TOWARDS COLLABORATIVE PROCUREMENT NETWORK ENTERPRISE SYSTEMS - A DESIGN SCIENCE RESEARCH PROJECT

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Abstract

Enterprise Systems in the form of ERP and extended ERP face challenges in supporting large business networks involving many organizations and people. First, the classic document exchange approach for connecting two systems across company borderlines is time-consuming and costly. Second, today's enterprise systems lack support of the people dimension with specific focus on enabling semi-/unstructured activities as part of the entire end-to-end-process. In this paper we present our research-in-progress of a running design science research project focusing on creating a software artifact addressing the two challenges of significant integration effort and the lack of semi-/unstructured process support. We look at these two challenges specifically in the domain of procurement, where the huge number of connections to suppliers results in high integration effort and involves a large number of semi-/unstructured activities.

Keywords:

Enterprise Resource Planning, Extended Enterprise Systems, ES Technology, Design Science Research, Business Networks, Procurement.

1 Introduction

The primary focus of Enterprise Resource Planning systems is to standardize and streamline company internal business processes from an end-to-end perspective (Davenport, 1998). The concept of extended ERP broadened this original scope and target business process optimization beyond company borderlines. They enable integration across companies by defining and establishing standards that structure the messages or documents being exchanged between the different existing systems. Typical representatives of extended ERP systems are supply chain management systems (Búrca, et al., 2005). The pursued approach usually results in costly and complex integration efforts (Tarn, et al., 2002).

Beside this integration challenge, ERP and extended ERP systems except for CRM systems are usually focused on streamlining structured business processes. Unlike semi- or unstructured business processes, structured business processes operate on well-defined business objects and follow a predetermined set of activities. Many activities that happen before and after the actual execution of structured business processes steps are not supported (Calisir, 2004). The huge potential for further increasing efficiency and effectiveness of semi-/unstructured processes are currently not or only partially leveraged.

In this paper we present first results of our research-in-progress in a running design science research project focusing on creating an initial software artifact that addresses the two challenges of integration efforts and semi-/unstructured process enablement in the context of networked businesses. We look at these two challenges specifically in the domain of procurement, where the huge number of connections to suppliers results in significant integration effort and involves a large number of semi-/unstructured activities.

The paper is structured as follows: Section 2 briefly introduces the underlying design science research approach. Section 3 summarizes the preliminary results of our first design cycle execution. First, we introduce a networked procurement use case and associated key challenges. Second, we put our work in the context of the existing theory base and elaborate on the initial qualitative research we have performed. Third, we present first artifacts that have been created as part of our development activities. Fourth, we present preliminary evaluation results of the created artifacts. Section 4 provides an overview on related work. Finally, Section 5 concludes with a short summary and an outlook on future work planned in our design science research project.

2 Research Approach

Our research project strictly follows the Design Science approach in information systems research according to Hevner, et al. (2004), as we are convinced that complex systems like business networks with a large number of heterogeneous performance drivers and interoperability points can only converge to an optimum by iterative design cycles.

Design science pursues the aim of “producing and applying knowledge of tasks or situations in order to create effective artifacts” (Mark & Smith, 1995). Figure 1 depicts the general design cycle. This framework was introduced in principle by Takeda et al. (1990) and refined by Vaishnavi, V. K. & Kuechler (2007). Accordingly, design science research starts with the “Awareness of a Problem” phase. The subsequent phases - “Suggestion”, “Development” and “Evaluation” - are normally performed iteratively during the course of the research project. By forcing back the design process to the “Awareness of Problem” phase, new constraints are defined, and the suggestion process is carried out building on these constraints. This is a fundamental activity in the design process, because it updates the knowledge base by adjusting the original theories that informed the design process.

