An email-based interoperability approach for SMEs

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Abstract

More than 99% of the enterprises in Europe are Small and Medium-sized Enterprises (SMEs). While in the current market situation collaboration is evolving to an indispensable key factor of success, there is a very poor software support for SME collaboration. Especially, such collaboration needs more functionality than a pure technical interoperability of IT-Systems. In this paper we develop an adequate definition for Process Interoperability (PI) and we show how PI can help SMEs to conduct their business. Further, we derive the requirements for an interoperability solution tailored for SMEs. Finally, we introduce an interoperability approach in the context of the European Project "Commius", which enables SMEs to collaborate easily on the level of PI using simple email communication.

1 Introduction

In today's global business environment, the ability to perform seamless interoperation with other companies substantially determines the competitiveness of an enterprise. Additionally, the process of innovation is decisive for the advantage of one enterprise over another. "Innovation" nowadays primarily implies the rapid assembly of value chains where new and increasingly complex products are manufactured collaboratively by multiple specialized companies. Thus, enterprise interoperability research is a crucial point with respect to competitiveness and further growth of European enterprises.[5] The European Commission as well as economic associations identified the importance of the subject "enterprise interoperability" and support corresponding research and development activities. Although the efforts also try to address the special needs of small and medium-sized enterprises (SMEs), an universally accepted solution for this target group is still missing. Due to the fact that 99.8% of all European enterprises are SMEs and that they provide 67.1% of all employments within the European Union [6], such a solution can be expected to have a considerable impact. Based on the latest eBusiness Survey conducted by the European Comission, the majority of interviewed SMEs characterized available technologies to support eBusiness activities as too expensive or too complicated. Furthermore, the respondents stressed the ubiquitous incompatibility of software systems as a main barrier. Similar statements were made concerning the use of SCM or ERP systems. Most SMEs neither have the financial nor the personnel resources to implement and use such a system in a reasonable way. However, due to rising customer expectations and the general increase in competition, European SMEs indicate a strong demand for software solutions supporting eBusiness activities and collaboration efforts.[4] According to the above mentioned eBusiness Survey, only a minor part of European SMEs use standards like EDI or XML. Rather common - if any - is the use of proprietary standards, which points towards two-way agreements between individual business partners. In contrast to a common standard, these pair wise agreements coerce the partners into their collaborative configuration - leaving or changing such an interoperability group is intrinsically tied to high opportunity costs for changing the IT interfaces.[17] Thus analogous to the problem of "technology silos" [11] the current situation could be described as "interface islands". This means, even though established standards to support collaborative business do exist and could be used, they are not accepted by the majority of European SMEs. Instead, email technologies were stated as the preferred medium to process business transactions, which is comprehensible due to the fact that almost every SME in the European Union is connected to the internet and is thereby able to participate in email communication with nearly no additional costs.[4] Taken these results into consideration, an email based approach to support enterprise interoperability matches the requirements of SMEs in particular. Before such an approach is introduced in section 3, the underlying concept

of interoperability and process interoperability is defined and explained in section 2. The case study provided in section 4 clarifies the necessary interactions to support cross-organizational business process on the basis of a concrete example. The paper will finish with a short consideration of related work and an outlook concerning future tasks to enable enterprise interoperability for SMEs. enables a (mostly) automated build-up of a company unique customer database.

