S^{3}C: Using Service Discovery to Support Requirements Elicitation in the ERP Domain

Markus Nöbauer[1], Norbert Seyff[2], Neil Maiden[3], and Konstantinos Zachos[3]

[1] InsideAX GmbH, Lunzerstraße 64, 4031 Linz, Austria
markus.noebauer@insideAx.at
[2] University of Zurich, Requirements Engineering Research Group, Zurich, Switzerland
seyff@ifi.uzh.ch
[3] City University London, Centre for HCI Design, London EC1V 0HB, UK
n.a.m.maiden@city.ac.uk, kzachos@soi.city.ac.uk

Abstract. Requirements Elicitation and Fit-Gap Analysis are amongst the most time and effort-consuming tasks in an ERP project. There is a potentially high rate of reuse in ERP projects as solutions are mainly based on standard software components and services. However, the consultants' ability to identify relevant components for reuse is affected by the increasing number of services available to them. The work described in this experience paper focuses on providing support for consultants to identify existing solutions informing system design. We report the development of a tool-supported approach called S^{3}C, based on Microsoft Sure Step methodology and SeCSE open source service discovery tools. The S^{3}C approach is tailored to the needs of SME companies in the ERP domain and overcomes limitations of Sure Step. The initial application and evaluation of the S^{3}C approach also allows presenting lessons learned.

Keywords: Information systems, requirements elicitation, service discovery, ERP.

1 Introduction

Enterprise Resource Planning (ERP) systems are software systems that support business operations. They were first introduced in material management but nowadays ERP systems support a broad range of business activities [1]. Woods [2] highlights that the service-oriented paradigm has changed the nature of ERP systems. Novel ERP systems are based on software services and software vendors provide various tool support and frameworks to integrate ERP systems in broader service-oriented systems [3].

The rising number of services makes the task of the consultants, who align an ERP system with a customer's requirements, increasingly difficult: the consultants need to know all these services, their functionality and quality of service in order to do their job properly. We observed this problem in two companies that provide ERP

H. Mouratidis and C. Rolland (Eds.): CAiSE 2011, LNCS 6741, pp. 18–32, 2011.

solutions based on Microsoft Dynamics AX for their customers. Dynamics AX is a business management solution that combines ERP functionality and additional domain specific modules [4]. The consultants at both companies apply Microsoft's Sure Step methodology [5], which provides guidance and support for gathering customers' requirements and identifying which requirements can be satisfied using standard ERP system functionality (Fit-Gap Analysis). However, the increasing number of services both provided by Dynamics AX [6] and developed by partner companies raises challenges for the application of Sure Step. The consultants find it increasingly difficult to keep track of the available services. This limits their ability to identify adequate services and negatively affects later system design and development.

In our current research, we are addressing the challenges resulting from the introduction of software services in the ERP domain. The research focuses on system design activities within ERP projects based on Sure Step. We explore the ways consultants can be supported in handling the increasing number of services within ERP systems. This paper presents the Semantic Service Search & Composition (S^{3}C) approach, a tool-based solution supporting consultants in identifying requirements and relevant services to inform the Fit-Gap Analysis within ERP projects. We further discuss the experience gained from two studies where the S^{3}C Solution Explorer was applied by ERP consultants at two different companies.

The remainder of the paper is organized as follows. Section 2 presents the Sure Step analysis phase and highlights the limitations of this approach and the challenges raised by service-centric system development. Section 3 presents the research goal and research objectives in more detail. In that section we then present the needs of ERP consultants. We further discuss the SeCSE Requirements Process which informed our solution. Section 3 then presents the S^{3}C approach which adapts Sure Step towards service-centric development. In the last part of Section 3 we present novel tools which were developed to support the S^{3}C approach as well as integrated service discovery components from SeCSE. In Section 4 we present and discuss the results of the initial evaluation of the S^{3}C Solution Explorer. Section 5 presents lessons learned and Section 6 concludes and presents further work.

2 Requirements Elicitation Based on Sure Step and Its Limitations

Sure Step defines roles such as that of the application consultant who is responsible for gathering and specifying requirements and for conducting a Fit-Gap Analysis. Figure 1 gives a detailed overview of Sure Step which divides an ERP installation project into six phases: Diagnostic, Analysis, Design, Development, Deployment and Operation. Each phase consists of mandatory and optional activities. In addition, there exist Cross Phase Processes that span across multiple phases. There are four activities relevant to this research which focuses on requirements elicitation and system design. These activities are usually conducted in sequential order. The following paragraphs give a more detailed description:

