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## Business Information Driven Approach for EA Development in Practice

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### Abstract

*In this paper, we extrapolate findings of using the Genre and Ontology based Business Information Architecture Framework (GOBIAF) as a methodology to approach enterprise architecture (EA) development from business perspective. GOBIAF seems to contribute as the first business critical information driven framework for EA development, addressing the importance on integrating (information creation) context to (information) content. GOBIAF was developed for and applied in a knowledge intensive, heterogeneous, and geographically dispersed environment in process industries. In the context, GOBIAF increased our knowledge of complex relationships between business, information, and technical domains. Further, GOBIAF provided needed structure for evaluating and developing difficult and heterogeneous issues in relation to organizational strategies.*

### Keywords

Enterprise architecture, business information architecture, ontology, genre, evaluation

### Introduction

Any kind of strategic consideration is a two-way process (Allen and Boynton 1991). On one hand, strategic analysis separate organisational entities from each other, reducing the complexity of the problem analysis. On the other hand, strategic alignment forms new entities by aggregating existing entities, providing basis for more holistic analysis and development. An example of this would be developing geographically dispersed production process line wide information management, harmonizing the existing practices in related business units. Either way, modular approaches seem to become state-of-the-art. The idea is to differentiate business critical issues from each other but then again show the dependencies between the new alliances. Enterprise architectures (EA) are such a tool, attracting discussion among both academics and practitioners.

Historically, EAs have been used for enterprise integration (IFIP-IFAC 1999) as a bridge between business and IT (Young 2001) within modelling approaches (e.g. Rensburg 1997) and classification frameworks (Malhotra 1996), emphasising the conceptual (McDavid 1999) and modelling aspects (Arab *et al.* 2002) in organisations. EA frameworks usually take a form of a grid (e.g., Zachman 1987), consisting of architectural views (business, information, application, and technology) and organisational levels (enterprise, domain, and information system). The clear advantage of EA is that it provides boundaries with coherent and balanced structure. Descriptively speaking, EA is a way of thinking to approach organisational strategic considerations. However, partly because of the history of EA (Evernden & Evernden 2003), existing EA frameworks seem to be IT-centric.

Applying EA frameworks require high know-how from both EA and context where EA is going to be applied. The lack of methodology (EA knowledge) and metrics (context knowledge) easily end in objectives that are not explicitly addressed and agreed. This poses a threat where the resulting architecture descriptions turn to be unquantifiable and hard to maintain. Another general problem seems to be that the content of and the semantics between cells and entities are static and the content is of descriptive nature (Schekkerman 2004). Thus, the lack of a holistic information representation mechanism seems to be a fundamental problem, providing negative impacts on the overall perception and outcome of an EA. In spite of attempts, seeking for coherent architecture descriptions (e.g., Jonkers *et al* 2003) the need for a single model type and notation in EA models still exist.

The lack of a consistent architecture description language is an issue because semantic consistency has been seen as a critical factor within heterogeneous business communities to provide business process integration (e.g., Guo 2006). In a similar way, vocabulary differences in collaboration (e.g., Chen 1994), especially in geographically distributed organisations, increase and complicate interoperability between stakeholders. The EA work is dealing with these issues in daily-basis. Thus, the key issue in EA development is how to bridge the existing differences in conceptual vocabulary. Further, it is not enough to understand the EA conceptually but the conceptual understanding must be able to transfer into implementation (Hayes 2003).

The Genre and Ontology based Business Information Architecture Framework (GOBIAF) (Kilpeläinen 2006b) was developed to overcome the above-described issues in EA development. GOBIAF focuses on analysing and representing organisational communication activities that can be paralleled to business behaviour (McDavid 1999). With the knowledge of business behaviour, the automation of communicative activities through EA descriptions can be designed. To put it another way, GOBIAF uses the soft side of an organisation (business and information architectures) as the fundamental starting point in building applications, managing the business critical information. The importance of the approach appears in contemporary organisations that may not have control over their business critical information (requirements) without a formal and abstract method due to the fact that they have to adopt information and process models embedded in software packages like ERP.