2 The Concept of Process interoperability

2.1 Defining Process interoperability

Interoperability is the ability of two or more systems or components to exchange information and to use the information that has been exchanged [1]. From the point of view of information systems (IS), this definition states very well that an IS is interoperable, if it is able to interwork with other IS. In principle, this definition is also suitable to organizations.[1] However, the transfer to the concept of business processes is not intuitive: Applying the approach stated above, process interoperability (PI) is the ability of a business process to interwork with other processes. But what does it mean? A business process is a synchronized, continuous series of enterprise tasks, undertaken for the purpose of creating output.[14] Thus, from the organizational perspective, a business process describes the coordination of enterprise activities. Its purpose is steering and control. Consequently, also process interoperability should be a concept on control and synchronization. The main difference is that PI takes no effect in current processes, but will be effective in potential, upcoming ones. Therefore, interoperable business processes must be able to integrate other business processes. In terms of control, this implies that PI describes a state in which an enterprise is able to steer activities, i.e. business process parts, within other firms or vice versa, to be partially steered by another enterprise. Process interoperability itself can be incorporated by two prerequisites: On the one hand, enterprises need organizational and technological instruments to ensure an efficient control beyond their own borders. These instruments can comprise e.g. standardized forms at specific points of the processes documenting the transfer of control and responsibility or ICT systems tracking the progress of a business process and arranging the corresponding duties. On the other hand, the process design needs to be adaptive and changeable. Interworking with other firms resp. business processes mostly mean to change specific aspects of your own business. Consequently, having interoperable processes implies to have mechanisms incorporated within these processes to make them adaptable to the requirements that could come up when initiating new process relationships. Actually, processes are always changeable; it is only a matter of cost, effort and time. In respect to PI, such a broad understanding makes no sense. Rather, PI should imply that processes can be changed and adapted to new process collaborations with almost zero cost, effort and time of change. In summary, we can define process interoperability by [12]:

Process interoperability is the ability of an enterprise to synchronize, partially control and integrate continuous series of enterprise tasks (i.e. business process parts) that are governed and executed outside of its own enterprise borders without the need to modify its own organizational and technical environment.

[1] Cf. [9] for a discussion of the applicability of technical interoperability for enterprises.

2.2 Incorporating Process Interoperability

In order to achieve such process interoperability explicitly for SMEs, certain aspects of the problem setting have to be taken into consideration. Traditionally SMEs are facing limited resources in terms of monetary personnel endowment due to imperfect usage of economies of scale. Therefore the usage of such a solution must not involve high start-up and running costs as well as specialized implementation and maintenance knowledge and its daily use must be accessible for a non-expert user rather than an IT specialist.[18] Furthermore compared to the sophisticated IS a global player has to its command, the IS -Landscape distributed among SMEs is rather poor. Approaches, enabling interoperability, based on system connectors i.e. the SAP business connector, are not applicable since they would hardly be accessible for SMEs.[4] Furthermore there is no widespread use of common interoperability standards, i.e. XML or EDI. Hence we have to find a common foundation, which is accessible and usable by the broad mass of SMEs, so that a suitable solution can be based on. Additionally in order to achieve PI, business processes have to be adaptable and linkable to enable frictionless collaboration. Hence a solution has to be customizable to the existing processes and provide gateways to connect business process beyond company borders and support cooperation involving multiple companies without the need to adapt the system every time collaborations are built or dissolved.

In summary, we can state four exigencies on a system enabling SME interoperability:

- Available at low cost, with zero start-up costs in terms of monetary and maintenance aspects, since most SMEs face limited resources,
- Compatible with systems and techniques every SME has to its disposal,
- Adaptable to the prevailed processes within SMEs,

- Frictionless linking with external processes

The European Project "Commius"[2] ties with this requirements and offers a strictly email based approach to enable interoperability between SMEs, since email has been exposed as the favorite medium of communication to perform collaboration in cross-organizational business processes.[4]

3 Commius - an email based approach

Within the further course of the paper, we will introduce the "Commius" project and give an example of its usage to clarify the functionalities. The designated solution can be installed by the SME itself and will automatically hook onto the existing Email infrastructure and collaboration systems such as Microsoft Exchange. It will then proceed to establish interoperability agreements with the peers of the SME. Interoperability will take place on three layers, system, semantic and process interoperability. Within figure 1 this three layers are also desplayed graphically.

- System interoperability: On the level of System interoperability each received email will be intercepted by the Commius system and will be analyzed, archived, decoded and decomposed. Each part of an email i.e. headers, body or attachments will be transformed into plaintext and merged into a single XML document to allow other Commius components to directly access the information for further processing. Additionally, the System interoperability layer will provide system connectors usable to interface external as well as legacy systems, required to be accessible by Commius throughout a task.