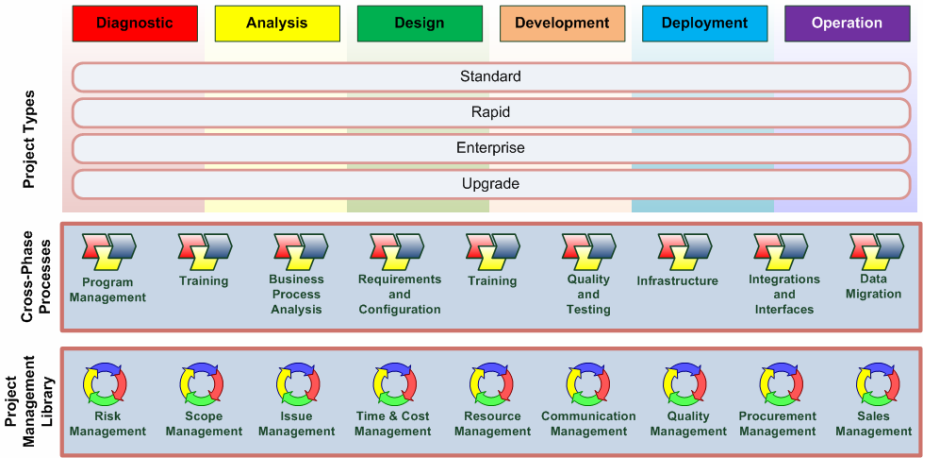

Fig. 1. Microsoft Dynamics Sure Step Phase Model

Conduct Business Process Analysis. A detailed business process analysis is conducted in a workshop, therefore consultants compare the customers' current business process with standard ERP processes. The result is a To-Be process model (see Figure 2) which describes business process steps using natural language text. For example, an item arrival process could include events such as: *A vendor delivers goods from different purchase orders.*

Gather Business Requirements. After defining the To-Be process model consultants and customer start to gather and document requirements following a predefined Word-template. Consultants document upcoming requirements using the Functional and Non-Functional Requirements Document (see Figure 2). An example requirement descriptions supporting the item arrival process could be: *The system should inform the warehouse worker if the delivered quantity is higher than the ordered quantity.*

Conduct Fit-Gap Analysis. After the workshop consultants conduct a Fit-Gap Analysis. For each requirement consultants try to identify an available solution. If the consultants are able to identify a software solution they document it as fit, otherwise it is a gap. In a next step the consultants and the customer jointly investigate ways to resolve the gaps. There are three ways to deal with gaps: (i) Adding a 3rd party solution; (ii) Changing the business process; (iii) Customizing the standard application to fit the requirements. Fits and gap resolutions are documented in the Fit-Gap Worksheet (see Figure 2).

Derive Functional Design Documents. After the Fit-Gap Analysis consultants create a Functional Design Document for Configuration which describes how selected standard software services need to be configured to fulfill customer needs. Furthermore, developers and consultants create a Functional Design Document for Customization. This document describes the planned development work needed to provide solutions for the gaps.

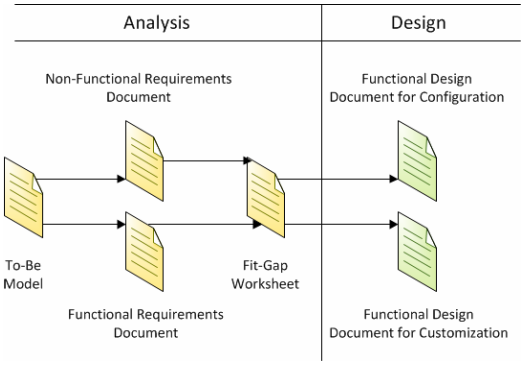

Fig. 2. Information Flow from Analysis to Design Phase in Sure Step

Sure Step was not designed to support the development of service-oriented systems. It is a document-oriented process which separates requirements elicitation workshops, investigation in gap resolutions and solution design. With a growing number of services, it is getting harder for consultants to identify suitable services. These circumstances lead to the following limitations of Sure Step in practice:

Services are not identified. Although existing services could provide a solution and fulfill a customer's request, a consultant might not be able to identify a suitable service solution due to the high number of services available. As a result, new services are developed instead of reusing existing services.

Inadequate services are selected. While the number of available services is increasing, the functionality provided by existing services changes. Consultants therefore cannot keep an overview on all existing services and the provided functionality of their current and depreciated versions. As a result, consultants select services they are familiar with although other services would provide more accurate functionality.

Late service discovery. In a later design phase, developers might identify services more accurate than those specified in the Fit-Gap Worksheet. This causes renegotiation of customer requirements. However, in most cases it is too late to change the planned solution as development has already started.

Inaccurate estimates. Time and cost estimations are based on the Fit-Gap Worksheet. Due to the inadequate selection of services, the Fit-Gap Worksheet may be incorrect. This results in inaccurate time and cost estimates.

