
Supporting Collaborative Engineering Using an Intelligent Web Service Middleware

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Abstract. T

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1. Introduction

Modern day engineering tasks typically demand a complexity not supported by individual companies – accordingly, enterprises join in collaborations to outsource and distribute tasks according to the tasks that need to be fulfilled. Such collaborations are normally difficult to manage considering their size and complexity.

In recent years, the concept of Virtual Organisations has been developed to describe such collaborations *on basis of resources exposed to the internet*. Following the grid concept, such organisations allow for managed and dynamic collaboration between different resource *types*, or in other words to enable transactions between different companies in a coordinated manner.

The TrustCoM project has delivered a framework, as well as a reference implementation that enables organised and contract managed collaborations in a secure and trusted environment. Even though TrustCoM principally allows for dynamic on-demand creation of Virtual Organisations, as well as their autonomous management according to predefined collaboration description, the project does not support all issues to ensure full uptake by the eBusiness community.

This paper examines TrustCoM in view of one its particular application scenarios, namely the “CE scenario”, in which different companies participate in a Virtual Organisation to adapt an airplane according to a specific customer’s personal requirements. Basing on this scenario, we will examine in how far TrustCoM actually supports the individual participants in their task of supporting the VO requirements and thereupon elaborate the gaps that the recently started IP project BREIN is addressing.

2. An Assured Environment for Collaborative Engineering: The TrustCoM Approach

... to add: describe the overall framework here ...

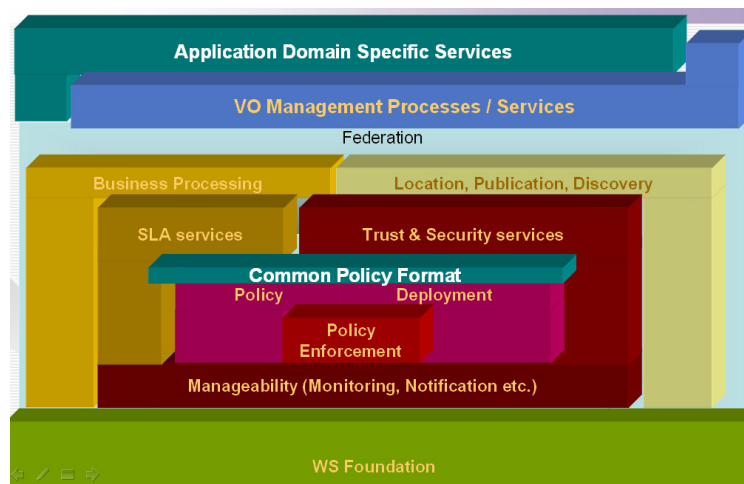


Figure 1. Block Schematic of the TrustCoM Framework

For more details on the framework structure as realised by the TrustCoM project, please refer to [1].

2.1 “Abstract Entities”

TrustCoM’s main achievement in bringing Virtual Organisations closer to modern day business needs consisted in particular in introducing the concepts of “abstract entities” to the Grid and Web Services community. As opposed to the classical approach, where each actual resource as maintained by the individual enterprises is exposed as a service of its own, be it humans, printers, computers or actual applications and utilities, the “abstract entities” approach foresees that each participant in a Virtual Organisation is actual a *conglomeration* of individual resources that are executed and linked in a coordinated manner.

This way, participants are considered *real* business entities, with their own existing typical workflows to generate the “products” they sell and with an infrastructure that they do not want to expose to, let alone be controlled by external bodies. From the TrustCoM perspective, enterprises participate in a Virtual Organisation according to the *roles* they bring in rather than according to their *resources*. This respects the first main issues in (electronic) business: the confidentiality of providers’ infrastructure and leaving complete control over this in their hands.

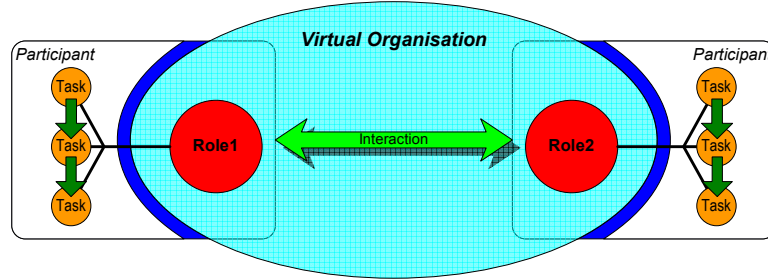


Figure 2. Abstract Entities in TrustCoM's Virtual Organisations

2.2 Managing the Virtual Organisation

Classical Grid VO approaches described the whole collaboration as a series of task executed by the individual resources as exposed by the participants. With actual enterprises participating in the Virtual Organisation, i.e. with them representing abstract entities that do not allow manipulation of their individual resources, such an approach is obviously not feasible anymore. Instead, TrustCoM describes the collaboration as interactions between roles as defined e.g. by WS-CDL.

