

2006

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## Recommended Citation

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## From Genre-based Ontologies to Business Information Architecture Descriptions

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### Abstract

*A high cohesion of business and information needed to operate the business provide the fundamental basis for approaching Enterprise Architecture (EA) development. The aim of the Business Information Architecture (BIA) presented in this paper is to support the development of holistic information management principles in geographically dispersed environments. BIA contributes as a shared mechanism to support business information based strategic and operational thinking, forcing isolated business units to become aware of, understand, structure, and present local business critical information using ontologies and communication genres to aid EA development, implementation, and management to support business objectives.*

### Keywords

Enterprise architecture, business information architecture, architecture descriptions, ontology

### INTRODUCTION

One way to approach the issue of holistic organizational information management in geographically dispersed environments is to use enterprise architectures (EA) as overall blueprints for applying information technology (IT) to achieve business objectives (van den Hoven 2003). However, the total EA is, at least in many cases, perceived as a too laborious and resource demanding tool (Hirvonen et al. 2003) because it demands a high abstraction level approach as a continuous activity of long-term strategic character (Spewak 1992). To overcome this problem, there seem to exist practical architectural models in literature (e.g. Ekstedt 2004, Pienimäki, 2005) that approach EA development from a specific perspective instead of elaborating all views. In particular, the technical aspects of an EA have been the fundamental starting points from which (existing) information systems and technologies are evaluated and developed to support distinct processes. However, this kind of an approach where business is accommodated to constraints IT poses (see Krumboltz and Maiden 2001) has been widely criticized (e.g. Davenport 1998), increasing the possibility of the traditional business/IT alignment problem.

Another way of approaching the issue would be to argue that information used and communicated to operate the business is the most permanent aspect of contemporary organizations (see Watson 2000). In other words, even though applications and technologies have evolved, and will evolve in an expeditious pace, information used in business operations especially in process industries has remained almost unaltered – only the tools for its management, representation, and communication have changed. As the amount of information is increasing, it is becoming ever more important for organizations to be aware of business critical information (later referred to as business information) to ensure its management, distribution, and usage in an appropriate level. Further, as enterprise systems are becoming more like a commodity (Channabasavaiah et al. 2004) than a tool for reaching a competitive advantage, EA development should be business information driven (see Armour et al. 1999) to give directions for building truly valuable solutions on top of functional infrastructure (Evernden and Evernden 2003).

The two approaches are not necessarily exclusive in their nature (Lankhorst 2004). Instead, the emphasized point of view implies how an organization applying EA values IT in relation to business, reflecting the role and possibility of IT culture (Kaarst-Brown 1995) to reinforce business (culture) as a whole. The problem of finding the balance between the views is emphasized in situations where diverging organizational cultures come into contact due to mergers and acquisitions, thus impeding the evaluation, design, and implementation of solutions that seek for common good. Behind the viewpoints, especially when discussing the ways in which EA should be developed, EA taxonomies play an important role, allocating sub-architectures to form semantics between them. The problem in recent EA taxonomies (e.g. Pienimäki 2005, Morganwalp 2003) has been how to position informational issues when reflecting the dual nature of contemporary organizations. That is, all technical aspects of an organization, which are managed in application and technology architectures, are perceived to belong to the hard side of an organization. The soft side, in turn, consists of business perspectives and socio-technical aspects that are discussed in business architecture. Instead of placing information (architecture) on the hard side with applications and technologies, it may be placed on the soft side with business architecture (see Gosling 1993).

This kind of categorization implies that there are whole bulks of business information (requirements) that are not necessarily expressed in explicit formats, i.e. in digital documents. In this way, information is loosely distinguished from the hard side that, in turn, highlights the role of applications and technologies as supportive elements of business operations (Kilpeläinen 2006). The taxonomy, in which information is the connective element between the hard and soft sides of an organization, would underscore the business (information) requirements driven approach that, first, seems to be missing from the field of EA. Second, it may have a positive influence on business/IT integration by shortening the gap between them.