Insufficient information for customers. Consultants do not have a deep knowledge of particular service functionality. Therefore, in Sure Step, consultants and customers usually do not discuss the functionality provided by selected services. However, consultants have found that such discussions provide an important input for customers; they even help triggering new customer requirements.

Time consuming approach. After defining the To-Be business process and gathering customers' requirements within an initial workshop, consultants have to conduct a Fit-Gap Analysis. As this task is very time consuming it is done after the workshop. However, consultants need to approach customers again to agree on gap resolutions.

The discussed limitations delay the completion of projects. Furthermore, these limitations lead to an unnecessary increase of costs to realize ERP systems.

3 Semantic Service Search and Composition (S^3C)

In the Semantic Service Search & Composition (S^3C) project, we are exploring the challenges of introducing services in the ERP domain. We are focusing on SMEs developing ERP systems by following the Microsoft Sure Step methodology. The goal is to develop possible solutions to overcome identified problems and to apply these solutions in practice. We want our research to supports consultants in identifying requirements and relevant services to inform Fit-Gap Analysis within ERP projects. We used action research [7] to conducting this work and aimed at meeting the following research objectives:

RO 1: Identify the needs of consultants regarding requirements elicitation in ERP projects based on Sure Step.
RO 2: Adapt and extend relevant service discovery approaches to support ERP projects based on Sure Step.
RO 3: Evaluate the benefits and limitations of the developed tool-supported approach.

The first research objective focuses on identifying the consultants' needs in order to overcome limitations of the existing approach. The second research objective investigates how to extend Sure Step. This task includes the identification of relevant research whose results could inform a possible tool-supported solution for requirements elicitation in ERP projects based on Sure Step. The third research objective focuses on investigating the usability and utility of the tool-supported approach. Our aim is to investigate if the envisioned tool-supported approach does support the daily work of consultants in ERP projects based on Sure Step.

3.1 Identifying the Needs of Business Consultants

In a first step we identified and analyzed the needs of consultants. We therefore interviewed 4 employees at Terna[1], an Austrian ERP partner following Sure Step. We discussed the identified limitations of Sure Step and asked them about their needs regarding a novel tool-supported approach which would overcome existing limitations. The following paragraphs describe the consultants' key requirements.

Integrated description of business processes and requirements. Sure Step uses Word templates to specify business processes and requirements. This results in the creation of several different documents and the distribution of information across several documents. Handling documents is therefore time consuming and often results in inconsistencies. The new tool-based approach should therefore provide an integrated solution which allows the structured and integrated specification of business process information and requirements.

Linking requirements and use cases. As discussed, Sure Step provides Word templates for documenting business processes and requirements. This means that there is no support for linking a requirement to a particular use case – a feature that should be supported by the new approach.

[1] Terna is an Austrian ERP company owned by Allgeier Holding AG. They are Microsoft Dynamics AX partner, Lawson M3 distributor and maintain AMS4U based on AS400.

Identifying existing solutions. Sure Step does not support the automatic identification of existing solutions. The new approach should be able to identify services based on use cases and linked requirements. More specifically, a novel integrated approach should propose a list of candidate services and provide service descriptions.

Narrow down service discovery results. In our discussions consultants empathized that the time to discuss solutions with customers is limited and that they would need a feature supporting them by highlighting the most promising solution(s). A novel approach should highlight the fact that this service only has a low priority and that it is unlikely that it can contribute to the envisioned solution.

Provide details on services of interest. Details of a service of interest need to be immediately accessible for further discussion. The new approach should allow consultants to access important information related to a selected service.

3.2 Identifying Research Informing S^{3}C

An analysis of existing work shows that similarity analysis is a well-described issue in ERP literature [8, 9]. However, we could not identify relevant work focusing on service discovery mechanisms for similarity matching. Also in requirements research, little has been reported on service discovery. Schmid et al. [10] discuss a requirements-led process enabling runtime service discovery but do not report on tool support. Elsewhere, Esmaeilsabzali et al. [11] present new models for requirements-based service discovery that assume formal expression of system operations. Zachos et al. [12] have researched new tools and techniques to form service queries from incomplete requirements specifications as part of the EU-funded SeCSE Integrated Project [13]. We considered the work by Zachos et al. [14] to be most promising for extending Sure Step.

The SeCSE requirements process is depicted in Figure 3. Service queries are extracted from a service request constructed from a requirements specification and then fired at service registries. The retrieved service descriptions enable consultants and customers to select the most appropriate service(s). The main innovation is to expand service queries to handle requirements expressed in natural language. As such, SeCSE appears to be the first approach to integrate requirements and service discovery methods and tools. Therefore it was chosen to be the base for the S^{3}C project.