This paper presents the results of using GOBIAF in an organisation in process industries to analyse and develop information management principles in a knowledge intensive, heterogeneous, and geographically dispersed production process line. The paper contributes by providing data from domain analysis of three business units. In addition, the paper ties down the distinct parts of the framework presented elsewhere as a separate entities. The paper is not, however, intended to go through the BIA development process step-by-step. That is, the paper evaluates GOBIAF and its elements as well as its adaptability in practice, explicating the key lessons learned.

## Research Design and GOBIAF Fundamentals

In this section, we describe the fundamentals of GOBIAF and the context where it is developed, utilized, and analysed in practice.

### Target Organization

The target organization (Kilpeläinen, Tyrväinen & Kärkkäinen 2006) is a large, internationally operating enterprise in process industries, providing production machinery. The main function of the geographically dispersed production process line and related business units is to develop new paper products and technology related to it and, in addition, papermaking processes. The main responsibility is to produce information instead of paper as the end product. The enterprise itself is a complex and highly product and function oriented organisation where specialised and autonomic business units operate under an umbrella of managerial consolidation without genuine operational integration. Thus, the lack of a holistic information management crossing the functional boundaries is a real issue, causing severe problems in customer service because of the lack of possibility to see, e.g., the production process line wide data in a coherent form.

For historical reasons, the production process line has been highly perceived from business unit perspective. Thus, holistic objectives, solutions, and applications have been dismissed by referring to business unit specific requirements. Because the distributed production machinery in real production environments is usually located in one location, the need for better collaboration and integration between the three business units is seen as a strategic objective. Both in the cross unit internal processes of the organisation and in the product, the process line delivered to the customer. We focus on the internal cross-unit production process in both business process and related information management perspectives. Namely, the direct reason for the organisation and, consequently, for the business units involved was the problems in daily collaboration due to lack of existence of BIA in practice. Thus, the fundamental objective of BIA development and utilisation was to aid alignment between related business units and to provide a holistic view over the production process line.

### GOBIAF in a Nutshell

The aim of GOBIAF (Kilpeläinen 2006b) is to express an in-depth state of the most important aspects of key business processes and related information as well as their management, so that extensive horizontal and vertical communication of business information can be assured in the organisational scale (see FEA DRM 2005). The direction of emphasis is, first, on business (processes), second, on information necessary to operate the business, and, third, applications and technologies necessary to support business operations. The idea is to identify the business critical information of interest and specify them in an ontological information model so that it is clear what that information is, what the semantics and interrelationship between organisational information concepts are, and what the information really means in the context. Thus, GOBIAF aims to support business critical information management based strategic and operational thinking, forcing dispersed business units to define, evaluate, and manage local business information in a collective and harmonized way.

Theoretical examination of the aspects of GOBIAF (ibid.) establishes some major similarities to make EAs, ontologies, and genres feasible candidates for integration to complement each other. Recent architectural approaches seem to lack consistent information representation mechanisms that ontologies provide. Ontologies, for one, traditionally suffer from an information acquisition bottleneck to reach essential, domain-specific conceptualisation for what the genre-based analysis method (e.g., Tyrväinen, Kilpeläinen & Järvenpää 2005) is designed for. In particular, genres are perceived here as prototypical models for communication (Swales 1990).

Within GOBIAF, BIA descriptions are achieved through an iterative, twofold development process (see Figure 1): from genres and information need interviews to ontologies and from genre-based ontologies to BIA descriptions. The first part covers the domain analysis phase in BIA development whose results are modelled by ontology descriptions. Ontology descriptions in the form of knowledge base (Kilpeläinen & Nurminen 2007) are, then, mapped to BIA descriptions. The issues in the framework are, thus, mentally approached top-down but the actual EA definition process takes place in a bottom-up fashion.

Figure 1 shows the high-level mapping of the phases, activities, and deliverables of activities. As the detailed descriptions of the phases can be found elsewhere, Figure 1 contributes by making the required mappings between them. There are no arrows presented from the deliverables of ‘Characteristic values and bottlenecks’ as well as from the ‘Information usage needs in business processes’. This is because the deliverables act as a master deliverables of domain analysis phase, having a comprehensive influence on the other parts of the BIA development process. In particular, the knowledge of these two deliverables can be seen in BIA descriptions where the *to-be* state is defined. The other concepts used in Figure 1 are defined later in this paper.