This paper responds to the need to provide an approach through which business information, independent of any system or implementation considerations and organizational constraints, communicated in business processes acts as the baseline in evaluating and developing holistic organizational information management principles. The paper introduces an outline for Business Information Architecture (BIA) descriptions in the Genre and Ontology based Business Information Architecture Framework (GOBIAF, forthcoming). The proposed approach for EA development will be elaborated as follows. We will start by examining the aspects of GOBIAF by providing a review of the theories and terminology of the domains that form the basis of the framework. Next, distinct levels of GOBIAF will be introduced through the generic steps of the BIA development process. Then, BIA and the use of ontologies as an architecture description language will be described. Finally, derived architecture specification will be compared to its most prominent competitors to indicate its contribution to the body of EA literature. It is worth mentioning that we do not go deep into the details of the deliverables in BIA descriptions, taking place in the target organization where the framework is developed and applied in practice. Contrary, this paper focuses on describing and defining what the BIA is and how ontologies are used as an architecture description language in GOBIAF. Other parts of the framework will be discussed elsewhere.

## **THEORY BASE AND RELATED TERMINOLOGY**

GOBIAF is based on three aspects of organizational information management: enterprise architectures (CIO Council 1999), ontologies (Abecker et al. 1998), and genre theory (Yates and Orlikowski 1992) especially through the use of the genre-based analysis method (Tyrväinen et al. 2005). Common to all these concepts is that they concentrate on information-centered issues within organizations, even though they approach the issue from different point of views and levels of abstraction. Somewhat surprisingly, these well formed, established, and documented concepts have not been integrated previously to build synergy between them.

### **Enterprise architectures**

In practice, EAs have been used, along with organizational strategic elements, to enable an integrated vision and a global perspective of informational resources in an enterprise (Niederman et al. 1991). Thus, EAs are tools to evaluate the current and future business objectives through examining the key business, information, application, and technology issues and their impact on business functions (Pereira and Sousa 2004). As an EA is the glue integrating these distinct issues into a cohesive framework, an EA may establish an enterprise's mission through optimal performance of its core business processes within an IT environment (CIO Council 2001). Therefore, architectural descriptions provide a way to map the information needs of an organization, to relate them to specific business functions, and to document their interrelationships to guide software development and to facilitate integration and sharing of data (Brancheau 1989). This is why architectural descriptions aim to act as a bridge between the hard and soft sides (cf. Young 2001) within organizations.

Because architectural descriptions are exactly as good and valuable as the underlying (source) data, methods used in domain analysis as well as tools for representing the results have to be rich and extensive enough (Kaisler and Armour 2005). For example, data derived from distinct interviews and document analysis may be individual-centric, its collection and interpretation may be time consuming, and its approval may be complicated because every interviewee has his/her own view on the issue. Further, state transition diagrams and use cases that are traditionally used in architecture development (CIO Council 2001) are valuable tools as such but their interconnection is weak, i.e., in alteration situations where changes in one model should be mapped to all the related models. Even if there have been attempts to provide coherent architecture descriptions (e.g. Jonkers et al. 2003) there still exists a need for a single model type and notation for modeling the semantics between entities in EA models (Ekstedt 2004). Thereby, there is a need for effective, but still comprehensive approaches, methods, models, and tools to assist the architecture development process in practice (e.g. Pienimäki 2005).

### **Ontologies and metadata**

Because ontological analysis clarifies the structure of knowledge within a specific domain (Chandrasekaran et al. 1999), ontologies can be used in an integration task to describe the semantics of information sources and to make content explicit (Wache et al. 2001). Thus, ontologies enable shared understanding and communication between people with different needs and viewpoints arising from their particular context (Uschold and Gruninger 1996, Devedzic 2002), minimizing ambiguity and maximizing understanding and precision in communication (Fox and

Grüniger 1994). However, the level of complexity, expressivity, and formality in ontologies may vary significantly. For example, a controlled vocabulary or a thesaurus can be considered as a simple ontology. A taxonomy or a class hierarchy -like structure with concepts and properties is, however, used more often as an ontology. Regardless of the formality or specificity of a particular model, ontologies are used to model real-world knowledge in a machine-readable, but also in a human-understandable, way.