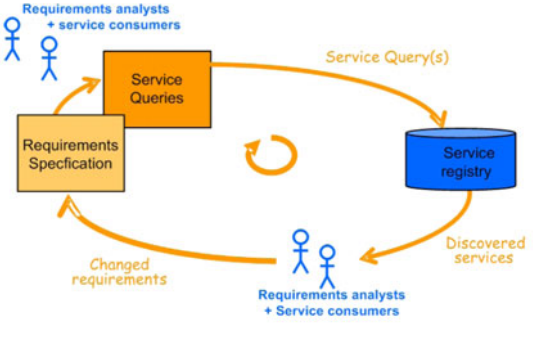

Fig. 3. SeCSE's Requirements Process

3.3 The S^{3}C Approach

The S^{3}C approach is based on Microsoft Sure Step and SeCSE to provide advanced support for consultants. It extends Sure Step by integrating SeCSE's service discovery mechanisms. However, a main contribution of the S^{3}C project are novel tools which provide support for consultants (see Section 3.4). The S^{3}C approach integrates Business Process Analysis, Gathering Business Requirements and Fit-Gap Analysis within the same workshop. Figure 4 shows the modified information flow with integrated service discovery.

Conduct Business Process Analysis. As in Sure Step a detailed business process analysis is conducted in a workshop. Consultants compare the customer's current business process with standard ERP processes and document results with the help of a To-Be process model (see Figure 4).

Gather Business Requirements. In the same workshop consultants and customers identify and discuss requirements on how the planned ERP system will support the To-Be process. These requirements are linked to the business process and are specified in the Requirements Document (see Figure 4).

Identify and Discuss Relevant Solutions (Fits). The To-Be business process description and gathered requirements are used as input to identify existing services which potentially can fulfill the customers' needs. For an item arrival use case the system will suggest a vendor service, described as *"Enables external systems to read, create, update and delete vendors."* Consultants and customers walk through and discuss the listed solutions. This can trigger new requirements which can then cause modifications in the list of relevant solutions. This iterative approach strengthens the interaction between consultants and customers and allows the customer to participate in the solution design. Selected solutions are documented as fits in the Fit-Gap Worksheet (see Figure 4).

Discuss Gap Resolutions. In a next step the consultants and the customer investigate gap resolutions which are documented in the Fit-Gap Worksheet.

Derive Functional Design Documents. As in Sure Step the Fit-Gap Worksheet is used to create the Functional Design Document for Configuration and Functional Design Document for Customization (see Figure 4).

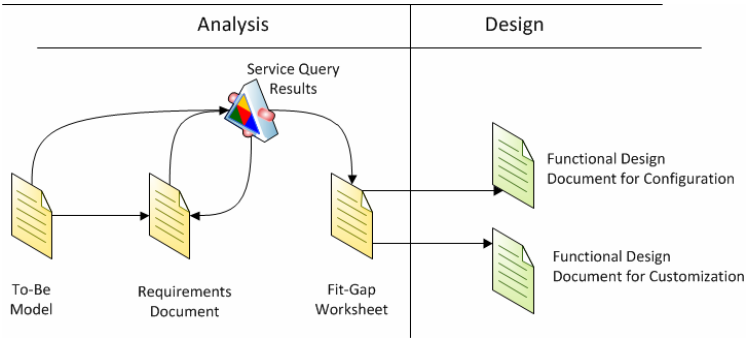

Fig. 4. Information Flow in Sure Step with Service Discovery (S^{3}C)

3.4 The S³C Tool Environment

We developed adequate tool support based on the conceptual solution – as outlined in the previous section. The S³C Tool Environment consists of a variety of applications, services, prototypes and databases. The main technical contribution are novel S³C tool which were built on top of selected SeCSE components. Figure 5 shows the S³C Tool Environment including newly developed tools as well as original SeCSE components.

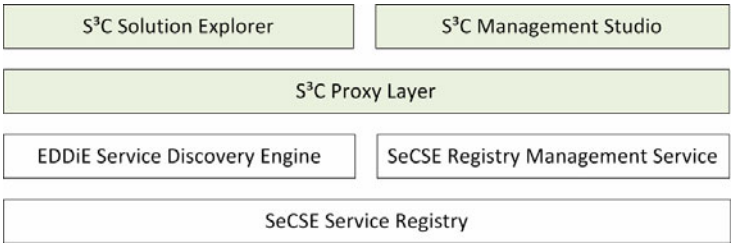

Fig. 5. S³C Tool Environment

The *S³C Solution Explorer* is an application for onsite consultants; it enables them to document the To-Be business model in the form of use cases and to link and document requirements. This information can be used as input to perform service discovery requests. To do so, the use case description and the linked requirements are compiled into an XML query document. The query document is used as input for the EDDiE service discovery engine. The query result is a XML document including candidate services, in order of relevance (calculated by the EDDiE service discovery engine). With this information, the S³C Solution Explorer presents a ranked list of relevant services also highlighting the matching probability for each service. The descriptions of these candidate services provide input for further discussions with customers and support solution selection. Figure 6 shows the S³C Solution Explorer representing the Item Arrival Use Case.

