How frequently?
- Are supplier compliance audits conducted? How frequently?
- What is the process for addressing and resolving supplier quality issues?
- What is the process for addressing and resolving supplier timing issues?
- What are the circumstances under which a supplier relationship would be dissolved?
- What is the process for dissolving a supplier relationship?
- Who are the final decision makers involved in dissolving a supplier relationship?

6 Tools, Systems, and Automation

- Are supplier quality systems and processes evaluated? How?
- To what extent are tools & systems supporting design capability evaluated?
- To what extent are tools & systems supporting manufacturing capability (including tooling) evaluated?
- To what extent are tools & systems supporting quality management evaluated?
- To what extent are tools and systems supporting distribution evaluated?
- What are the supplier testing requirements?
- How significant is supplier tool, system, and automation commonality with the OEM?
- How significant is supplier process commonality with the OEM?
- Are common information systems required?
- What are the data exchange requirements?
- Is there a common supplier quality tracking and metrics tool used across the organization?
- What are the systems involved in supplier quality tracking?

9 Appendix C: Business and Social Aspects of Reputation

9.1 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.

9.2 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 is 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).

9.3 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 Schopler 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*.

10 Appendix D: Supplier Scoring and Risk Assessment

10.1 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.

10.1.1 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:

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

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	Sum of labor hour attribute in all warranty records regarding	Count the number of delayed deliveries	Average of importance of failure rate. This includes document	Average of importance of computational violations (e.g. SLA driven).

	regarding quality of service	the part		delivery	
Weight	3	1	2	3	1

10.2 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.

10.2.1 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:

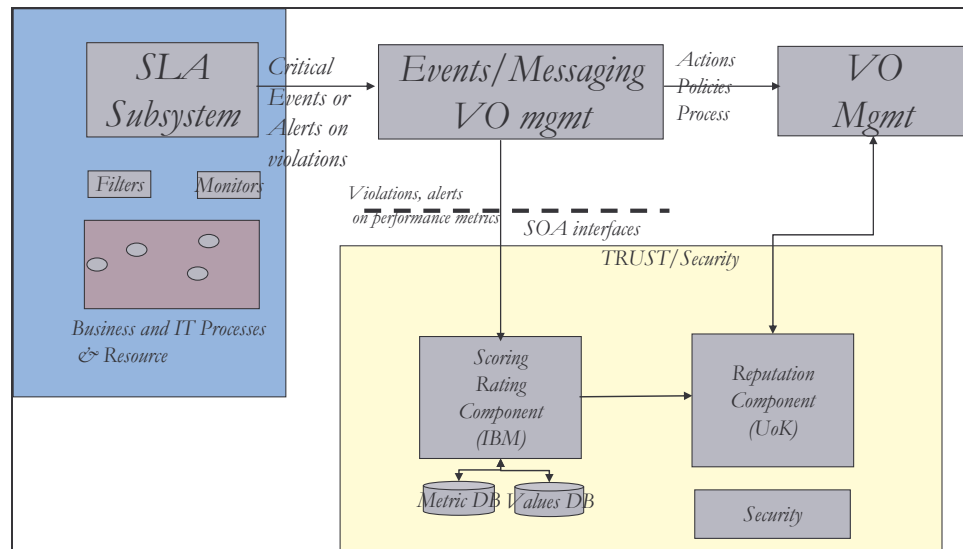
- Labor
- Health and Safety
- Environmental
- Management System
- Ethics

Supplier Conduct Principles:

- a. Forced or involuntary labour
 - b. Child labour
 - c. Wages and benefits
 - d. Working hours
 - e. Non-discrimination
 - f. Respect and dignity
 - g. Freedom of association
 - h. Health and safety
 - i. Protection of the environment
- Laws
Ethical dealings
Communications
Monitoring/Record Keeping

10.3 Supplier Scoring System

We present a supplier scoring system for enabling the TrustCom reputation system to compute and rate suppliers or VO members. The figure below illustrates the supplier scoring system in relation to the rest of the TrustCom components.



In the figure above, we show that the supplier scoring system can take potential event input from SLA or VO management subsystems to trigger the scoring of a supplier. The model of interaction is such that the reputation subsystem will leverage as much of the scoring system as possible for doing daily or weekly or monthly scoring of suppliers. The scoring system can also be used by the VO manager when creating a new VO with current and new members.