- Semantic interoperability: The semantic interoperability layer signifies meaningful communication among enterprises. As such, it underpins other kinds of interoperability between collaborating enterprises and thereby constitutes an essential prerequisite for enterprises to be truly interoperable. Outgoing from pattern based information extraction using for example regular expressions, notifications, invoices, payments, orders and other communication can be identified and relevant information in this regard may be extracted.

- Process interoperability: The third layer, concerning process interoperability constitutes the main part of this paper and will be addressed more closely in this section. The layer is subdivided into four Run-Time components and one Build-Time Component, which are described in the following subsections.

[2] www.commius.eu

3.1 Commius Configuration (Built-Time

To immediately assist the user, Commius processes have to be highly adaptable in a fast and user-friendly way. Hence a process configuration tool will be developed which enables the user to comprehend its company specific processes comfortably. Commius will provide a Reference Model Directory, containing adaptable process templates for a diversity of SME standard processes like selling, invoicing, etc. Two customizing methods are being designated. If there is no need for far-reaching customization effort and the process in terms of its actual workflow equates the standard process provided by Commius and only certain aspects like relevant email addresses or keywords have to be defined, Commius will use a questioning system to retrieve the required information and implement them into the process-workflow. If fundamental changes of the standard template are inevitable, the user will have the opportunity to customize processes, using an easy-to-use graphical modelling interface, based on drag and drop. Independent from the applied customization method, the adapted process is being stored in an enterprise process repository which is specific for each user because it reflects its very own processes.

3.2 Commius Operations (Run-Time

Having defined its own process settings, the Commius system can be used. Commius intercepts the incoming and outgoing email traffic and pass it through the different system layer. In the context of this paper, we will only describe the steps performed within the process interoperability layer:

3.3 Detecting

In this task the Commius system checks, if the incoming Email concerns an already running process or a new process instance has to be initiated. Either the email constitutes a next step within a running process and can hence, based on the prior semantical analysis, be assigned to it or the incoming email has been identified as a starting event triggering a new process. Outgoing from the corresponding reference model template from the enterprise process repository a new process instance with its specific Process ID will be created. The correct assignment of the actual process to the correct template is being realized by an analysis of process characteristics done by the semantic layer. Future incoming Emails concerning this particular process will be assigned to this initial process instance henceforth.

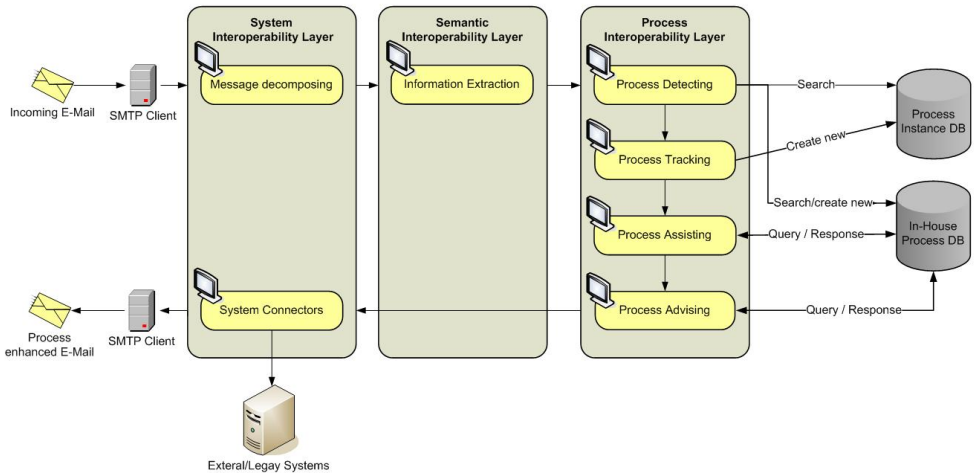

Figure 1. Overview of the three Commius layers

3.4 Tracking

The process tracking functionality is responsible for monitoring all incidents occurring within a running process. Every performed process step will be monitored and stored in the context of the related process. Additionally relevant information like customer IDs or order quantities will be saved as well. Following this approach, every performed step and conjoined information within a process instance is documented and comprehensible for further disposal. This high amount of transparent information constitutes the precondition for further beneficial functionalities of Commius.