Since Virtual Organisations may loose individual participants during execution, be it due to actual loss of connection, due to violation of the contractual terms etc., such a choreography and the according list of role providers needs to be carefully maintained by the Virtual Organisation. To this end, TrustCoM provides the VO Management structures that manages participants in the collaboration and enacts the relevant tasks to maintain the VO structure, which includes the typical VO lifecycle phases as described by [2] (cf. figure 3).

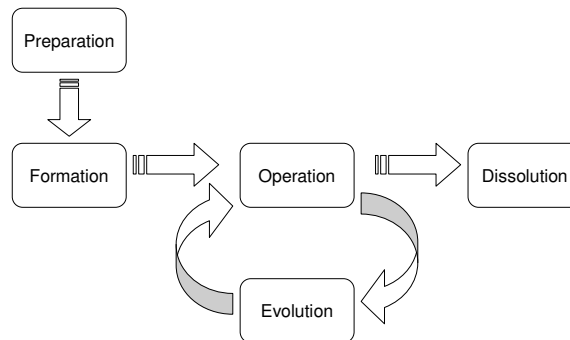


Figure 3. Typical Phases in the VO Lifecycle

3. Applying Virtual Organisations: The Collaborative Engineering Scenario

One particular application scenario (cf. of the TrustCoM project consisted in an engineering consortium (here “CE VO”) collaborating with a team of airplane analysts (“Analysis VO”) to support the tasks of an airline manufacturer that e.g. wants to extend the capabilities of an airplane to host internet capabilities on-flight to fulfil customer demands (cf. figure 4). It has to be noted here, that the so-called VOs in this scenario are actually the “abstract entities” as described in the preceding section, i.e. (smaller) collaborations that exist prior to the actual VO as supported by the TrustCoM framework and that only adapted minimally to the according customer needs. For more details on the legal impacts of such an approach, please refer to [4].

The main issue here is that the TrustCoM framework allows for such collaboration by providing a secure and contract managed middleware that enables the individual participants to expose “virtual” resources that reflect the capabilities of the respective “local” and private business processes. The framework provides participants with a means to host such an interface that secures message exchange, controls access according to the overall collaboration description and ensures that the according transaction requirements are met and automatically updated. From the individual participant’s perspective, interactions take place as with a single entity, non-regarding the changes in the VO structure. What is more, none of the participants needs to take over responsibility for any other entity, but itself.

This reduces the management overhead typically associated with such scenarios greatly. This scenario has also been thoroughly discussed in [3].

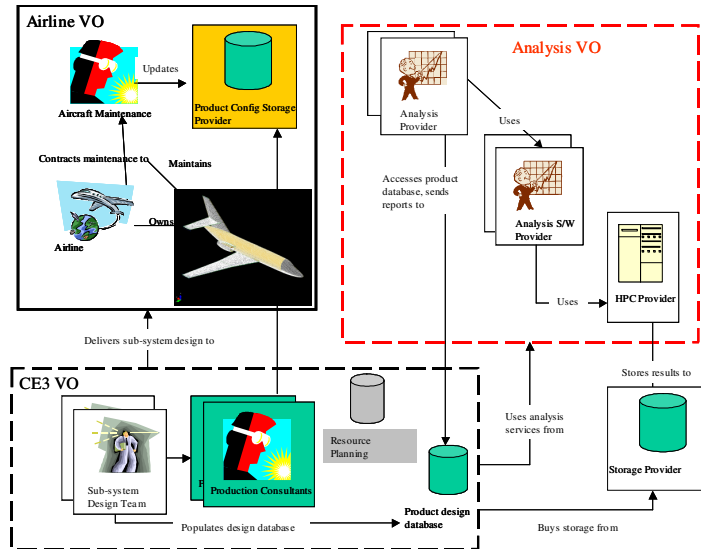


Figure 4. Actors in TrustCoM's CE Scenario

4. Ready for eBusiness 2010?

TrustCoM provides all the relevant features to relieve business providers from the burden of complex and in particular costly adaptations of the infrastructure to meet individual customer's demands and to maintain security and access right restrictions. It also ensures that dynamicity is maintained without impact on the individual participants and that the risk of participation is reduced through means of contractual binding, sensible responsibility distribution and SLA support.

However, TrustCoM can not relieve the participants from the burden to *understand* the system and to prepare their infrastructures so as to meet the TrustCoM requirements. As such, business ("role") providers need to understand the Service Level Agreement language, as well as describe the link between those and their resource capabilities. They need to be capable of reading and understanding the policy descriptions they subscribe to as part of their contracts. They need to describe and set up their infrastructure so that it can interface a business process engine which in turn is exposed to the VO. And customers wanting to exploit the TrustCoM framework need to have great knowledge about collaborations so as to form the initial collaboration description and specify the requirements with respect to the individual participants.

Since furthermore the TrustCoM system does currently not support any intelligent matching, it takes a unique way of describing service capabilities to ensure that the exposed functionalities match the ones described in the collaboration description.