Informally, ontologies can be regarded as vocabularies (or schemas) for metadata (Antoniou and van Harmelen 2004). That is, an ontology may contain both class definitions and instances of classes (or even metaclasses), whereas metadata is concerned only with instances (e.g. describing the data). When discussing ontologies not just for conceptual analysis but also for implementation purposes (i.e. information system development), one should note that the concepts of data, metadata, and ontology are distinct but at the same time highly interdependent and context-specific. Thus, it is not always apparent what entities in a collected formalized knowledge should be considered to belong to an ontology. In addition, it is not necessarily clear what application-specific metadata is. In any case, metadata exploitation requires knowledge about the meaning of the vocabularies and structures used in the descriptions. Thus, as it was the case with architectural descriptions, constructing ontologies from scratch is a difficult and time-consuming task, suffering especially from the information acquisition bottleneck (Omelayenko 2002). Thereby, there is a need for developing suitable tools and techniques for domain analysis (Chandrasekaran et al. 1999) to make ontologies more approachable and, accordingly, easy to use and apply.

## Genres

Where ontologies are tools to specify organizational conceptualization (Gruber 1993), genre instances can be regarded as domain specific information concepts expressed in organizational communication. Even if the concept of genre may sound confusing in the first place the underlying denotation is considerably simpler. Connecting the term into business life, genres are used and recognized in everyday responsibilities. In fact, genres can be perceived as prototypical models for communication (Swales 1990). In this sense, a genre of organizational communication represents a typified piece of information responding to a recurrent communicative situation that is not an individual's private motive (Yates et al. 1999). In practice, genres appear within and between organizations, are recognized by participating stakeholders in a certain context, carry an identified name, serve specific purposes, and to some extent enact social substance(s) and form(s) (e.g. Yates and Orlikowski 1992). Thus, genres as such have been regarded as a useful concept especially in information systems development (Päivärinta et al. 2001) through the analysis of organizational communication.

The concept of genre was selected as a basis for the domain analysis method because it captures all information flows (Spinuzzi 2001) including verbal communication, data in information systems, and paper as well as electronic documents. With the genre-based analysis method (Tyrväinen et al. 2005), information communicated within and between organizations is measured as communication per person per day and the results are represented either as proportions out of total communication volume or as absolute values. Furthermore, the volume of communicated information is measured in pages (A4 size, for example) in order to provide an equivalent criterion of displayed information regardless of the communication form used. These fundamental premises provide a realistic point of comparison not dependent on the size of an organization, the number of employees, and other such transient variables (Kilpeläinen et al. 2006), thus, producing a somewhat reliable analysis between distinct case studies (Tyrväinen et al. 2005). Thereby, the key internal operations in the success of business processes can be evaluated without technology constraints in mind.

## TOWARDS GOBIAF

Theoretical examination of the concepts of EA, ontologies, and genres seems to establish some major similarities to make them feasible candidates for integration to complement each other. That is, 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 conceptualization for what the genre-based analysis method is designed for. To put it another way, genres and ontologies are perceived here as theories, approaches, and tools to support architecture development and implementation. Altogether, the concepts form the basis for four levels that together compose GOBIAF: the business process model, information management, ontology, and enterprise architecture levels (Figure 1). Basically, the aim of GOBIAF 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 organizational scale. Therefore, 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.

Even if the overall setting sounds hierarchical, we do not want to present it that way because of the genuine need for iterative development in practice. Thus, the issues in the framework are mentally approached top-down (architecture principles set guidelines and constraints for the development process) but the actual EA definition

process takes place in a bottom-up fashion (genre analyses provide knowledge for ontologies and genre-based ontologies provide knowledge for architecture descriptions). As a result, architecture descriptions are acquired through an iterative development process that is twofold: from genres (business process model level) and information need interviews (information management level) to ontologies (ontology level) and from genre-based ontologies to BIA descriptions (enterprise architecture level). As given, this paper focuses on the latter.