3.5 Assisting

The process assisting functionality consists of two segments. One provides case related in-formation about the particular process step, like customer history, contact information or useful web links while the other procures relevant process history from the process incident database. While not every information Commius may deliver, might be as useful in one context as in one other, the nature and the level of detail of the information to be displayed can be adjusted using the customization tool. The shipping department personnel would require item IDs and ordered quantity as well as the customer address for example, while account details useful for the accountancy would not be expedient in this context.

3.6 Advising

The process advising functionality prepares recommendations for further steps in a particular process. Since Commius already identified the correct process type, it can revert to knowledge about the identified task from the process database to provide suggestions about further steps. If the incoming Email has, for example, been identified as a confirmation of payment of an order transaction, Commius would recommend triggering the shipment and procure reasonable options like forwarding the confirmation to the shipping department. The gathered information is then being forwarded to the system interoperability layer, which includes the auxiliary information into one email, allowing the respective user accessing the ascertained information. Using the method of embedding the information directly into an email, allows Commius to be applicable as well in a collaboration scenario in which only one partner deploys the system, due to the wide spreading of the email standard. The following case study will introduce a Commius supported order process more closely.

4 Case Study

4.1 A Commius supported order process

This section will point out, how, with the use of Commius, cross-organizational interoperability could be realized. In order to exemplify the appliance possibilities of Commius, an example of use will be described which will show the utilization of the Commius components as well as possibilities to use Commius supporting a cross-organizational business process. In this scenario the system applied throughout an order process, triggered by a manufacturing company, ordering commodities from its supplier. The incoming order of the manufacturing user is being intercepted by Commius which is connected as an intermediary proxy. Supported by the Semantic and System Interoperability layers, the Email is being transformed into a