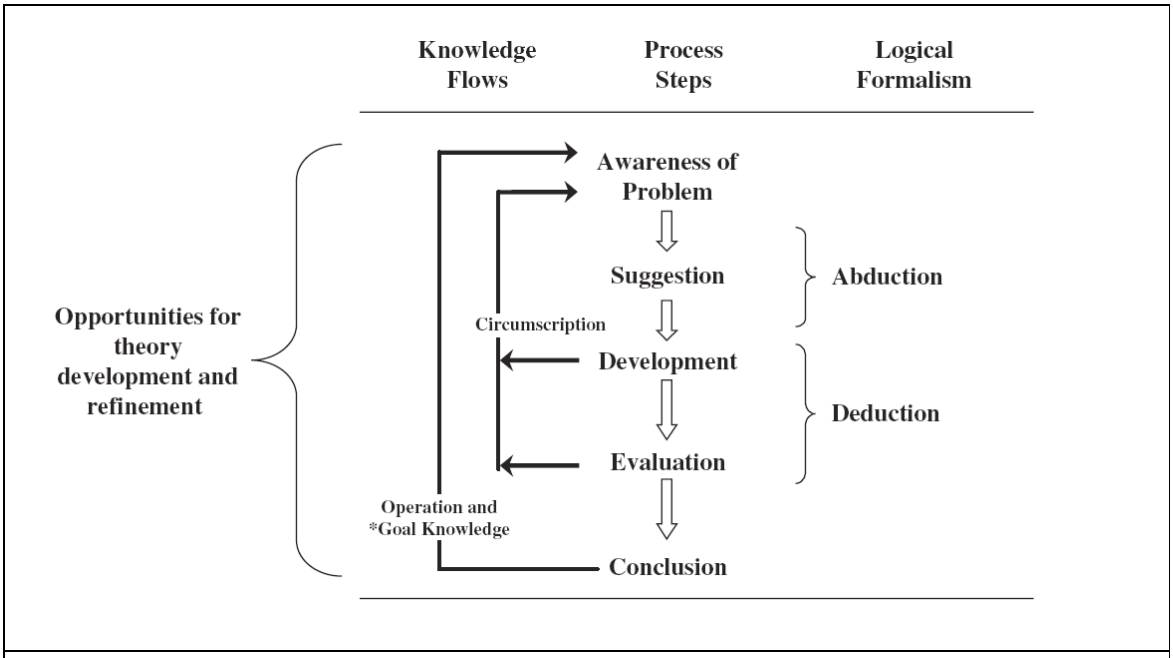

Figure 1: Design Cycle Framework (Vaishnavi, V. K., & Kuechler, W. , 2007, pp. 493, extended from Vaishnavi, V. K., & Kuechler, W. , 2004 as adopted from Takeda, et al., 1990)

3 Design Cycle Framework for Networked Procurement

3.1 Awareness of the Problem

Business Networks can be defined as a "set of connected relationships" (Anderson, et al., 1994), therefore going beyond dyadic relations between business partners, capturing the business context they are embedded in and the connections between relationships. Networked Procurement is a specific kind of a business network (Camarinha-Matos, et al., 2009). It is characterized by intense intra- and cross-organizational business process integration and high collaboration requirements of the involved parties, such as sales representatives, lead buyers, category managers, foreign trade agents, chief procurement officers (CPOs) etc. A basic procurement scenario is illustrated in Figure 2. It starts with a request for a quotation by the buyer, responded to by the supplier's or suppliers' quote(s), followed by the purchase order if the quote meets the buyer's requirements and finally the creation of the sales order at the supplier site. Further intermediate information such as purchase order response and advanced shipping notification (ASN) are usually exchanged, followed by the goods issues at the supplier site and the corresponding goods receipt at the buyer's company. The scenario is completed with the financial transaction reflected by creation of the supplier invoice, dispatching of the invoiced document and verification of the invoice by the buyer organization.