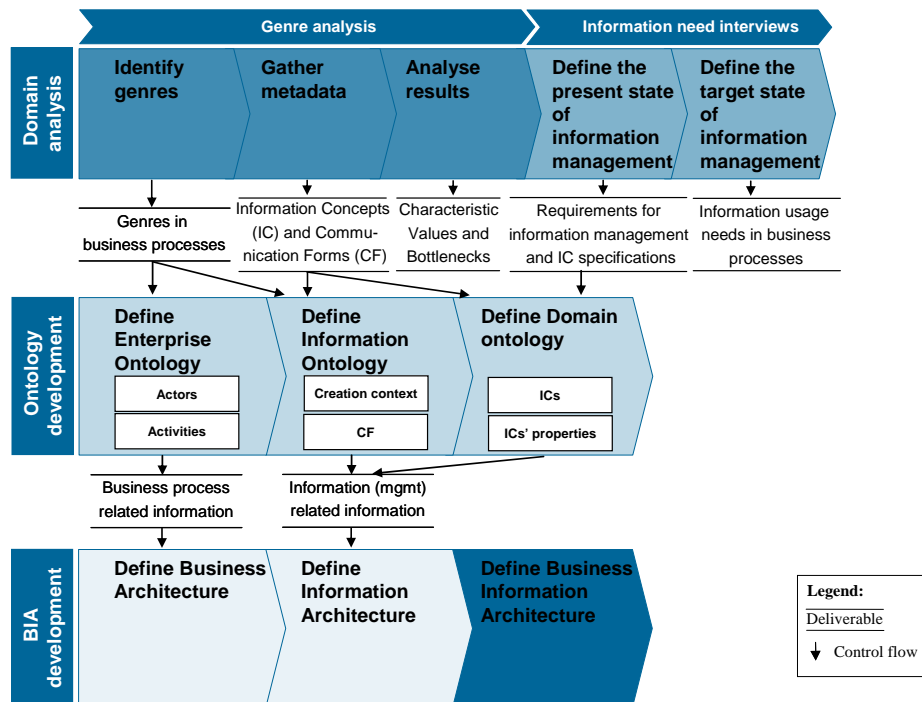


Figure 1: The phases/steps of the BIA development process

## Overall Results of Domain Analysis

In this section, we summarise the high-level results of utilising the GOBIAF in practice. Detailed structures of the ontology descriptions, which are based on these results, are reported in (Kilpeläinen & Nurminen 2007). The content of the ontology and BIA descriptions are confidential so that only the general outline related to them can be provided. The architecture descriptions of GOBIAF are outline in (Kilpeläinen 2006b).

## Communication Volumes

Table 1 describes the categorisation of communication presented in Table 2 where communication is divided to internal communication of the business units and communication crossing the boundary of the units. The latter communication is divided further into two categories – communication with other parts of the organisation (referred to as ‘O’) and external parties to the organisation (referred to as ‘E’). The resulting five communication categories are the internal communication of the unit (referred to as ‘UU’) and the four communication categories crossing the border of the organisation unit (i.e., UO, UE, EU, and OU) as described in Table 1.

As GOBIAF accentuates the role of the soft side of contemporary organisations, we used genres as the unit of analysis by utilizing the genre-based analysis method in three business units within the organisation. Variation in data collection procedures was minimized by using the same researcher to conduct the analysis. However, there exists variance in characteristic values provided here when compared to the results presented earlier. The difference can be seen between the characteristic values of Business Unit 2 (BU2) in this paper and the Case Study 3 in (Tyrväinen, Kilpeläinen & Järvenpää 2005). The difference stems from the fact that the initial results were augmented at the point in the long-term research collaboration where the study was leveraged to cover the

whole production process line. In the initial data, only the internal operations of the business unit were taken into account whereas the results in Table 2 include the production process line wide communication also.