As such TrustCoM must be regarded as a great step towards providing business providers with a framework that supports their business needs from a *technical* perspective, yet as such it could not cater for specific needs that would allow "business agnostic" providers easy integration into the system. With smaller to medium enterprises in particular focus of the Virtual Organisation goals, the TrustCoM middleware runs the risk of being yet too complicated for fast uptake, non-regarding the simplifications achieved by this project.

TrustCom can hence only be an intermediary step towards reaching the actual end-user, be it SME "role provider" or customer.

5. Filling in the Gaps: The BREIN Approach

The BREIN project is loosely coupled to TrustCoM and extends the achievements of the latter with a particular focus on the *human* behind the system. It pursues three main goals:

- supporting the business providers in all tasks related to exposing and integrating his/her capabilities into a Virtual Organisation.
- supporting the customer in getting the capabilities and services he/she needs.
- optimising the behaviour of both the whole VO *and* the individual participant in a way that respects everybody's demands without disrespecting according corporate policies.

As such, BREIN is one of the first IP projects to address the *whole* requirements of enterprises to participate in Virtual Organisations (cf. figure , i.e. by enhancing the pure technical level according to *human* needs. As opposed to TrustCoM, the project does *not* look into the legal aspects involved in VO enactment and does not intend to extend the issues related to measuring individual participant's trustworthiness. With this respect it builds upon existing results (such as by TrustCoM).

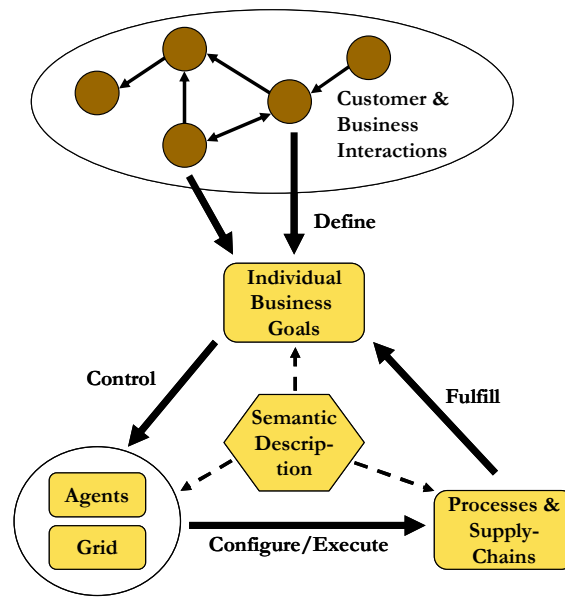


Figure 5. An Overview Over The Technologies In The BREIN project

5.1 CE Scenario Revisited

With the enhancements as pursued by the BREIN project, scenarios such as the Collaborative Engineering one described above will profit very much from both provider as well as customer perspective:

- customer and provider may describe their requirements, respectively their capabilities in a more abstract way
This way, no additional background knowledge about the underlying common language model needs to be acquired and participants can expose and make use of functionalities in their own way. This allows in particular integrating providers according to their capabilities, rather than having to respect interoperability issues.
- business processes and collaboration may be described in a more intuitive manner with only limited business expertise, collaboration details are derived automatically from capabilities and requirements

Since complex engineering processes are difficult to design and require expertise in particular to optimise the execution, such an approach allows providers to implement and realise new services more effectively.

Given the business processes and the requirements / capability descriptions, the BREIN framework furthermore supports the design process in a way that allows customers to define complex collaborations even with limited business expertise

- contract details are human readable
- the collaboration is capable to adapt to changes in the environment in a more autonomous manner

With the intelligence to monitor and integrate environmental information, participants in the VO are enabled to react more quickly and effectively. This may involve both changes on the local infrastructure side (such as limited resources) as well as external effects (such as additional customer requirements).

Given the capabilities, the BREIN framework will allow participants to generate and integrate their services more efficiently with less effort. From the CE perspective, this allows in particular to realize more complex engineering tasks without the additional effort of having to “understand” the system first.

6. Summary & Conclusion

The paper has shown that the Collaborative Engineering scenarios can gain much from the current progress being made in Virtual Organisation research: not only does it allow to reduce risk and adaptation cost, it also allows more flexibility and easier integration into collaborations.

Great progress has been made over the recent year to achieve this goal by such projects like TrustCoM which furthermore laid the basis for integrating legal and trust aspects. Reference implementation and demonstrations have shown that the vision of dynamic Virtual Organisations on an internet / network basis *are* possible indeed and will form the future of eBusiness.

However, the approaches so far still show great inflexibility with respect to human specific needs, in particular where such complex issues such as business objectives are concerned. And even though deployment and administration of such middleware becomes more and more easy, the actual usage is still restricted to technically educated engineers with the according knowledge.

One step in overcoming these obstacles is taken by the BREIN project which integrates Agent, Semantics and Web Service technologies with VO middleware to provide the necessary flexibility that brings eBusiness closer to the day-to-day market.

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