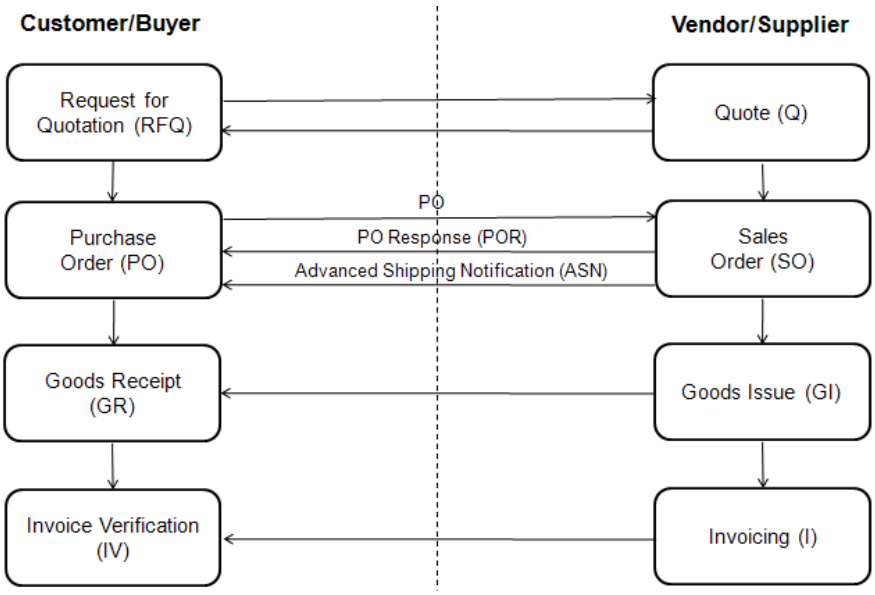

Figure 2: Classical Procurement Scenario

This straight forward scenario describes just one direct interaction between a buyer and a supplier. It is applied in many supply chains, involving thousands of companies and people worldwide. A huge number of heterogeneous structured business objects and unstructured content such as documents or emails are exchanged. Heterogeneity appears on the syntactic and semantic layers and results in huge complexity. In procurement networks involving cross-organizational (e.g. multi-tier quality management in the automotive industry) and cross-border collaboration (e.g. foreign trade global risk and compliance agencies) as well as semi-/unstructured interactions (e.g. business contact initialization, supplier evaluation, document collaboration, emails and calls), the complexity increases exponentially (Madlberger & Roztocki, 2008).

Further challenges and cost drivers in traditional procurement integration based on structured data type exchange, mapping and asynchronous transfer protocols result from high on-boarding and integration cost, leading to total cost of ownership (TCO) increase for all involved parties in extending networked business relations.

Heterogeneous and inflexible collaboration models lead to low transparency with regard to business performance and slow business opportunity adoption in particular in multi-tier supply chains. Seamless interfacing of ERP systems with people networks today is also lacking, resulting in limited interlinkage between semi-/unstructured and structured interaction and therefore between procurement and people network context.

3.2 Suggestion

To come up with reasonable design proposals to increase performance of procurement networks, embracing a variety of business network participants with heterogeneous capabilities and tasks and indifferent to their organizational/hierarchical relationships, our research is grounded on two core theories: First, the Actor-Network Theory (ANT) (Sarker, et al., 2006) which describes complex systems as the alignment of social networks of human and non-human actors or other elements. In IS literature, ANT is frequently used to explain the complex interactions related to the implementation and use of IT. Second, the Network Effect Theory (NET) ((Rohlfs, 1974) and (Oren & Smith, 1981)) which proposes that adopters of a particular network technology obtain benefits that grow as the size of the existing network increases - meaning, the value of a given product increases with the growing number of users.

Besides looking into the existing knowledge base, we have carried out initial qualitative research in the form of an exploratory study to better understand the activities and challenges of end users in the context of networked procurement supported by existing enterprise systems. From the methodology perspective we used heuristic

evaluations to analyze expert perspectives along defined persona descriptions and uses cases (Nielsen & Molich, 1990). Eight semi-structured interviews were conducted with interviewees from the domains of product management and enterprise architecture management, specifically responsible for supply chain management, supplier relationship management and procurement. These subject matter experts deal on a daily basis with procurement user from small, medium and large enterprises. The qualitative data analysis resulting from our exploratory study of current practices exposed that enterprise systems end users in procurement networks are still forced to switch software tool environments to complete business transactions, in particular when the type of interaction changes rapidly between synchronous, asynchronous, structured and semi-/unstructured. Users perceive a loss in regards to process performance and context. The need for flexible business object handling is also obvious, moving from simple structured objects like a quote with just one line item, unstructured document collaboration with versioning to complex business object handling like invoice verification with referencing to several related objects (e.g. quotation, purchase order, sales order, goods issues, goods receipt, invoice, unstructured technical and financial documentation, events, emails, instant messages).

Other important aspects are interoperation and consistency challenges faced by collaboration and exchange environments like electronic marketplaces and global trade platforms. Different semantic and syntactic formats of document transferred between N buyers to M suppliers and vice versa lead to time leakage, high integration and on-boarding cost and low fault tolerance – very often some of the main supply chain issues result from documents simply get stuck when moving from an integration infrastructure to the next. Finally, we also learned that social networking service used in private life like Facebook, Xing, LikendIn etc. are increasingly used to capture business relationships in procurement networks.

Based on the findings of our literature research and our exploratory study we have derived a set of preliminary design propositions for a networked procurement enterprise system artifact:

- Prevent document exchange between network users
- Enable collaboration on shared, networked business objects
- Ensure seamless interaction flow between semi-/unstructured and structured content without losing the business context
- Provide adaptable and interchangeable business templates.

