Anatomy of Business Networks: Future Internet Enterprise Systems Accelerating Procurement Interoperability

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Abstract. Large Business Networks impose interoperability challenges on Enterprise Systems in the form of ERP and extended ERP, involving many organizations and people. First, the classic document exchange based system connection approach 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-structured and 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 that addresses the two challenges of significant integration effort and the lack of semi-structured and unstructured process support. We look at these two challenges specifically in the domain of procurement, where many connections between business partner result in high integration effort and involves a large number of semi-structured and unstructured activities.

Keywords: Internet Enterprise Systems, Design Science Research, Business Networks, Procurement, Interoperability.

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 [1]. The concept of extended ERP broadened this original scope and target business process optimization beyond company borderlines. ERP and extended ERP enable integration across companies by defining and establishing standards that structure the messages or documents being exchanged between the different existing systems. Typical examples of extended ERP systems are supply chain management systems [2]. The pursued approach usually results in costly and complex integration [3].

Beside this integration challenge, ERP and extended ERP systems (with the exception of CRM systems) are normally focused on streamlining structured business processes. Unlike semi-structured 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 [4]. The huge potential for further increasing the efficiency and effectiveness of semi-structured and unstructured processes is not sufficiently leveraged at present.

In this paper, we present our research-in-progress of a running design science research project focusing on creating a software artifact that addresses the two challenges of integration efforts and semi-structured and 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-structured and unstructured activities.

The paper is structured as follows: Section 2 briefly describes current practice. Section 3 introduces Procurement as a business network instantiation and its key challenges. Section 4 summarizes our solution proposal including preliminary results of our first design cycle execution. First, we introduce the underlying design science research approach. 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. Finally, Section 5 concludes with a short summary and an outlook on future work planned in our design science research project.

2 Current Practice

Grounding practice with regards to business object interoperability is the early work of Bal, et al. [5] based on a shared data object model for parallel applications and loosely coupled distributed systems. To reduce object access time significantly and to increase parallelism they do not use traditional techniques for distributed development like RPCs. They apply user-defined abstract data types instead, leveraging object oriented principles with instantiation of shared data objects, replicated among local memories and processors. Compiler, runtime system and a reliable broadcast protocol make up the architecture of their shared data object model. The concept still imposes quite an overhead though in terms of replication mechanisms and consistency management of data object instances allocated on different network resources.

Closely related to the topic of procurement interoperability are electronic marketplaces, which emerged extensively in the early years of the new millennium. We reflect the interrelation, challenges, further developments etc. with studies of the different types of e-marketplaces [6], their role in supply chains [7], [8] and their challenges in collaborative business [9].

Promising approaches to accelerate business interoperability are pushed by new areas of software provisioning paradigms, combined with recent software delivery technologies. In this context we consider all of the following relevant: Virtualization [10], Cloud Computing (CC) [11] as well as Software as a Service (SaaS) and On-Demand enterprise application provisioning [12], [13].

We also consider relevant recent offerings in the software market like SAPs products 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 cloud solutions from Salesforce like Chatter, Sales Cloud and Service Cloud as well as the Force.com platform which offers an environment for collaboration, application development and cloud infrastructure.

Other phenomena which impact business in general and enterprise systems specifically are advanced collaboration and community concepts such as Social Networks [14], [15], [16] like Facebook or synchronous collaboration tools like Skype for non-business use.

3 Procurement – A Business Network Instantiation

Business Networks can be defined as a "set of connected relationships" [17], going beyond dyadic relations between business partners, including the connections between relationships and the business context they are embedded in.

Procurement is and was always a business area where interoperability between people, organizations and IT infrastructures is imperative. In the supply chain intersections of buyers and suppliers, many procurement business scenarios and use cases require powerful connectivity, collaboration and analytical capabilities [18]. Some examples are Supply Base Management, RFx processes (Request for Information, Quotation), Contract Management and Reverse Auctioning.

In addition to the classical B2B 1:n buyer/supplier relations, the early initialization steps of procurement businesses in particular require the involvement of intra-organizational and inter-organizational parties, e.g. in global trade scenarios, where foreign trade agencies, lawyers, customs authorities etc are also involved in implementing a given business case. Figure 1 provides an overview of typical global commodity chains in foreign trade.

