Experience Report: Appropriateness of the BCI-Method for Identifying Business Components in large-scale Information Systems

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Abstract. The deployment of business components in large enterprise information systems offers great potential. Nonetheless the process of finding and defining the right business components is very challenging. While the definition of business components is comparatively simple for small business domains, it becomes very complex for larger domains of interest. This paper illustrates the experiences made during the modeling process of an integrated information system architecture for Customer Relation Management (CRM) and Supply Chain Management (SCM) with more than 500 functions and 1000 information objects under usage of the Business Component Identification (BCI)-Method. Based on this experience possible enhancements and needed extensions for the BCI-Method are proposed and explained.

1 Introduction

Innovations in information and communication technologies, primarily the emergence of the Internet, shifted managerial attention towards the use of information technologies to increase flexibility of the business system and to improve intercompany collaboration in value networks, often referred to as inter-organizational systems (IOS), e-collaboration and collaborative commerce [6, 9]. In order to enable such an inter-organizational information exchange an integration of all involved parts of the value chain is necessary. This paper shows how an integrative information system architecture (ISA) for Customer Relation Management (CRM) and Supply Chain Management (SCM) was developed and which experiences were made during the modeling process of a component-oriented ISA under usage of the Business Component Identification (BCI)-Method [1, 4].

Therefore, in section 2 the need for a component-oriented and integrated information system architecture for CRM and SCM is illustrated. Section 3 shows how the BCI-Method was used in order to develop an integrated ISA and which experiences were made during the application of this method. Concluding remarks and an outlook to future work can be found in section 4.

2 The need for a component-based integration of CRM and SCM

Actual research efforts show that information systems, which are interconnected along the value chain, offer great potential for risk and cost reduction [8]. This implies that every organization within the value chain has to connect its own IT-application systems with the ones of its suppliers and customers. The goal is to establish an inter-organizational system that allows automated data interchange and integrated information processing. In most cases IT-systems for Customer Relation Management (CRM) and Supply Chain Management (SCM) represent the communication endpoints of an enterprise with regard to inter-organizational information exchange. These can therefore act as integration points for the above mentioned interconnection task. However, integration of these systems is also necessary within the enterprise in order to make value networks work.

While inter-organizational aspects of integration are subject of current research and standardization efforts [5], the internal interconnection of CRM-, ERP- and SCM-systems is usually solved by adapters or standard interfaces. But this kind of integration causes data-redundancy and actuality problems as well as a loss of functionality as the adapters and standard interfaces frequently do not provide access to all functions of the respective systems. In order to improve this situation in terms of inter-organizational interconnection, an integration of CRM- and SCM-systems into one integrative information system architecture (ISA) seems to be advisable. This ISA would allow an efficient connection of CRM- and SCM-related functionality through the deployment of an integrated database which would also improve the consistency and up-to-dateness of data. However, an implementation of the ISA into a monolithic architecture would not be favorable with regard to flexibility and future developments. It would rather be reasonable to develop an integrated but also component-oriented architecture, so that the inter-organizational system can be reconfigured along the value chain over time, e.g. by replacement of single business components if newer versions or extended functionality is available. In this work, we therefore followed a component-oriented approach to derive an integrative information system architecture.

3 Evaluation of the BCI-Method

After a detailed analysis of contemplable methods for the development of the integrative information system architecture based on business components, the decision came to the Business Component Identification (BCI)-Method [1, 4], because it con-

siders function-information-relationships to identify suitable components and therefore uses a bottom-up approach to identify suitable components. This is in line with the goal to avoid a monolithic architecture while trying to integrate functionality belonging together.

At first, the development of an integrative information system architecture for CRM and SCM required a detailed analysis of both application domains. Therefore, a broad literature research as well as an analysis of a variety of CRM- and SCM-products (e.g. SAP, Siebel, I2) has been conducted. This analysis primarily focused on the identification and decomposition of relevant functions and information objects as well as the determination of relationships between them. This was achieved by functional decomposition diagrams [7], information object decomposition diagrams, and input-output-tables. The latter were used to illustrate relations between functions and information objects. For checking the consistency of the above mentioned models, further models and diagrams have been used, e.g. semantic data models [10] and information flow diagrams [11]. Figure 1 shows an excerpt of the information flow diagram for the process *create customer order*.
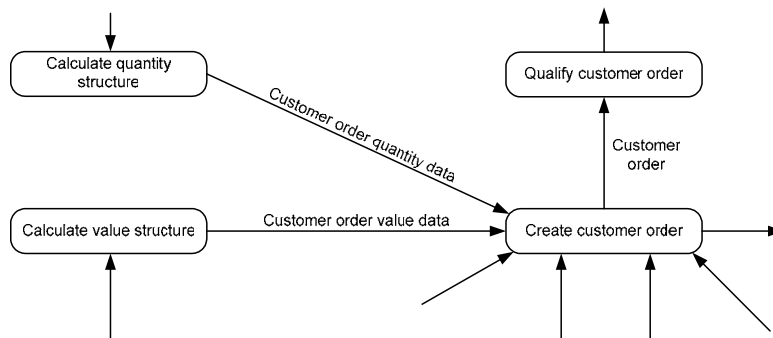

Figure 1: Information flow diagram

For creating the customer order, value and quantity data amongst others is necessary. This data is created by functions *calculate quantity structure* and *calculate value structure* and sent to the function *create customer order*. This diagram illustrates the coherence between different functions by information objects. Table 1 shows the way how relations between information objects and functions have been illustrated. An *Input-Information Object* is necessary to execute a function whereas an *Output-Information Object* is the result of an executed function.