Table 1: Descriptions of the symbols used

Symbol	Description
U	Unit in an organisation
O	Organisation
E	External parties, i.e., all external parties the employees of the unit communicate with
UU	Internal communication within the unit, i.e., from Unit to Unit
UO	Communication from the Unit to the other parts of the Organisation, i.e., within units
UE	Communication from the Unit to the External parties to the organisation
OU	Communication from the other parts of the Organisation to the Unit
EU	Communication from the External parties to the organisation to the Unit

Table 2 summarises the distribution of internal and external communication of the units. There are five rows representing the distribution using five different metrics for each of the business units as well as their aggregation to depict the production process line (PPL) wide communication. The four first indicators are proportions of the volumes, e.g., in the business unit 2 (BU2), 96% of all unique communication instances of the unit were internal communication within the unit, while in the business unit 3 (BU3), 77% were internal to the unit. The fifth row with title 'Genre' represents the portion of communication genres identified to be used for this communication, e.g., in the production process line (PPL) about 17% of all communication genres were used for communication from the unit to external parties to the organisation. The columns represent the proportion of communication adding up to total 100% (with rounded percentages). Note that the value 0 in Table 2 does not necessarily mean that there is no communication. Instead, the volume in those cells is such a low that, when rounded to whole numbers, it did not provide significant response.

Table 2: Summary of the results from the three distinct, geographically dispersed business units and the production process line that consists of the business units

	EU %	OU %	UU %	UO %	UE %	Total
<b>Business Unit 1 (BU1)</b>						
Unique instances	2	0	92	1	5	100
Unique pages	1	0	89	4	5	100
All instances	0	1	95	1	3	100
All pages	0	0	87	6	7	100
Genres	9	6	58	5	22	100
<b>Business Unit 2 (BU2)</b>						
Unique instances	0	1	96	1	2	100
Unique pages	0	2	90	1	7	100
All instances	1	1	92	1	5	100
All pages	0	1	57	1	41	100
Genres	7	16	59	9	9	100
<b>Business Unit 3 (BU3)</b>						
Unique instances	2	3	77	3	15	100
Unique pages	7	9	46	12	26	100
All instances	2	2	75	3	18	100
All pages	5	7	33	8	47	100
Genres	8	8	59	6	26	100
<b>Production Process Line (PPL)</b>						
Unique instances	0	1	95	1	3	100
Unique pages	1	2	89	1	7	100
All instances	1	1	93	1	4	100
All pages	1	1	69	2	27	100
Genres	8	10	59	6	17	100

In general, the results in all the business units seem to follow the same trend. The business units are autonomous, having no true collaboration to aid organisational objectives. Thus, when analysing the genres in a qualitative way, the information flows crossing the boundaries of distinct business units (OU and UO) are limited to process specifications and reporting. Somewhat surprisingly, timely feedback for example in the form of closing meetings after the distinct projects is scarce. Further, knowledge sharing across one business unit (i.e., from BU1 to BU3 or vice versa) does not exist at all. Thus, an interesting finding was that there exists more communication to external parties than to other business units within the enterprise (see Ross, Weill & Robertson, 2006).

The values in organisational communication (OU and UO) are a bit higher in BU3 compared to the others, highlighting its role as a master unit in the total production process. In addition to internal responsibilities in

overall management of the production process, BU3 is responsible for customer service in general. During the different stages of the production process, business units in place do have informal communications with customers but the formal communication is done centrally by BU3. Because the PPL-wide data can not be provided, there exist a paradigm in which decentralised business processes are managed centrally without sufficient tools to do that. The level of collaboration and data level integration of the business units should be developed by concentrating on analysing, developing, and supporting especially the information flows crossing the boundaries of the units. These information flows, or the business critical information concepts embedded in those flows, and their structure should be harmonized and rooted to organisational operative functions. This seems to be the only way to be able to automate the information flows in a reasonable extent.