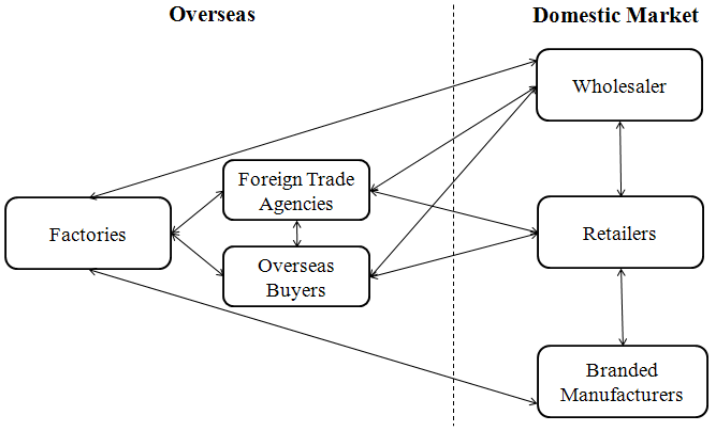

Fig. 1. Foreign Trade Producer-driven and Buyer-driven Global Commodity Chains (based on Gereffi, [19])

Camarinha-Matos, et al. [20] characterize Business Networks by intense intra-organizational 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. It can thus be concluded that Procurement is a specific kind or instantiation of Business Networks.

4 Solution Proposal

4.1 Research Approach

Our research project will strictly follow the Design Science approach, 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 "seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts" [21]. Figure 2 depicts the general design cycle. This framework was introduced in principle by Takeda et al. [22] and refined by Vaishnavi, V. K. & Kuechler [23]. 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.

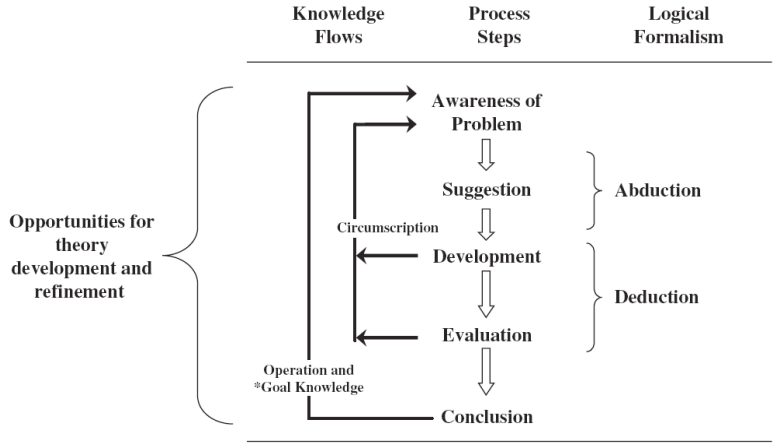

Fig. 2. Design Science Framework.

4.2 Interoperability Challenges in Procurement

A basic procurement scenario is illustrated in Figure 3. Initiated by the buyer who creates a request for quotation, responded to by the supplier's or suppliers' quote(s), followed by the purchase order if a quote meets the buyer's requirements and finally the creation of the sales order by the supplier. Further intermediate information such as purchase order response and advanced shipping notification (ASN) can also be exchanged, followed by goods issue by the supplier and the corresponding goods receipt by the buyer. The scenario is completed with the financial transaction triggered by the supplier invoice and verification of the invoice by the buyer organization.