10.4 Risk Assessment

An example risk assessment is included below to better illustrate the risk assessment process and how it drives the development of scoring criteria.

For the risk assessment example we have selected the TC SP within the CE Scenario Business Model A where the CE VO owns the relationship with the TC SP. In this example, we are conducting a risk assessment at the product level for the SP from the perspective of the CE VO.

Because the scenario is limited in detail, we have made assumptions to drive the development of risks as well as the impact and likelihood classifications of these risks. Based on the risk assessment and mapping we have developed the evaluation criteria at the product level for the TC SP.

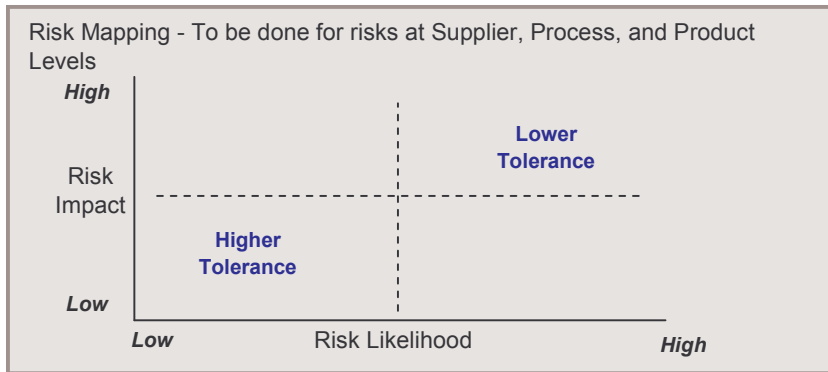
This example represents the process by which evaluation criteria are developed. In a subsequent appendix we have included example evaluation criteria for the remaining evaluation levels of the SP as well as the TC HPC and TC Cons Eng.

Risk Mapping Example

Scenario: Risk Assessment and Product-level Evaluation Criteria based on Business Model "A" product-level Evaluation for TC SP. Risks and Criteria are from the TC VO Perspective.

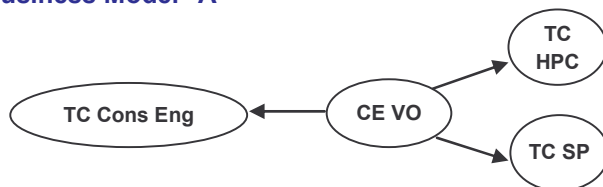
Risk Tolerance Assessment Framework

- Evaluate risks at Supplier, Process, and Product Level



- Assign risk tolerance variables based on criticality evaluation and risk tolerance assessment
 - Supplier Risk Tolerance Variable - Based on decision sensitivity to supplier stability and corporate reputation
 - Process Risk Tolerance Variable - Based on part or service sensitivity to process maturity and consistency
 - Product Risk Tolerance Variable - Based on part or service specific sensitivity to risk. Impact of variability of part or service specifics
- Risk tolerance variables will be used in scoring algorithms for supplier assessment