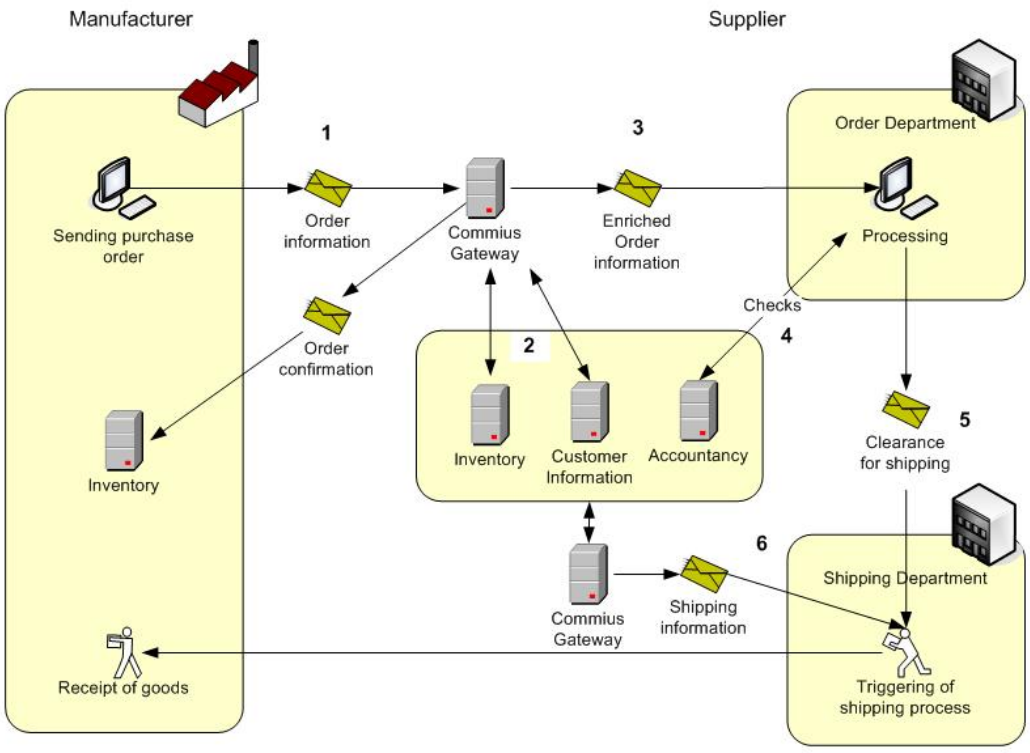

Figure 2. A Commius supported order process

standardized XML file with semantically enhanced tags and identified as a new process instance of type ”Order”. The detecting functionality will then assign a specific process ID which can be referred to, through all future occurrences concerning this process. This will be done by the tracking functionality. Based on the preconfigured template from the enterprise process repository the Commius system will now start to conduct the desired actions which are also visualized in Figure 2. In case of incoming order processes, the supplying company configured its Commius system to respond with an automated order confirmation (cf. 1). Further, customer history as well as information about the current quantity on stock of the ordered goods is being compiled (cf. 2). The gathered information as well as a link querying the payment status of the order; i.e. ”payment received” will be embedded into an enriched email and delivered to the order department (cf. 3). The employee there can immediately check the payment status based on the given customer information and confirm the payment using the embedded link (cf. 4). At this point the advising component will recommend forwarding the order to the shipping department for further processing and offer to do this automatically (cf. 5). The system will then create an email containing customer address, necessary product information and quantity and the confirmation, that the order has been cleared for shipping by the order department (cf. 6). The shipping department can now dispatch the order without need for further information. Additionally the email received by the shipping department might be enriched with a link used to confirm the shipping. Using this information Commius could now send a shipping confirmation to the customer. After giving this short overview of a complete Commius supported process, the following section will describe the tracking functionality more detailed from a technical point of view using class diagrams.

4.2 Tracking Component

Picking up the context of the given example above, we will describe the tracking component more closely, since its framework mirrors the basic Commius data structure (visualized in Figure 3). The core part of the component constitutes the predefined process template, whose instances are furthermore subdivided into single steps of a process. This dispartment sets the foundation of the tracking functionality, since each performed step within a process can be stored separately. Supplementary, each performed step concerns two occurrences, actions and events. Actions signify human or application triggered activities, which, in the context of email interoperability, mainly occur sending an

email. Events on the other hand have no active part and match, in the context of Commius, incoming emails. Transcribing this concept on the use case given above, an order process instance would be derived and subdivided into several action or events i.e. ”sending order confirmation” or ”order received”. Since every performed step is related to its unique process instance, it can be tracked and on this basis recommendations for further steps can be obtained. Using the tracking functionality as a foundation, the assisting functionality may be exemplified as well. Additionally to the performed steps, process related data will be linked to a process instance. In the context of the order process above, customer information as well as ordered articles and their corresponding quantity would be linked to the process. At this point other beneficial aspects of the tracking component and respectively the Commius Project reveal. Due to the semantically extraction of process information i.e. customer information and quantity of ordered goods, the system enables a (mostly) automated build-up of a company unique customer database. Furthermore transaction, inventory and process knowledge can be easily documented. Based on the documenting function of the tracking component, Commius not only supports process workflows, but gives SMEs raise to business supporting functionalities only accessible by large scale enterprise using complex databases or ERP systems. Gathered information, for example about the consumer behaviour of customers, could be used by SMEs to send out individual offers to customers, to support other marketing activities, etc.