The *S³C Management Studio* is used by system administrations to access the service registry to keep the stored information up to date. Managing the service registry includes providing and updating information about services, such as the service provider, a description and other meta-data. Accurate information about services is vital for service discovery requests as it enables the system to identify accurate candidate services.

The *S³C Proxy Layer* was introduced to overcome the heterogonous nature of the SeCSE platform. Due to the involvement of different research partners in SeCSE the provided solution is a mix of different platforms and technologies. The S³C Proxy Layer is an abstraction layer that provides an interface for performing service discovery and manipulating services in the service registry. The S³C Proxy is built using Microsoft .NET technology and translates either in Java or XML to the SeCSE components. All S³C tools are built upon the S³C Proxy Layer and have no contact with the underlying SeCSE components.

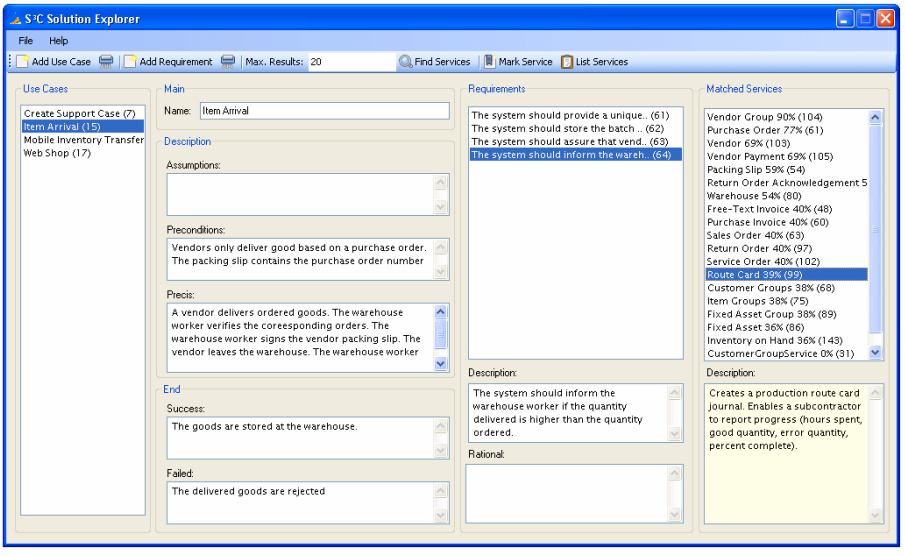

Fig. 6. The S³C Solution Explorer Application

The *EDDiE Service Discovery Engine* uses the information gathered with the S³C Solution Explorer as input to retrieve services. EDDiE implements advanced term disambiguation and query expansion algorithms to add different terms with similar meanings to the query using the WordNet online lexicon [15, 16], thus increasing the number of web services retrieved from the registries. Furthermore, EDDiE provides capabilities to calculate the relevance of a discovered service [14].

The *SeCSE Management Service* provides an application interface to the SeCSE Registry via a web service. It is used to manage providers, services and meta-data such as description, quality of service, commercial information and signatures.

The *SeCSE Service Registry* is a XML database that holds all the information about services and their descriptions. While SeCSE tools used a federated online database, the S³C solution is based on a locally installed database.

4 Initial Evaluation of the S³C Solution Explorer

Our evaluation strategy focused on investigating the utility of the S³C Tool Environment. We conducted two studies at different ERP partners who both follow Sure Step. We first performed an initial utility and usability study at Terna to figure out whether the S³C Solution Explorer application fulfills the key requirements of consultants. The second evaluation was conducted at InsideAx[2] to investigate the utility of the S³C Solution Explorer in more detail. This study focused on comparing the time needed to identify relevant services with the help of the S³C Solution Explorer to Sure Step and investigated the correctness and completeness of the solution.

[2] InsideAx is an Austrian ERP company focusing on Microsoft Dynamics AX Solutions.

4.1 S^{3}C Solution Explorer Initial Utility and Usability Evaluation at Terna

Three consultants participated in the initial utility evaluation of the S^{3}C Solution Explorer at Terna. Each has a master degree in business informatics and more than three years of experience in ERP system customization. None of the consultants is an author of this paper, and none had had contact with the S^{3}C Solution Explorer prior to the evaluation. However, two of the consultants also participated in the first interview where requirements for S^{3}C approach were identified (see Section 3.1).