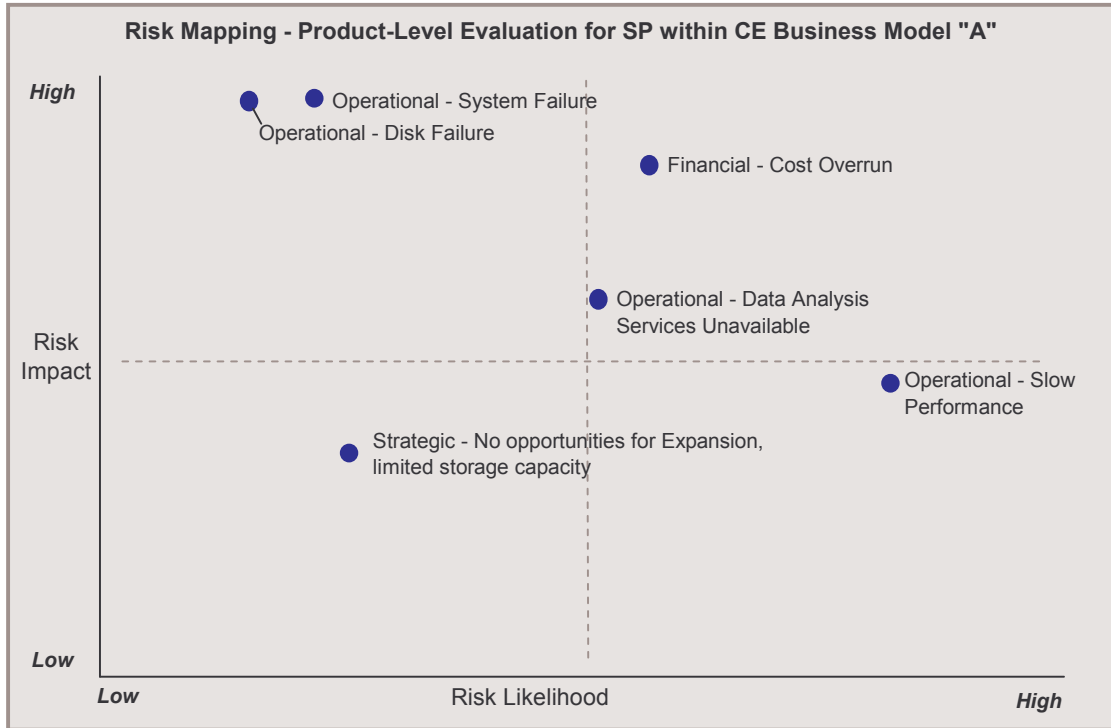
Business Model "A"



Identify and Map the Product-level Risks

For this example risk likelihoods have been assumed

Note: The risks are from the perspective of the CE VO



Develop Product-Level Evaluation Criteria to Address Risks Identified in Risk Assessment

Product Evaluation					
Criteria	Definition	Weight	Supplier Performance Target	Actual Performance	Target Miss Action
SP Availability	% of Storage availability over time	0.5			
SP Performance	% of slow storage and access speed over average and specified speed	0.25			
Computing Uptime (availability)	% of downtime over time	0.75			
SP access times (Calculations per second)	Variation in access times	0.25			
Scalability (upward and downward)	Scalability in terms of data replication and movement	0.5			
SP failure rate		0.25			
Data Analysis Services	Data mining				
SP costs	ratio of Costs over performance	0.75			

10.5 Scoring Criteria

Below we have included scoring criteria developed for the TC Cons Eng, TC HPS, and TC SP. These criteria are highly representative of industry practice and reflect the results of our research and interviews.

At the supplier scoring level the scoring criteria are highly consistent. This will remain the case in many situations as organizations consistently look for metrics around competitive positioning, stability, and values. At the process level differentiation is more pronounced as process requirements change to reflect the specific needs of the sourcing decision to be made. At the product level criteria are very specific to the delivery and quality requirements of the product or service to be sourced.

The scoring criteria are included in the scoring system spreadsheet, a template for evaluating and scoring potential suppliers/partners. The weights assigned are representative.

Supplier Scoring Spreadsheet - TC Cons Eng ((weights: 1.0, 0.75, 0.5, 0.25 and 0)

Supplier Evaluation					
Criteria	Definition	Weight	Supplier Performance Target	Actual Performance	Target Miss Action
Competitive Position (supplier Dunn & Bradstreet rating)	Relative position of supplier among competitors - strong, weak, etc...	0.25			
Financial Strength (Sales versus costs)	Supplier financial position, financial strength. Expressed through Market Capitalization, Debt to Equity Ratio, Share Value, etc	0.25			
Stability	Representative measure of stability and business continuity over time. Expressed through age of company, executive level turnover, etc	0.25			
Quality Reputation (JD Powers Quality Score or something similar)	Representative measure of historical quality and competitive quality position based on historical performance/reputation data collected internally or external industry research or word-of-mouth	0.5			
Delivery Reputation (Score based on % of delivery misses, hits, delivery failure rates, delivery service and wrong deliveries)	Representative measure of historical delivery and competitive delivery position based on historical performance/reputation data collected internally or external industry research or word-of-mouth	0.5			
Alignment with Corporate Values (Not sure)	Representative metrics indicative of alignment with corporate values and culture. Includes media perception and word-of-mouth	0.25			