Figure 3 illustrates the overall concept approach.

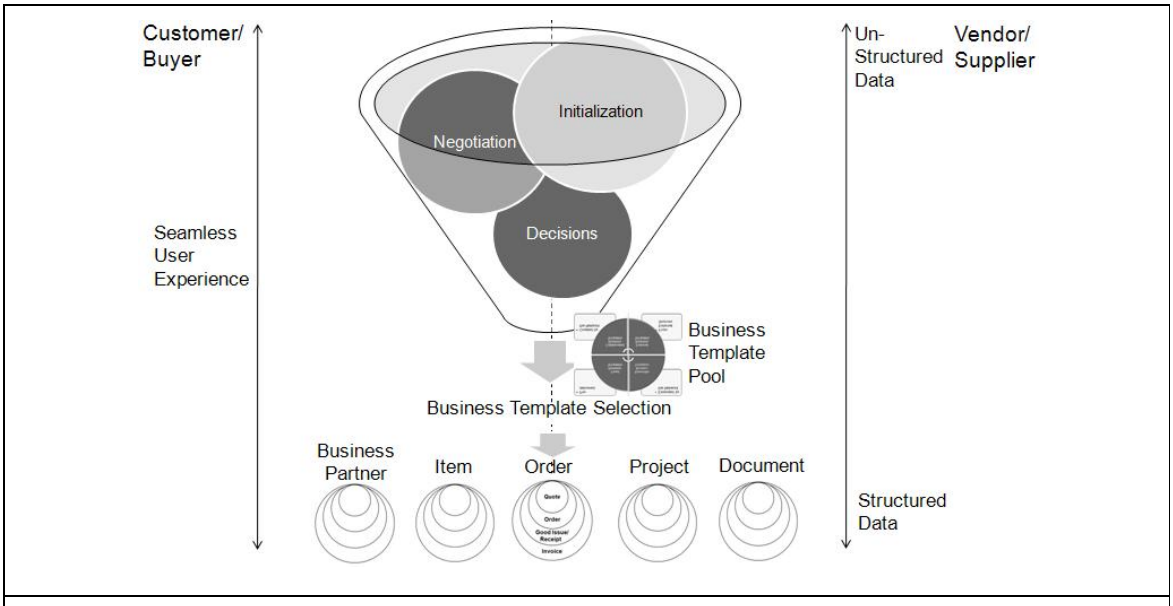

Figure 3: Networked Procurement Concept Approach

In our proposed Networked Procurement concept, Customer (Buyer) and Vendor (Supplier) are working on the same platform, they share common structured and semi-/unstructured data and experience a similar seamless user

experience between different structured and semi-/unstructured interactions. The proposal goes along a intuitive people interaction pattern, starting with a first contact initialization, sharing common user and optional company related information. From there the collaboration partners could move to a kind of high-level negotiation if and about what they could do business and finally they could move to a decision about a concrete business use case like contract negotiation, order, a joint project or just exchanging further business data or documents about their companies, products, services etc. By moving to a joint business use case, both collaboration partners could select one or more business templates from a business template pool to detail their business interaction. Business templates could be pre-defined (not modifiable), created by the network, extended by the network or from external sources like other business partners. Moving along the use case, the business relations could become increasingly mature, moving for example from generic negotiations, to placing orders to issuing and receiving invoices. The shared business objects would thus evolve accordingly.

3.3 Development

Following the design propositions outlined above, this section describes the preliminary results of our development activities for the networked procurement artifact, called 'B-Zone'. The development is done in cooperation with labs of SAP AG. Leveraging user-centered design methods (Constantine, 1999), starting with networked procurement persona definitions, use case descriptions - the latter along the classical procurement scenario from quote, order, shipment to invoice - and adding semi-/unstructured process steps in between. From there we start with the user-centric design with wireframes and visual designs which build the first prototype tangible artifact.

From the persona perspective we described in detail the category manager and sales manager - both instrumental in a networked procurement use case - in persona sheets. The category manager is normally a person who acts on the buying as well as on the selling site, being responsible end-to-end and across different use cases for the overall business performance of a certain set of products or services. The sales manager in networked procurement is strongly driven by sales figures and interacts with an extended network of customers and service providers to achieve her/his goals.