### Communication Categories

In addition to percentual distribution of the communication volumes, communication forms play an important role in evaluation of the current state of organisational information management. After the recommendations of BIA development are implemented in practice the genre analysis can be conducted again to see how the characteristic values have evolved. This kind of an approach provides both quantitative and qualitative data that can be used to show the transformation from *as-is* to *to-be* stage as well as its value, e.g., in shorter throughput times. In addition, the knowledge of information concepts taking place in information flows can be used as a baseline in conceptual information model development. These are the ways how management needs of the information concepts identified in genre analysis are explicated and rationalised with the aid of BIA descriptions.

Digitalisation of all communication (all pages) of the three business units as well as the PPL is summarised in Figure 2. The categories of communication forms (CCF) (Tyrväinen 2003) are combined in the way that the bar “Digital” indicates the portion of digital communication forms, i.e., digital documents and database data. The bar “Analogue” refers to communication that takes place in analogue format, i.e., in paper. The bar “Other” represents the share of communication not using stored media. In practice, this category includes mostly verbal communication, but also CCF categories “material” and “mediated/semi-transient” used, e.g., for phone calls.

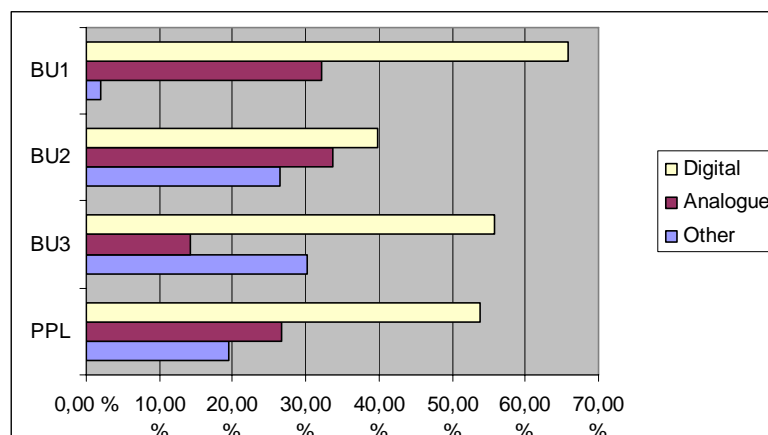


Figure 2: Digitalisation of all communication in the three business units (BU1-BU3) and production process line (PPL)

The high proportion of digital information in BU1 is a consequence of highly developed information management through which all the phases in the production are specified, controlled, and reported. The problem is that the data is local (i.e., not accessible for other business units) and it requires high domain-knowledge to be interpreted. Further, the information management principles and information systems used are custom made that do not follow the corporate standards. Thus, the same information that is managed and communicated in digital formats in BU1 is communicated mainly in face-to-face communication (the bar “Other” in Figure 2) in BU2. The main proportion of digital information in BU2 is due to digital reports.

Another conspicuous issue is the high proportion of analogue information. For example paper documents used in specifying the laboratory analysis seem somewhat superfluous in a sense that those documents must be carried to the laboratory. Simple solution would be to redeploy the information exchange to mobile devices (e.g., hand-held devices), resolving a number of practical problems related to paper-based communication, e.g., person dependency, lack of history information in a long run, chance of loss, and difficulties to cope with handwriting. Further, the role of tacit knowledge (residing in the column “Other” in Figure 2) is quite high whose explication to digital formats was seen as a must. This is because, based on the information need interviews conducted, it is the fundamental element in the subsequent analysis and specification of the production process afterwards.

## Evaluation and Lessons Learned

The mapping of the data provided so far to ontologies and, further, to BIA descriptions is made according to the principles presented in Figure 1. As given, the mapping is documented elsewhere. That is why we now move on to evaluation through which the main lessons learned are explicated.

### General Evaluation Principles

Most of the existing frameworks used for EA evaluation (e.g., Kazman, Klein & Clements 2000) are directed to software architecture evaluation (Skadron *et al.* 2003). This reflects the fact that discussion in the EA field is concentrated on technical aspects of an EA, while hardly any attempt is made to establish a connection between business, information, and technical architectures (Versteeg & Bouwman 2006). Similarly, a limited effort is done to measure EA progress and value (Gotze & Christiansen 2007) as well as metrics and maturity (Rosen 2007). As the criteria for evaluating the state of business are more often qualitative (e.g., Tang, Han & Chen 2004), commonly accepted set of concepts, tools, and viewpoints to construct valid EA descriptions do not exist (Ylimäki & Halttunen, 2005). Further, the existing evaluation frameworks seem to be inadequate in case of GOBIAF evaluation, approaching and valuing the EA development from the soft side of organisations.