Process Evaluation					
Criteria	Definition	Weight	Supplier Performance Target	Actual Performance	Target Miss Action
HR Processes	NA	0			
Training Processes and Curriculum	NA	0			
Quality Control Processes	% of failed quality processes and non-conformance	0.5			
QC Process Maturity	Following CMMI 5.0, Quality gates, and others	0.25			
Data Management Processes	Following the appropriate certified document system	0.25			
Security Processes	% of security lapses over a long period of time, certification level of security	0.25			

Product Evaluation					
Criteria	Definition	Weight	Supplier Performance Target	Actual Performance	Target Miss Action
Delivery to Specifications / Compliance	% of Delivery misses versus hits, % of delivery failures versus success, % of wrong location deliveries and % of logistical errors in costs and invoices.	0.25			
On-Time Delivery/Performance	% of bad-timing deliveries, cost of missed delivery on product development	0.5			
Quality of Documentation and Deliverable Materials	% quality of product or service based on key attributes (Design evaluation	0.75			
Availability of Specified and appropriate resources	% of allocated expert time versus non-expert development time	0.25			
Document Control		0.25			
Performance to Target Cost (overrun % etc)	% of costs for consulting versus performance	0.25			

Cost of Product or Service Cost of product or service per unit of the product 0.5

Supplier Scoring Spreadsheet - TC HPC (weights: 1.0, 0.75, 0.5, 0.25 and 0)

Supplier Evaluation					
Criteria	Definition	Weight	Supplier Performance Target	Actual Performance	Target Miss Action
Competitive Position	Relative position of supplier among competitors - strong, weak, etc...	0.5			
Financial Strength	Supplier financial position, financial strength. Expressed through Market Capitalization, Debt to Equity Ratio, Share Value, etc	0.5			
Stability	Representative measure of stability and business continuity over time. Expressed through age of company, executive level turnover, etc	0.5			
Quality Reputation	Representative measure of historical quality and competitive quality position based on historical performance/reputation data collected internally or external industry research or word-of-mouth	0.5			
Delivery Reputation	Representative measure of historical delivery and competitive delivery position based on historical performance/reputation data collected internally or external industry research or word-of-mouth	0.5			
Alignment with Corporate Values	Representative metrics indicative of alignment with corporate values and culture. Includes media perception and word-of-mouth	0.25			

Process Evaluation					
Criteria	Definition	Weight	Supplier Performance Target	Actual Performance	Target Miss Action
Connectivity Standards		0.5			
Communication Standards and issues	% of communication errors in network for computational job submission	0.5			
Technology Standards and issues		0.5			
Maintenance Processes	% of downtime for maintenance and loss of job submissions	0.5			
Facility Management Processes	% of failures in management of jobs and completion reports	0.5			
Security Processes	% of security lapses over time (months or years)	0.75			

Product Evaluation					
Criteria	Definition	Weight	Supplier Performance Target	Actual Performance	Target Miss Action
CPU Availability	% of CPU time allocated for job and job completion times	0.5			
Processor Performance (Jitter)	Jitter of job completion times over average completion times (this the variation in job completion times)	0.25			
Computing Uptime (availability)	% of downtime of computational jobs over the total number of jobs	0.5			
Computational Power (Calculations per second)	% of jobs completed within the specified time versus over all job completion time	0.25			
Scalability (upward and downward)		0.5			
Computational Success Rate	% of successful completions over the number of completions	0.25			
Costs	Costs of service over the computational allocation	0.75			

Supplier Scoring Spreadsheet - TC SP

Supplier Evaluation					
Criteria	Definition	Weight	Supplier Performance Target	Actual Performance	Target Miss Action
Competitive Position	Relative position of supplier among competitors - strong, weak, etc...	0.5			
Financial Strength	Supplier financial position, financial strength. Expressed through Market Capitalization, Debt to Equity Ratio, Share Value, etc	0.5			
Stability	Representative measure of stability and business continuity over time. Expressed through age of company, executive level turnover, etc	0.5			
Quality Reputation	Representative measure of historical quality and competitive quality position based on historical performance/reputation data collected internally or external industry research or word-of-mouth	0.5			
Delivery Reputation	Representative measure of historical delivery and competitive delivery position based on historical performance/reputation data collected internally or external industry research or word-of-mouth	0.5			
Alignment with Corporate Values	Representative metrics indicative of alignment with corporate values and culture. Includes media perception and word-of-mouth	0.25			