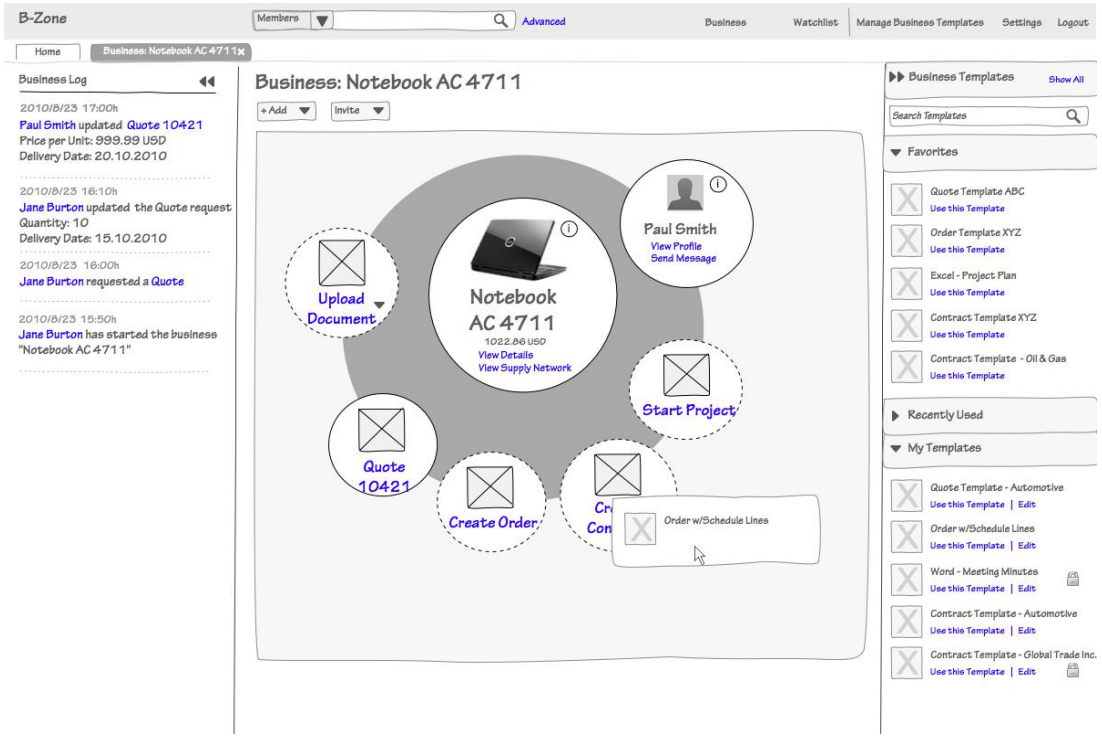

Figure 4: Business Template Exchange Wireframe in 'B-Zone' Artifact

Figure 4 shows the wireframe where the category manager is able to exchange the business template s/he wants to use for the particular use case in the middle content section of the screen. In this example the category manager who wants to buy a certain quantity of IT equipment for two subsequent delivery dates, replaces the simple order template in the middle section by a more complex one by selecting the one with schedule lines from the right business template panel and drops it to the middle section. In the left panel the business log informs the category manager about the use case history and related people interactions.

Figure 5 illustrates the results of the visual design process, experimenting with different color codes, icons and controls to make the user experience appealing and the interaction as well as the screen navigation intuitive for the user.

Figure 5: Business Template Exchange Visual Design in 'B-Zone' Artifact

3.4 Evaluation

We used the heuristic evaluation method based on wireframes and visual design artifacts again to obtain first hand qualitative feedback from the domain experts and input for the following artifact iterations. The preliminary evaluation results of the artifact showed that the interaction flow is intuitive and appealing, people feel comfortable navigating in the business network environment, and the move from semi-/unstructured to structured process steps appears consistent and natural.

The flexibility to use, exchange, adopt, create, search and manage business templates are perceived as very powerful, and the design concept of multiple users collaborating on the same networked business objects without document exchange is described as significantly increasing the performance of procurement users.

We also received encouraging feedback with regard to the tight integration of analytical data along the use case, the user-friendly document collaboration and the tight integration of ranking/rating as well as powerful search, trade notification and watch list features.