Each evaluation was structured in 3 parts – briefing, evaluation and debriefing. During the briefing each participant was informed of the study's purpose and the task they were intended to perform. The briefing also included a short introduction to the S^{3}C Solution Explorer. For the study we prepared a typical ERP use case describing how a warehouse worker handles the receipt of goods – the item arrival use case. The example use case also included four requirements which were gathered from customers in previous projects (e.g. *The system should provide a unique identification number for each vendor*). During the evaluation each consultant used the S^{3}C Solution Explorer to enter the use case and the related requirements. Furthermore, they were asked to use the Solution Explorer to identify relevant services for that use case. One of the authors observed each consultant who spoke loudly throughout the process. The utility of the S^{3}C Solution Explorer concerning the previously discovered consultants' requirements (see Section 3.1) was discussed during the debriefing. The debriefing was then used to discuss usability problems of the S^{3}C Solution Explorer. All 3 consultants completed the evaluation and debriefing, which lasted on average 20 and 25 minutes respectively.

Observations and qualitative feedback were encouraging but they also identified some limitations. The study revealed that the S^{3}C Solution Explorer does fulfill most of the consultants' requirements (see Section 3.1):

- The consultants were able to document use cases and requirements.
- The consultants said that the tool provides a clear structure in linking use cases and requirements.
- The consultants were able to use the tool to run service queries.
- The consultants said that the tool suggested relevant service solutions.
- The consultants said that a ranked list of relevant services and the provided matching probabilities supported them in narrowing down the discovered results.
- The consultants said that the current service description does provide key information which (in most cases) allows them to decide whether a service is relevant. However, they requested more detailed service descriptions to improve the decision process. For example, consultants requested information about the usage of the service in previous projects.

In the debriefing meetings, the consultants also highlighted the fact that they would be willing to use a tool such as the S^{3}C Solution Explorer for their daily work with customers. However, the interview also revealed several usability issues. They pointed out that the first prototype does present too much information at a time and that it is therefore hard to keep an overview. They argued that service discovery queries take too much time (on the average 3 seconds) and that they would prefer quicker responses in order to strengthen seamless discussions with customers. They requested

that the list of relevant services should be automatically updated in time when entering new requirements.

However, results from the debriefing sessions indicated that most usability deficiencies were not critical to the main tasks and that the current S^{3}C Solution Explorer prototype does fulfill the consultants' key requirements. With these results, we decided to use the S^{3}C Solution Explorer without further development in more naturalistic studies in order to explore its utility in more detail.

4.2 S^{3}C Solution Explorer Utility Evaluation at InsideAx

This study investigated the effect of the S^{3}C Solution Explorer on the discovery of relevant services. We explored whether consultants need less time to identify relevant services with the help of the S^{3}C Solution Explorer compared to non-tool supported service identification. Furthermore, we investigated the correctness and completeness of these solutions. Three consultants from InsideAx participated in this S^{3}C Solution Explorer evaluation. One has a master degree in business informatics and more than three years of experience in ERP system customization (Consultant 1). The second consultant had more than three years of experience in ERP system customization while the 3rd consultant only had one year experience. None of the consultants is an author of this paper, and none had had contact with the S^{3}C Solution Explorer prior to the evaluation.

As for the first study, each evaluation was structured in briefing, evaluation and debriefing. For the evaluation we prepared an application example which included three use cases and typical use case requirements derived from previous projects. For each of the use case we reviewed existing implementations and ERP system documentations and defined a list of relevant services out of more than 70 available services. This standard solution was used as a basis for evaluating consultants' solutions. The application example consisted of following use cases:

- *Item Arrival* describing the handling of delivered goods from vendors. Five relevant services were identified as standard solution for this use case.
- *Transfer production goods to warehouse* representing events relevant for inventory management. Again, five relevant services were identified as standard solution for this use case.
- *Buy Item in a Web Shop* discussing sale related events. Six services were considered to be the standard solution for this use case.