Process Evaluation					
Criteria	Definition	Weight	Supplier Performance Target	Actual Performance	Target Miss Action
Connectivity Standards	% of connectivity failures and non-conformance issues	0.5			
Communication Standards	% of job submission communication failures	0.5			
Technology Standards	Non conformance to industry standards	0.5			
Maintenance Processes	% of downtime for maintenance	0.5			
Facility Management Processes	% of failed management processes in reporting and billing errors	0.5			
Security Processes	%Loss of confidential information over time	0.75			

Product Evaluation					
Criteria	Definition	Weight	Supplier Performance Target	Actual Performance	Target Miss Action
SP Availability	% of Storage availability over time	0.5			
SP Performance	% of slow storage and access speed over average and specified speed	0.25			
Computing Uptime (availability)	% of downtime over time	0.75			
SP access times (Calculations per second)	Variation in access times	0.25			
Scalability (upward and downward)	Scalability in terms of data replication and movement	0.5			
SP failure rate		0.25			
Data Analysis Services	Data mining				
SP costs	ratio of Costs over performance	0.75			

10.6 Scoring Process

After the scoring criteria are developed the execution of the scoring activity takes place. At each of the three levels: Supplier, Process, and Product/Service, a scoring exercise is conducted. The objective of the scoring is to provide a relative comparison of the available suppliers across all of the required dimensions. Each supplier is evaluated individually based on their capability on each of the various scoring criteria. Some criteria may require minimum performance levels and in these situations suppliers who do not demonstrate those levels of performance will be removed from the assessment pool.

The actual scoring requires data collection with respect to the full set of scoring criteria developed. This data collection exercise can take many forms among which may include:

- Interviews
- Checklists
- Structured requests for information (RFI) or requests for proposal (RFP)
- Data collected from external information providers
- Documented demonstration results

Once the data is collected and assimilated results are compared for all considered suppliers. A combination of performance on scoring criteria and cost will be considered when making the ultimate judgement decision.

It is of significance to note, however, that while there are limited degrees of consistency from company to company in the supplier scoring process there is a great deal of variation in the details and operational application of scoring and selection methodologies. Even within companies consistency is most frequent where the functional domain of the purchased product or service as well as the criticality and risk tolerance of the product or service are consistent. In cases where function domain, criticality, and risk tolerance are varied the actual application of the selection and scoring exercise is rarely consistent. Additionally, we wish to reiterate the significance of the cost-quality trade-off. Where there is little business case to do so, few resources will be utilized in the selection and scoring process.

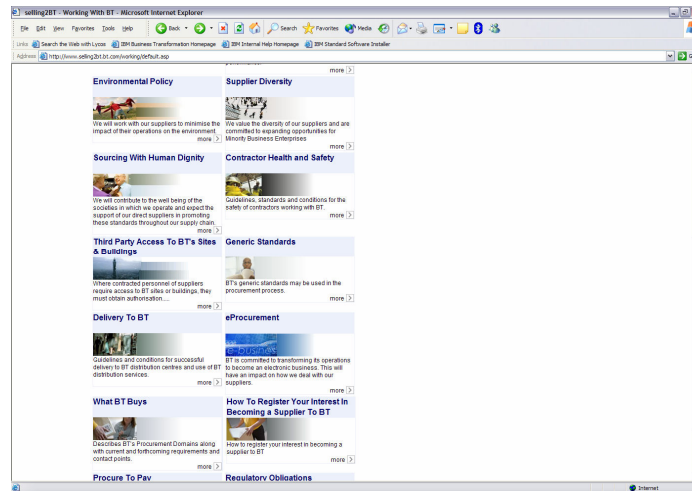
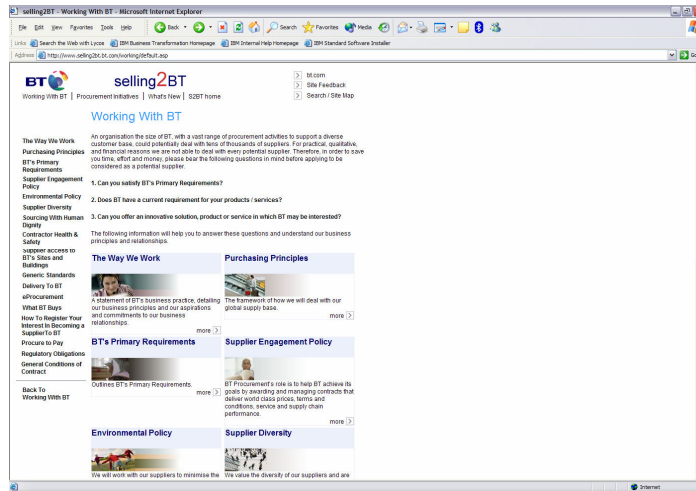
10.7 Published Supplier Selection Criteria