4 Related Work

In regards to Networked Procurement as a specific instance of Business Networks, we base our research framework on (Camarinha-Matos, 2004). He analyzed in the context of Collaborative Networked Organizations

(CNOs) and Virtual Organizations (VO's) opportunities of new information technology usage to enable new collaboration forms. In (Camarinha-Matos, et al., 2009) a holistic definition with regards to networking, coordinated networking, cooperation, collaboration and different CNO types is established.

The impact of networkability investments on supply chain performance is investigated by (Huisman & Smits, 2007) by connecting networkability according to (Österle, et al., 2001) and network performance defined by Straub, et al. (2004) and exploring the relation between IT investments on dependencies, degree of information sharing and network performance, particularly in small and medium enterprises (SME). They propose that non-specific IT investments in the network business buses decrease dependency, increase information sharing, and increase network performance.

Additional research work in the context of network performance is reflected in the concept model of (Ghosh & Bertisen, 2007) for e-business networking, which defines 18 critical success factors along four categories with strategic network performance as the core, surrounded by network marketing, network design and network value delivery. Finally they propose further research in the areas of key performance indicators to measure and monitor the network performance on an ongoing basis against strategic objectives and process definitions to optimize the function of the critical success factors on operational performance. We will leverage these concepts to further elaborate our evaluation approach in subsequent cycles of our design science research project.

The work of (Bal, et al., 1989) proposes a shared data object model for simple implementation of parallel applications and loosely coupled distributed systems. The core idea is not to use common techniques for distributed implementation like RPCs but to rather apply user-defined abstract data types, leveraging object oriented design principles like encapsulation, with instantiation of shared data-objects, replicated among local memories and processors. This concept significantly reduces object access time and increase parallelism. The overall architecture elements of their shared data-object model consist of compiler, runtime system and a reliable broadcast protocol. Obviously this concept imposes quite an overhead with regard to replication mechanisms and consistency management of data-object instances allocated on different network resources.

The close relation to the topic of electronic marketplaces, which have been pushed in particular in the early 2000 years we reflect with studies of the different types of e-marketplaces (Matook & Vessey, 2008), their role in supply chains (Park & Suresh, 2005) (Chang, 2008) and their challenges in collaborative business (Grey, et al., 2005).

The areas of new software provisioning paradigms, combined with the recent software delivery technologies are promising approaches to accelerate business networking. We specifically consider as relevant Virtualization (e.g. Kraut, R. et al., 1999) and Cloud Computing (CC) (e.g. Stanoevska-Slabeva, et al., 2010) concepts as well as Software as a Service (SaaS) and On-Demand delivery of enterprise systems (e.g. Buxmann, et al., 2008 and Friedel, 2009). Current practice examples from SAP are Business by Design (ByD), a complete ERP suite on-demand offering, Streamwork (activity management), Sourcing On-Demand and Business Intelligence On-Demand. Other examples are on-demand solutions from Salesforce, in particular cloud applications like Sales Cloud, Service Cloud, Small Business and Retail as well as the Force.com platform which offers an environment for collaboration, application development and cloud infrastructure.

The strong adoption of advanced collaboration and community concepts such as Social Networks (e.g. Wellman, et al., 1996, Haythornthwaite, 2005 and Ellison, et al. 2007) like Facebook or synchronous collaboration tools like Skype in private life impacts business in general and enterprise systems specifically.

Our research project will follow strictly the design science approach as we are convinced that complex systems like business networks with many heterogeneous performance drivers can only converge to an optimum by iterative design cycles.

5 Summary

The first cycle of our design science research project provides encouraging indications that the concept model and artifact are having positive impact on people performance in a collaborative procurement network.

This initial evidence needs further research however. We will therefore run next design cycles elaborating the design propositions with end users, expanding the use cases and enhancing the artifact design by developing a running concept prototype. In this context we will use qualitative (e.g. user lab experiments, expert interviews) as well as quantitative methods (e.g. field studies in online communities) to gain rigor evaluation of the design proposals.

To gain further relevant industry requirements we will establish a Networked Procurement Customer Focus Group, driven with SAP AG, for continuous communication and elaboration along the design progress.

With a focus on analyzing and measuring the level of the overall performance in business networks, we will define a 'Business Network Evaluation Framework' (BNEF), a hierarchical schema of performance drivers and impediments. The BNEF will be applied to our artifact to measure the effects of adaptation and extensions of the artifact as well as to evaluate other business networks in the context of particular use cases.

The ultimate goal is to pilot the running software with business end users and to explicitly demonstrate the performance enhancements that can be achieved in real-world procurement networks.

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