In the briefing session, the consultants were told about the purpose of the study. We further discussed the application example with the consultants. Each of them was asked to estimate the time he would need for the identification of relevant services without tool support (see Table 1). During the evaluation each consultant used the S^{3}C Solution Explorer to identify relevant services for the three use cases and to document the results. The debriefing session was used to discuss their solution and to identify utility issues regarding the S^{3}C Solution Explorer. We compared particularly the time required for the identification of relevant services to the estimates. Furthermore, the developed solutions were compared to the standard solution in terms of correctness and completeness (see Figure 7).

$$\text{Correctness} = \frac{|\ \text{Identified Services} \cap \text{Relevant Services}\ |}{|\ \text{Identified Services}\ |}$$

$$\text{Completeness} = \frac{|\ \text{Identified Services} \cap \text{Relevant Services}\ |}{|\ \text{Relevant Services}\ |}$$

Fig. 7. Correctness and Completeness metrics

The results of the evaluation are shown in Table 1. The consultants' estimates for performing the service identification without tool support ranged from 2:30 hours to 4:20 hours. The experiment revealed that using the S³C Solution Explorer consultants needed between 45 minutes and 1:20 hours to actually conduct the task. Consultants were able to indentify correct services – apart from one exception; all identified services were included in the standard solution. Services completeness ranged from 50% to 80%. On the average consultants identified 62% of the relevant services.

Table 1. InsideAx Evaluation Results

	Time Estimation (no tool support)	Actual Time (with tool support)	Correctness			Completeness		
			Item Arrival Use Case	Invent Transfer Use Case	Web shop Use Case	Item Arrival Use Case	Invent Transfer Use Case	Web shop Use Case
Consultant 1	02:30	01:05	100%	100%	100%	60%	80%	50%
Consultant 2	04:00	00:45	100%	100%	100%	60%	60%	66%
Consultant 3	04:20	01:20	75%	100%	100%	60%	60%	66%

The results reveal that the S³C Solution Explorer enables consultants to discover relevant services in significantly less time than their estimates for service identification without tool support. In debriefing meetings consultants said that service identification with the help of S³C Solution Explorer was faster because services were presented using a ranked list with matching probabilities.

The two experienced consultants had a 100% correctness rate. In the debriefing meeting they argued that having service descriptions and requirements presented next to each other did support their matching process and did speed up the actual decision. However, they also mentioned that their experience did support them in taking decisions. The two experienced consultants argued that their knowledge about ERP systems did in particular support them in taking the right decision when the provided service description was limited (e.g. the Inventory Transaction Service was described as "Describes the inventory transactions document"). The less experienced consultant (Consultant 3) argued that he needed more time to make decisions. He said that in most of the cases the provided service description did allow him to make a correct decision. However, he also mentioned that more information on the services would have been helpful and would have made him more confident in his decisions.

The consultants did indentify key services relevant for the use case. However, other relevant services were not identified in this first iteration. Discussions with the consultants revealed that they did focus on correctness rather than completeness. They explained that they only selected services where they felt certain that they were relevant. They also explained that they did consider other services to be relevant. However, in most cases they preferred not to select them because of doubts caused by limited descriptions.

As for the initial evaluation all consultants' said that a tool such as the S^3C Solution Explorer can support their daily work. However, they also mentioned utility and usability issues.

4.3 Threats to Validity

The validity of the reported results was subject to the following possible threats. The limited number of experiments and the limited number of participants within the experiments does not allow drawing any statistically relevant conclusions. No comparative evaluation has been undertaken. Because of time and resource constraints, we decided not to have a control group to conduct the experiment without tool support. Although time estimations made by consultants do reflect experiences from practice, not having a control group means that these results need to be interpreted with care. This issue also applies to the presented results on service selection correctness and completeness. However, the uniqueness of the presented S^3C approach and the paucity of data on service discovery tools within the ERP domain means that the results presented provide a valuable input for further evaluations.

5 Lessons Learned

In the following we do present lessons learned that highlight benefits and weaknesses and discuss interesting facts regarding the conducted research:

Lesson 1: Adequate service descriptions are essential to decide about the relevance of a service. Our studies revealed that, in some cases, the provided service descriptions are too short to make a clear decision. In such cases, it was easier for experienced analysts compared with inexperienced to make a decision. We do see great potential in providing more detailed service descriptions. This might have positive effects on completeness and might further enable analysts to make decisions faster.

Lesson 2: Using the S^3C solution did allow substantial time savings, compared to estimates for non-tool supported Sure Step. One of the consultants was able to perform the analysis in about 20% of the estimated time. Even the analyst who had the lowest estimate was able to finish the task in less than half of the estimated time.

Lesson 3: Discussions with ERP experts of the two companies revealed that time estimates are normally of high quality. However, there are no records showing the correctness and completeness regarding the output of the analysis phase. The lack of such a baseline did not allow a more detailed comparison of our study results. However, ERP domain experts did consider the quality of the output of the second evaluation as good.

Lesson 4: Companies argue that the output of the analysis strongly depends on the experience of the consultant. Our experiment indicates that the S³C Solution Explorer particularly supports inexperienced consultants to come up with good quality results (which were similar to results from experienced consultants).