Companies typically make publicly available some information on their basic supplier requirements through their externally facing websites.

Below we have included URL information and screen shots from the companies that were interviewed as part of the research for the creation of this document. All three have publicly available information on supplier requirements. These requirements, within the context of the supplier selection process we have presented, are closely related to supplier-level selection criteria.

For British Telecom the URL that directs suppliers to requirements is: <http://www.selling2bt.bt.com>

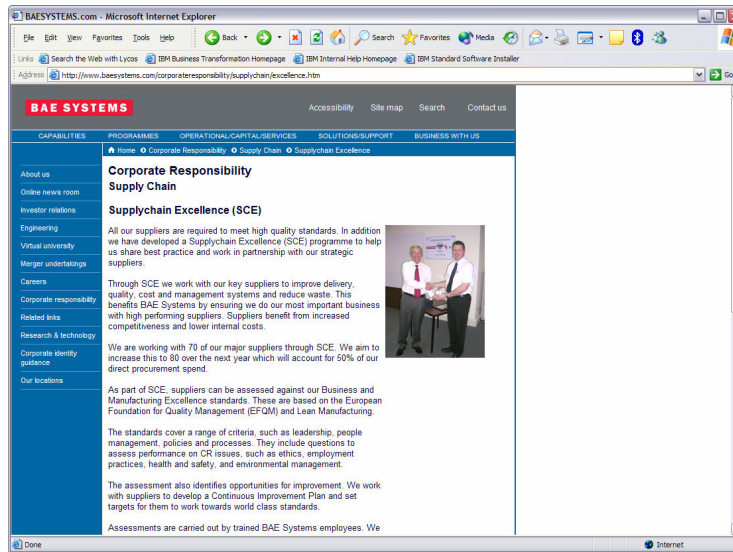
The URL includes links and documentation regarding BT's business practices, purchasing principles, supplier quality requirements, diversity, environmental policy, health and safety requirements, standards, and much else.



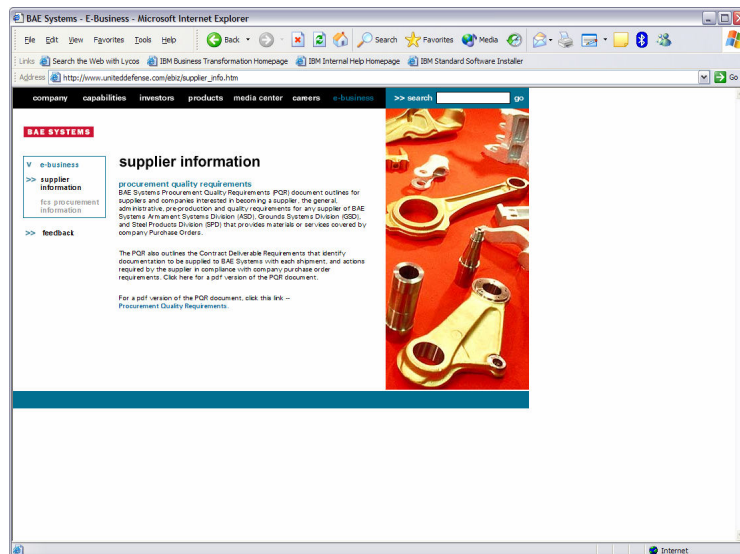
For BAE Systems the supplier requirements are presented in less detail than those of BT and are done so on an organizationally decentralized basis where separate divisions have unique requirements listed.