Input-Information Object	Function	Output- Information Object
…	Calculate quantity structure	Customer order quantity structure
…	Calculate value structure	Customer order value structure
Customer order quantity structure	Create customer order	Customer order
Customer order value structure	Create customer order	…
…	Create customer order	

Table 1: Input-output-table

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Using above mentioned diagrams, models and tables permitted a broad description of CRM and SCM with more than 500 functions and more than 1000 information objects. This collection of models was then used as input for the BCI-Method, which is explained in the following.

The BCI-Method takes business tasks of a specific domain as input, as e.g. defined in the functional-decomposition diagram, and the domain based data model, both obtained from the domain analysis. In a first step a matrix is built defining the relationships between the single business tasks and the information objects. The relationships are visualized inserting "C" and "U" in the matrix. "C" denotes that the data is created by the specific business task, and "U" indicates the usage of informational data by a given task. In our case especially the input-output-tables have been helpful to build this matrix. A definition of relationships between functions and information objects after having put them into the rows and columns of the matrix would not have been possible due to the size of this model. In changing the order of data and of business tasks according to some metrics defined, e.g. minimal communication between and maximal compactness of components, groups of relationships can be recognized [4]. These groups identify potential business components. If some "U"s are outside the groups, arrows are used to identify the data flow from one group to the other. The result of the BCI is an abstract business component model with defined dependencies between the components [1, 2, 3]. Figure 2 shows an excerpt of the matrix with two business components.

	Data of Sales Solution	Disposition Data	Basic Sales Potential	Initial Customer Order Probability Data	Customer Order Probability Measures	Product Price	Special Price	Procurement Participant Data	Procurement Decision Data	Probability Criteria of Sales Possibility	Potential of Procurement Benefit	Criteria of Procurement Benefit	Criteria of Procurement Costs	Follow-Up Data of Customer Offer	Shipment Data of Customer Order	Customer Offer Measures	Qualification Data of Customer Offer	Presentation Data of Customer Offer	Required Quantity of Customer Order	Delivery and Payment Conditions of Customer Order	Value Data of Customer Order	Follow-Up Reaction Data of Customer Offer	Follow-Up Measures of Customer Offer	Quantity Availability of Customer Order	Sponsoring Data	Status Data of Customer Order	Procurement Objection Data	Modification Request data of Customer Order	Ressource Consumption of Order Processing
Determine disposition data	C	C																											
Consult	C		C														U	U	U		U		U				U		
Determine specific sales solution	C									U																			
Determine possibility of sale				C						U																			
Adjust possibility of sale				U	C																U								
Execute price calculation						C																							
Determine price change						U	C																						
Identify buying team								U																					
Determine decision criteria									U						U						U	U	U			U	U		
Develop vision of purchase										U																			
Alter vision of purchase											U																		
Process objection														U									U				U		
Create cost-benefit analysis												U	U																
Create customer offer														C	C	C	C	C			U	U			U				
Set status of the customer offer				U	U									C				U										U	
Update order stock														C	U	U	U	U	U		C	U	U	U			U		U
Verify availability	U													C			C	C	C						U				
Present customer offer														C			U	C	C	C									
Send customer offer														U				C	C	C									
Determine quantity structure	U																		C						C				U
Determine conditions	U	U						U	U											C									
Calculate sponsoring	U																								C		C	U	
Follow up on customer offer														U	U	C	U	U			U	U	C	C			U		
Qualify customer offer												U	U	U					C		U	U	U				U		U
Determine value structure	U																				C								

Figure 2: Excerpt of the matrix

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As the matrix is quite large a test of all possible combinations in order to find the most suitable component model is impossible, even if tool support is available. Though, a repeated execution of the BCI-Method with random initial configurations showed varying results. After a close examination of the initial configuration's impact on the outcome of the algorithm, we noticed that specific knowledge about component characteristics has to be included into the initial configuration. Such knowledge includes for example information about functional relationships or dependencies between single information objects. For the development of the integrative information architecture information about functional relationships, taken from the functional decomposition diagrams, was inserted into the initial configuration. However, the resulting abstract component model is not a copy of the functional diagrams. It contains 48 business components. These components were identified under the objective of minimizing the communication between the components.

There is still a potential to extend and further optimize the BCI-Method as well as the obtained component model. Besides the inserting of knowledge about functional dependencies, which has already led to promising results, we suggest following extensions:

- At this time, the implemented functional coherence follows the functional decomposition diagrams. It should be examined if this restricts the range of possible solutions.
- Additional consideration of relationships between information objects.
- By using information flow diagram the relations between functions and information flows are illustrated. These information flows are similar to process steps, but they do not include real business processes and relationships of all functions. Thus, processes have to be considered within the BCI-method.
- The communication intensity of functions is not considered in the BCI-method, although it is relevant for mapping a function to a business component.

4   Conclusion

In this experience report, we addressed the problem of identifying business components in large-scaled information systems by the BCI-Method. Although the BCI-Method is specialized for the design of component-orientated information systems, it has to be modified in order to be applicable for voluminous input models. In these cases tool support, which relies on an explicit formulation of algorithms and their constraints, is necessary. After having implemented the first enhancement to our BCI-toolset, future work will consider the suggestions made in chapter 3. With these extensions, an application of the BCI-Method within large-scaled information systems is expected to lead to better model quality. Hence, test series using the extensive input models are planned to allow a comparison of different BCI-Method modifications.

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