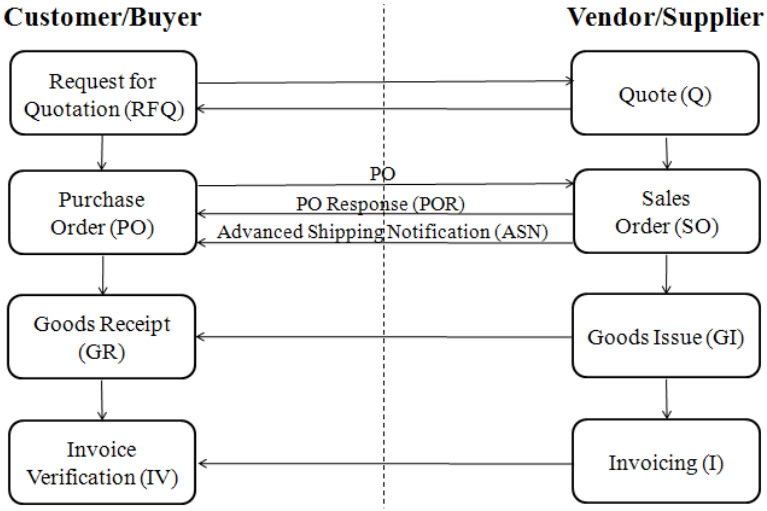

Fig. 3. Classical Procurement Scenario

This straightforward scenario describes only the direct interaction between one buyer and one or many suppliers and how it is deployed in a large number of supply chains, involving thousands of companies and people worldwide. A huge amount of heterogeneous structured business objects and unstructured content such as documents or emails are exchanged. Heterogeneity appears on the syntactic and semantic levels. Complexity increases exponentially in procurement networks [24] by involving cross-organizational (e.g. in multi-tier quality assurance in the automotive industry) and cross-border (e.g. foreign trade global risk and compliance agencies) collaboration as well as by semi-structured and unstructured interaction (e.g. business contact initialization, supplier evaluation, document collaboration, emails and calls).

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

Heterogeneous and inflexible collaboration models lead to low transparency in terms of business performance and slow business opportunity adoption, especially in multi-tier supply chains.

Seamless interoperability of enterprise systems with people networks is also lacking at present, resulting in limited interlinkage between semi-structured and unstructured and structured interaction, and therefore between people networks and the procurement context.

4.3 Suggestion and Development – The Networked Procurement Artifact 'B-Zone'

Building on the knowledge base of Actor-Network Theory (ANT) [25] and the Network Effect Theory (NET) [26] [27], we have carried out initial qualitative research [28] in the form of an exploratory study to better understand the activities and challenges of end users in the context of procurement network use cases supported by existing enterprise systems.

Eight semi-structured interviews were conducted with interviewees from product management and enterprise system architecture, 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, large enterprises and cross industries. We also interviewed industry representatives for retail, wholesale and global trade who are confronted with extended interoperability requirements in the supply chain. From the methodology perspective, we used heuristic evaluations to analyze expert perspectives based on persona descriptions and detailed use cases [29].

The qualitative data analysis from our exploratory study of current practices exposed that end users of enterprise systems 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-structured/unstructured, often combined with role changes, for example when a user moves from a buyer to a supplier role. Users perceive a loss in terms of process performance and context.

The need for flexible business object handling also became obvious, moving from simple structured objects like a quote with view line items, unstructured document collaboration with versioning to complex business object handling, such as invoice verification with referencing to several related objects such as quotation, purchase/sales order, goods issues/receipt, invoice data, unstructured technical and financial documentation, events, emails and instant messages.

We also learned that social networking services used for non-business purposes, like Facebook, Xing and Likedin are increasingly used to maintain business relationships in procurement.

Based on our study of current research, practice and qualitative exploratory study, we propose a set of preliminary design constructs 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 business context
- Provide adaptable and interchangeable business templates.

Figure 4 illustrates the overall design approach.