The following URL directs suppliers to BAE's Supply Chain Excellence site where supplier relationship objectives and intent are documented including standards requirements such as European Foundation for Quality Management (EFQM) and Lean Manufacturing.

<http://www.baesystems.com/corporateresponsibility/supplychain/excellence.htm>

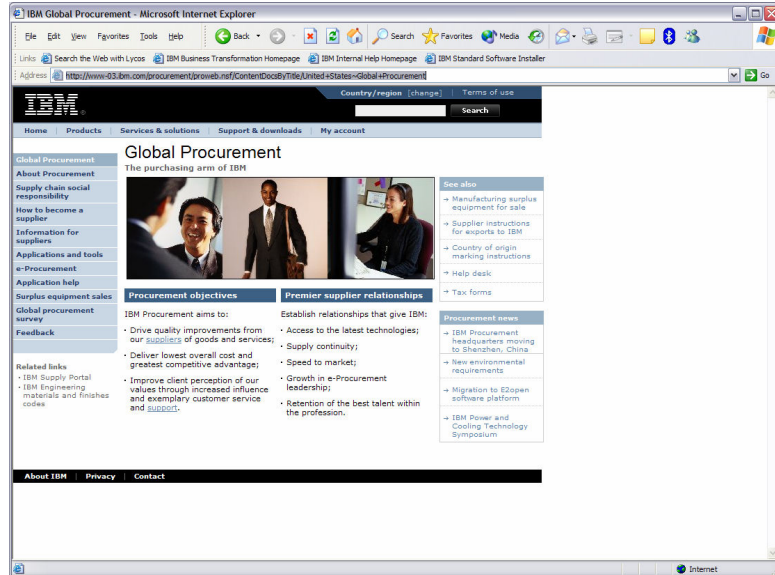


BAE - BAE Systems Armament Systems Division (ASD), Grounds Systems Division (GSD), and Steel Products Division (SPD) present unique requirements accessible through the following URL: http://www.uniteddefense.com/ebiz/supplier_info.htm.

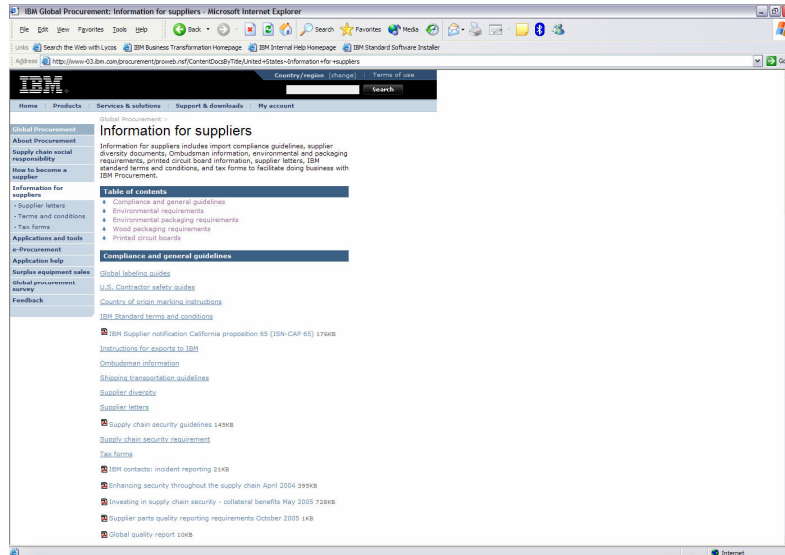


IBM has developed a global procurement website that is publicly available through the following URL:

http://www-03.ibm.com/procurement/proweb.nsf/ContentDocsByTitle/United+States~Global+Procurement



From this site supplier can access information on compliance and general guidelines at the supplier level, and in certain cases the process and product level (as is the case for wood packaging and printed circuit boards)



IBM has also made available their Supplier Global Quality Reporting Requirements which are accessible from the previous page.