Because there have been criticism about the difficulties in applying general criteria in all environments (Mazhelis *et al.* 2006), fundamental evaluation targets as well as metrics and criteria that fit best in the target organisation should be described. Similar trend can also be observed in other fields, such as BPR (Kohli & Hoadley 2006). The use of domain-specific requirements and criteria should be expressed in terms that are concrete and measurable or observable (Kazman, Klein & Clements 2000) – both qualitative and quantitative (Dobrica & Niemelä 2002). When qualitative requirements are evaluated, the questioning approach seems to be the most suitable method (Abowd *et al.* 1997). As quantitative metrics, we recommend to apply the reference values of communication volumes and categories from the genre analysis. Quantitative data is not provided here because the actual transformation from *as-is* to *to-be* state is on the way in the target organisation.

### GOBIAF Evaluation

As the special nature of the target organisation poses both general purpose and domain-specific requirements, we elaborated and approved the objectives and principles (cf., CIO Council 1999) derived from the domain analysis phase (Table 3). The principles are aimed to set fundamental guidelines whereas components are intended to present mechanisms to cover the aspects that are related to the principles. To categorise the principles, flexibility/configurability (standards-based architecture and modularity), maintainability/adaptability (scalability and reusable solutions), and reliability (completeness, availability, and ease of use) are the key issues to address.

Table 3: GOBIAF principles and their components

#	Principle	Component
1	BIA descriptions are only as good as the information collected from subject matter experts and domain owners	Genre-based analysis of business processes and open and semi-structured information need interviews used as approaches to collect high quality source information in an efficient way
2	Architectures aim at minimizing the burden of information collection, streamlining information storage, and enhancing information access	A method brings all relevant stakeholders together to discuss the issues under consideration. Here, ontologies are used as tool for conceptual analysis, modelling, and harmonization because they take the differences in conceptualisation into account
3	The tools within the framework must support bottom-up oriented domain analysis, i.e., from elaborate to common	Ontologies abstract the results of genre analysis and BIA descriptions abstract the genre-based ontology descriptions
4	GOBIAF should be efficient and easy to adopt, use, and maintain	GOBIAF is built upon recent methodologies presented in the literature to be generic in its nature. Further, they complement each other to build synergy between them.
5	The aim in building a present architecture should be based on a high cohesion of business processes and information taking place in those processes. The role of technical solutions is to support business operations	Processes, ISs, and technologies may change more frequently but the information concepts used to operate the business are expected to be more stable because they are based on organizational culture and core business functionality.
6	The architecture descriptions should be modelled in a consistent and harmonized way, providing an opportunity to automated processing	Presumably, maintainability of BIA descriptions can be improved by using ontological descriptions. Further, as ontologies are enterprise models and, thus, executable entities they can be applied directly to IS development.

Even though architectural descriptions and estimates should be coarse (Versterg & Bouwman 2006), enterprise architects must know the dynamics underneath in a much lower abstraction level to both establish and verify architectural requirements, but also to assess the interdependencies within the EA (Kaisler, Armour &

Valivullah 2005). The underlying assumption is that business processes today are decentralised and cross the boundaries of a number of business units within and between organisations. Thereby, it is not obvious what the communication and, thus, the basis for ontology and architecture descriptions within the units is. According to Waddington (2004), the organisational characteristics (e.g., degree of digitalisation of organisational communication) may play a role in determining the choices for EA models to meet certain requirements. That is why we use genres and open and semi-structured information need interviews (Principle 1) to go quite deep in organisational activities to reach the actual business and IT requirements. Ontologies are, then, used to abstract the knowledge derived from domain analysis and present it in an appropriate level in the BIA descriptions (see Principle 6).