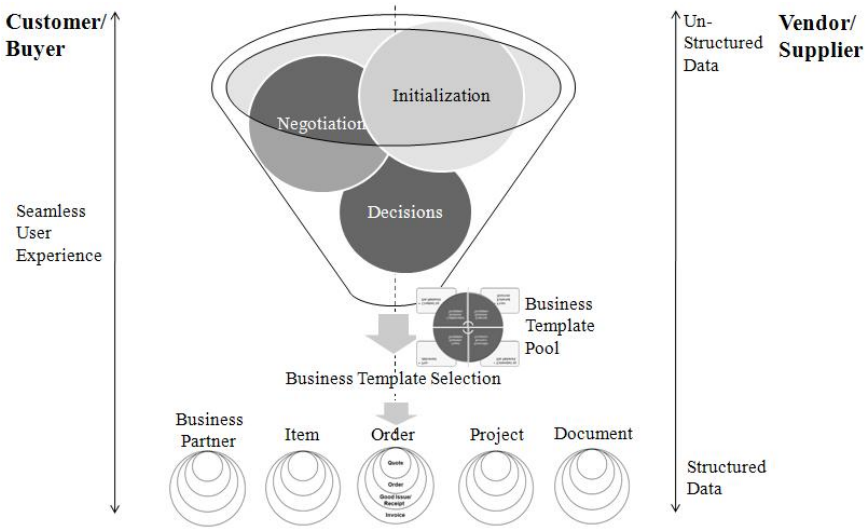

Fig. 4. Networked Procurement Concept Approach

In the Networked Procurement concept, Customer (Buyer) and Vendor (Supplier) are working on the same collaboration platform, share common structured and semi-structured/unstructured data and experience a similar seamless user interface, navigating between structured and semi-structured/unstructured context. The proposal follows a natural people interaction pattern, starting with 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 arrive at a decision about a concrete business use case, such as quotation, 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 network partners. Moving along the use case, the business relations could become increasingly mature, moving for example from generic negotiations, to placing orders, exchanging invoices and to joint projects. The shared business objects would thus evolve accordingly.

Following the design propositions outlined above, our research results in development activities for the networked procurement artifact, called ‘B-Zone’.

Leveraging user-centered design principles [30], 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-structured/unstructured process steps on top. From there we start with the user-centric design, with wireframes and visual designs which build the first prototype tangible artifact.

The 'category manager' persona for example describes a person who normally acts at both the buying and 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. In networked procurement, the 'sales manager' persona is strongly driven by sales figures and interacts with an extended network of customers and service providers to achieve her/his goals.

Figure 5 shows an example of a 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 business 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. On the left, the business log panel informs the category manager about the use case history and related people interactions.

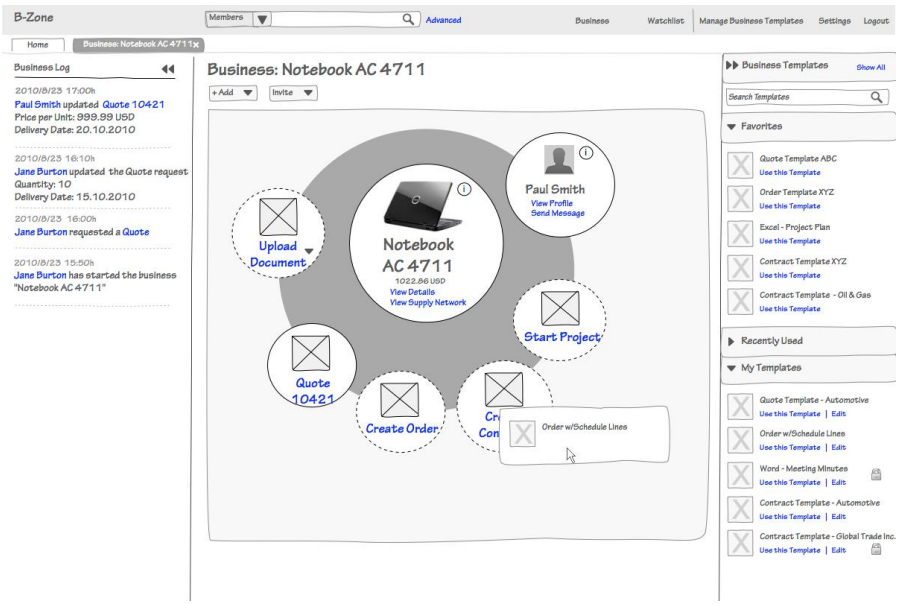

Fig. 5. Business Template Exchange Wireframe in 'B-Zone' Artifact

4.3 Evaluation Approach

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.

5 Conclusion

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

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).

With the 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 and to evaluate other business networks in the context of particular use cases.

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

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