Lesson 5: Current usability and utility issues still limit the usage of the S³C Solution Explorer in real-world projects. However, the presented studies revealed its potential. Consultants were able to work with the S³C Solution Explorer without training and all confirmed that they want to use an improved version of the S³C Solution Explorer in customer workshops.

6 Conclusions and Further Work

In this paper, we present the tool-supported S³C approach which was built to overcome limitations of Microsoft Dynamics Sure Step, an existing approach used for requirements elicitation and Fit-Gap Analysis within ERP projects. In a first step, we discussed the limitations of Sure Step which result from the increasing use of software services in the ERP domain. The high number of services hinders consultants in discovering and selecting appropriate service-based solutions. As a result, projects take longer which leads to increased costs.

To figure out how to overcome these limitations (RO 1), we asked consultants in an ERP company about their needs on a tool-supported approach which enables them to identify relevant service solutions. Considering the identified needs and we identified SeCSE as a base for our research and realized the tool-supported S³C approach (RO 2). It is based on Sure Step but provides sophisticated service discovery mechanisms and novel tool support for consultants. The S³C Solution Explorer enables consultants to identify relevant solutions while they discuss upcoming requirements with customers. The evaluation of the benefits and limitations of the S³C solution (RO 3) suggests that the tool-supported S³C approach fulfils the consultants' needs and has the potential to support them in their daily work.

The development and evaluation of the S³C solution is the main contribution of our work. Although our research is focusing on ERP projects based on Sure Step, we assume that companies in the ERP domain that follow other approaches face similar challenges. We envision that the tool-supported S³C approach will stimulate further research in the field and support other ERP companies in overcoming the issues raised by introducing services in the ERP domain.

Our future research will focus on case studies to investigate the benefits and limitations of the S³C approach in real-world projects. We plan to evaluate whether the usage of the S³C Solution Explorer leads to more and more complete requirements. Informed by the results of such studies, we plan to provide an improved version of the S³C tools and more guidance and support for consultants on how to apply the S³C approach.

Acknowledgements

The research conducted was in part funded by the Austrian Research Promotion Agency (FFG, Project Nr.: 821614).

References

1. Daneva, M., Wieringa, R.: Requirements Engineering for Cross-organizational ERP Implementation: Undocumented Assumptions and Potential Mismatches (2005)
2. Woods, J.: Business Managers Need to Care About SOA in ERP. Gartner Research (2008)
3. Microsoft Corporation: Enabling "Real World SOA" through the Microsoft Platform (2006)
4. Microsoft Corporation: Microsoft Dynamics AX 2009: Designed to Enhance Productivity (2010), http://download.microsoft.com/download/E/2/2/E228B46E-F0E2-4C38-8F02-A21B7B544B39/AX_User_Productivitywp.xps
5. Microsoft Corporation: Microsoft Dynamics Sure Step Methodology, Platform 2.6.4.0 (2009)
6. Microsoft Corporation: Standard Axd Documents, http://msdn.microsoft.com/en-us/library/aa859008.aspx
7. Davison, R.M., Martinsons, M.G., Kock, N.: Principles of canonical action research. Information Systems Journal (2004)
8. Rolland, C., Prakash, N.: Bridging the gap between organizational needs and ERP functionality. Requirements Eng. 41, 180–193 (2000)
9. Salinesi, C., Bouzid, M., Elfassy, E.: An Experience of Reuse Based Requirements Engineering in ERP Implementation Projects. In: 11th IEEE International Enterprise Distributed Object Computing Conference
10. Schmid, K., Eisenbarth, M., Grund, M.: From Requirements Engineering to Knowledge Engineering: Challenges in Adaptive Systems. In: Proceedings SOCCER Workshop, RE 2005 Conference, Paris (2005)
11. Esmaeilsabzali, S., Day, N., Mavadatt, F.: Specifying Search Queries for Web Service Discovery. In: Proceedings SOCCER (Service-Oriented Computing: Consequences for Engineering Requirements) Workshop, RE 2005 Conference, Paris (2005)
12. Zachos, K., Maiden, N.A.M., Zhu, X., Jones, S.V.: Discovering Web Services to Specify More Complete System Requirements. In: Krogstie, J., Opdahl, A.L., Sindre, G. (eds.) CAiSE 2007 and WES 2007. LNCS, vol. 4495, pp. 142–157. Springer, Heidelberg (2007)
13. SeCSE Home (2010), http://www.secse-project.eu/
14. Zachos, K.: Using Discovered Services to Create Requirements for Service-centric System, Centre of Human-Computer Interaction Design, City University London (2008)
15. WordNet (2010), http://wordnet.princeton.edu/
16. Voorhees, E.: Using wordnet to disarnbiguate word senses for text retrieval. In: Proceedings of the 16th ACM-SIGIR Conference, pp. 171–180 (1993)