Socially oriented methodologies for domain analysis provide more support for user involvement in design than the rigidity of more traditional methods, facilitating the degree of user-designer communication and the capture of requirements (Coughlan & Macredie 2002). Apart from that, the use of genres (Principle 2) itself can be motivated by the fact that the information communicated to operate the business during business processes can be regarded as important. Because of the critical nature of the information concepts, their explication to digital formats can be rationalised in architecture descriptions to act as a development direction to the overall organisational information management principles. Information need interviews are then used to complement the genre analysis in the way that the issues discussed in those interviews are based on findings derived from genre analysis. That is, people from a department or from a social network are interviewed, providing a possibility to go much deeper on domain-specific issues than with the basic genre-analysis.

GOBIAF is an approach for total EA development, including the process description through which the BIA descriptions are derived. In practice, GOBIAF integrates three aspects of total organizational information management efficiently, providing basis for bottom-up development (Principle 3). The bottom-up approach is preferred here to reflect the terminology used in initial contexts, i.e., in business processes among related stakeholders. In practice, all the elements of GOBIAF are valuable concepts by themselves also, but done in parallel they contribute significantly to aid the same purpose. Even though, BIA and ontology construction activities, especially when done separately, can be regarded as challenging and time-consuming tasks. However, when the issues are carried out in parallel, the synergy effect through genre analysis is reached (Principle 4). Thereby, early resource investments may provide savings in the later stages of EA development, implementation, and maintenance (Kilpeläinen 2006b). In addition, Principle 4 highlights the flexibility of GOBIAF because of its support for incremental development and alignment between business units. In this way, a threshold of going forward should be relative straight-forward decision, provided that the true needs exist.

As IT as a field is evolving rapidly, the most permanent aspect of contemporary organizations seems to be the information used and communicated to operate the business (Kilpeläinen 2006a). As enterprise systems are becoming more like a commodity than a tool for reaching a competitive advantage, EA development should be business information driven (see Kaisler, Armour & Valivullah 2005) to give directions for building truly valuable solutions on top of functional infrastructure (Evernden & Evernden 2003). Thus, the role of technical solutions should be to support business objectives and operations. As the contemporary EA models are directed in technical aspects of the total EA, GOBIAF provides another extreme by using the soft side of an organisation as the baseline in EA development. BIA is capable of linking heterogeneous (explicit and implicit) business critical information (e.g., different naming practices) together. Thus, BIA seeks for better awareness and management of the (content of) information concepts, occurring in those processes. The exploitation of high cohesion of business (processes) and information needed to operate the business (Principle 5) as the baseline in EA development seems quite unique when compared to other recent architecture models.

Because ontologies are enterprise models, they are executable entities as such. That means that when the baseline architecture is described by using ontologies as an architecture description language, the architecture descriptions become source for actual implementation of solutions (Principle 6), e.g., in semantic information retrieval and information systems planning. In comparison to the traditional architecture descriptions (such as plain text and organizational charts) whose role is to act as a common and static source of reference, ontologies seem to provide a clear advantage. Even though the concept of ontologies itself and its technical orientation may cause frustration and resistance in ontology development and maintenance (Sommerville, 2004), its expressivity and perspicuity were seen as its concomitant asset. Even when the usefulness of the knowledge base as an architecture description repository is compared to functionalities the EA tools (e.g., METIS and System Architect) have to offer, the advantages seem to be explicit mainly because of its flexibility. However, when the maintenance and updating issues are considered, the commercial EA tools seem to provide a better functionality.

## Lessons Learned

From our experience, we offer a set of lessons learned from both the industry and academic perspectives. We offer these as issues to be addressed during the whole BIA application life cycle. The list is not intended to be all-embracing. Instead, we contribute by highlighting the issues we considered crucial in BIA development.