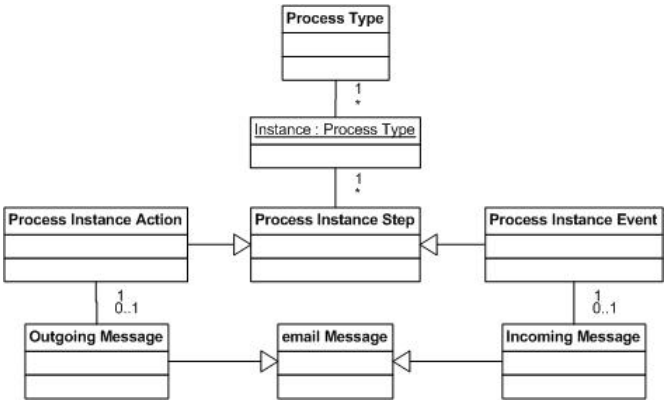

Figure 3. A Class Diagram of the tracking component

5 Related Work

The field of research concerning the integration of application systems currently focuses flexible architectures like Enterprise Application Integration (EAI) and Web Services. EAI are attributed to middleware integration technologies which are basically characterized by the use of an integration platform.[16] This platform serves as a standardized communication interface connecting the application systems which should be integrated.[3] Basically, two different types of EAI architectures do exist - one type is based on a centralized platform while the other one features distributed integration platforms which are located at the application systems to be integrated. In both types, the communication between the platform or platforms and the application systems proceeds via internet interfaces.[16] However, to realize a nearly seamless handling of procedures, a special, so called Process Service is necessary, which enables a pre-defined execution of data transfer sequences automatically.[13] Web Services are distributed, loosely coupled and reusable software components, which can be accessed via standard internet protocols.[15] Currently, Web Services mainly support simple functions but they could be combined to so called SuperServices which can realize comprehensive business processes automatically to a large extent.[2] In network organizations, the business partners use the Web or SuperService via their own applications systems. The service itself is provided either by one partner of the network or by an external contractor. Although the architecture of middleware based integration platforms seems to be very similar to Web Services, there is one fundamental difference between the two concepts: while in EAI solutions, the integration platform is used basically as a communication interface, Web Services provide application functionalities namely the Services.[16] The importance of developing a SME interoperability approach is also underlined by an ampleness of projects addressing this issue. The Group-Process Project [9] enables the user to create on-the-fly modelling of workflow processes, in which tasks are not assigned to organizational units, but to specific persons, through a Java-based graphical modelling interface, in order to reorganize weakly structured processes. In this context, the Endeavor project [10] from the University of California (UCI) or Hanuri/TFlow [8] from the School of Engineering Korea have to be mentioned as well, since they follow a similar strictly workflow-orientated approach like the Group-Process-Project. Although the approach introduced in this paper also comprises a workflow-component due to its action triggered process handling, its respective focus is on a more holistic view of the processes rather than just the workflow component. The Open Water Project aims at tracking and monitoring of Email activity in order to create a knowledge Database consisting of past process activities. Based on past worksequences Emails can be forwarded to the most common recipient.[9] In contrary the approach addressed above, only the next step is taken into account, while Commius focuses on the complete workflow. The ”reinventing Email” Project

from IBM follows the idea of enriching Email with useful additional services like integrated document processing or highlighting of information in Emails.[7] The similarity of this concept with the assisting functionality (c.f. section 3.4) may be of use for the further evolvement of the project. Other approaches to implement context-sensitive information into email can be seen in projects like kMail or Zimbra.[19] kMail provides a special tool (which constitutes the main difference to Commius) implementing organizational memory and knowledge into emails, while Zimbra, a web based client, is able to detect relevant information like names or telephone numbers and use them in some predefined operations. Nevertheless, none of these approaches provides a holistic solution, flexible enough to match SMEs needs.

6 Conclusion and Outlook

In this paper, we have presented a concept to support enterprise interoperability based on email technologies which fits the special needs of SMEs. To ensure the marketability of the concept and the future solution, the main requirements of the target group were extracted from a European Study. They can be summarized as follows. First of all, an adequate solution should be affordable and adjusted to the financial restrictions of small companies. Furthermore, the implementation and daily use must be practicable for the normal user and not only for an IT specialist. Last but not least, such an interoperability solution should support the cooperation with multiple companies without the need to adapt the system every time collaborations are forged. Based on these findings, an adequate approach developed in the European Research Project Commius was introduced with special focus on process interoperability. In particular, the four run-time components to detect, track, assist and advise a business process as well as the build-time component to configure own business processes were presented. Furthermore, the interaction of these components was clarified in a case study on the basis of a concrete example. The challenge in future work will be to transfer the introduced concept in an adequate technological architecture, which fits the requirements of the target group. This means, the implementation of the Commius solution must enable SMEs to use and maintain it without major financial efforts and changes in their technological landscape - only in this way a widespread dissemination and utilization can be expected for the future.

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