- As in any other strategic initiative, a successful BIA project requires organisational investments that can be realised as availability of human capital. This is crucial because a useful and purposeful architecture is developed from active involvement of the organisation. More than that, a proper supportive management system is a must. In this way, the organisation is most likely to receive a BIA, putting forward and focusing on their needs.
- It is of overriding importance to know the metrics the senior managers are using in evaluating organisational operations and development. In addition to the resources the senior managers can provide, the priorities of an BIA project should be closely tied to senior managers' priorities that they are keen and evaluating. At certain points of the project, you must be able to, if not quantify but relate the qualitative requirements to managers' priorities in a way that the improvements can be explicated to show the value behind them.
- Utilisation of the genre-based analysis method provides quantitative characteristic values that can be used as EA metrics for number of reasons. First, the analysis process before and after the development activity is relatively easy. Second, information communicated and, thus, used to operate the business can be seen as business critical information whose management should be developed to a reasonable extent. That is the reason why it is of special interest of senior managers. Third, the characteristic values make benchmarking between distinct case studies possible because the fundamental premises of the genre-based analysis method provide a realistic point of comparison not dependent on the size of an organisation, the number of employees, and other such transient variables.
- In some cases, the difficulty in academia-led projects may be the under-estimation (e.g., researchers are cheap resources of work) of the capabilities. In addition, researchers should be aware of the so-called pull-effect where an organisation does not feel the issue developed as their own. Thus, the need for BIA development should arise from organisational needs. Even though researchers may awake the need for BIA development, the most fruitful ground is provided when the initial need comes from practitioners. At least one spokesman who is ready to underpin the BIA project internally has to be attained.
- It takes a lot of effort for academics to be able to present concepts (for example an enterprise architecture or ontology) in a way practitioners understand, i.e., to speak the language of the customer. Sometimes it seems too easy to hide behind the academic jargon. The most important concepts must be clearly defined and introduced in all the material provided for the customer. These conceptual definitions should fit in one PowerPoint slide and it should be displayed at the beginning of the meetings to avoid misunderstandings and conceptual contradictions. By doing this consistently, you minimize the usage of best human resources for arguing about terminology.
- The researcher should be able to reach the required data, information, and knowledge freely. A practical solution is to place the researcher to the facilities of the target organization. In this way, the information sources (data repositories, domain experts etc.) are close to cooperate. Thereby, the ease and usefulness of using informal meetings provide valuable insights into real business situations. Further, the stakeholders within an organization may feel committed because of the early inclusion. Agile methods that are latterly applied to EA (Amber 2007) use this kind of collaboration-based approach where a customer is available for developers on daily basis.
- BIA, especially its domain analysis phase, is intensive, versatile, and long-term in its nature. Executive summaries should be done from all the deliverables, helping to discuss with different stakeholders. The problem is in many cases that the material should be done before actual data is acquired, e.g., a domain-specific business case with actual numbers and estimates should be provided when an EA project is initiated. This relates to the importance of making the deliverables concrete and easy to understand.
- GOBIAF was seen as a practical approach in the context in a number of ways versatility being the most appreciated factor. It is, however, acknowledged that providing data for application and technology architectures may need different kind of an approach. As an example, different kind of application portfolio optimization approaches may be used when application architectures are defined.

## Summary, Conclusions, and Further Research

In this paper, we evaluated the results of developing and utilizing GOBIAF in an organization in process industries. The study was done through active involvement in the design and development of a production process line-wide BIA, during a four-year period (2003-2006). We do not pretend to provide conclusions of a generalizing nature on the basis of our study, and are well aware that the case in itself cannot be considered to be

representative. Further, we do not intend to be profound. That is, BIA development and maintenance in practice is a continuing process as requirements change over time.

The results contribute by providing well-documented reference points on multiple variables, measuring digitalisation or internal and inter-organisational communication in a knowledge intensive, heterogeneous, and geographically dispersed environment. Thus, the results of domain analysis as well as lessons learned of utilizing the business critical information driven approach for EA development in developing organisational information management principles can be used as a basis for a wide spectrum of further research. BIA, as applied here, provides qualitative and quantitative data on focal points of business, such as the percentages of non-digital business critical information of the total organisational information resource. The characteristic values guide the total EA development and provide means to implement information systems by pin-pointing the information concepts and their definitions in the cross-unit communication. To be specific, these characteristic values can be used as quantitative metrics to evaluate the BIA development. BIA was seen as an approach, providing needed structure for the evaluation and development of difficult and heterogeneous issues.

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