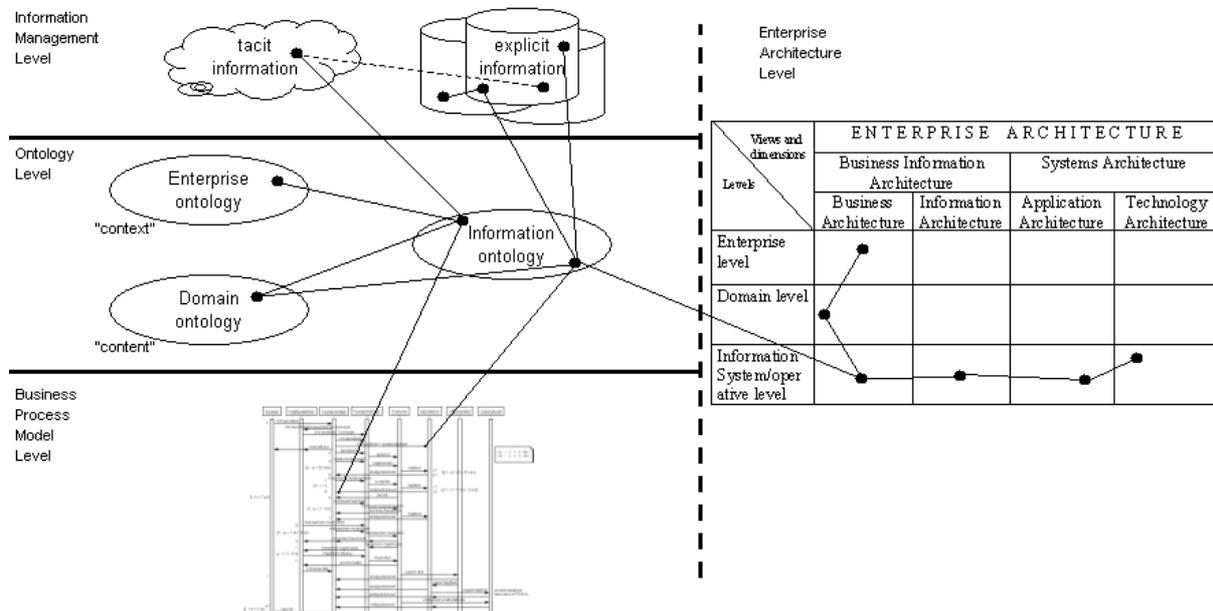


Figure 1: GOBIA framework

### Business process model level and information management level

The first step in the BIA development process is genre analysis (see Tyrväinen et al. 2005) and information needs elicitation (Kilpeläinen et al. 2006). Within GOBIAF, the main target of the genre analysis is to accomplish an extensive process model from the organizational communication point of view. Thus, the original diagonal matrix contrived in genre sessions is elaborated to the form of process description or model. To be specific, genres are collected with the process aspect in mind, i.e. depicting information flows from the beginning to the end of a business process. Thereby, the perceived sequence diagram should be taken as a rich business process description where genre instances represent activities related to specific sequence of events. In contrast to mere information flows, genres emphasize the social aspects of communication, implying human comprehension and impact to the particular communicative situation. Through this characteristic, genres provide a way to reach deep, domain-specific knowledge of informational issues that is of special interest in GOBIAF. Thus, we do not (necessarily) need any rigid business process modeling language, such as BPEL, the use of which would be a prerequisite when focusing on business process harmonization (cf. Channabasavaiah et al 2004).

Because genre analyses are concerned with organizational communication, they do not explicitly express the attributes of the technical aspects of an EA to a reasonable extent. To be specific, genre analysis reveals the existence and utilization of contemporary information systems and applications but it is not capable of, or even intended for, describing the systems in detail. Furthermore, the genre-based analysis method does not reveal the usage needs, i.e., how different interest groups are likely to use the managed information or even what that information is, or should be. Open and semi-structured information need interviews (at the information management level) are, thus, seen as prerequisites for deepening the knowledge of the existing systems. Thus, all the relevant interest groups are interviewed to get an overall understanding of the actual organization-wide daily information needs. The participants are encouraged to evaluate and rethink their operations and routines without any technology-driven constraints in mind. Once the needs of individual groups are identified, they are summarized and presented in a meeting where all the interest groups are present. This kind of procedure causes a lot of interesting discussion that is crucial for the development process as a whole. Thus, the interviews are seen as a mechanism for elaborating the needs in order to enhance the overall organizational information management.

### Ontology level

Once extensive domain analyses in both business process and information management levels are conducted, ontology construction begins to bind these distinct sources of information together. In short, the role of ontologies in our case is to define business unit-specific information concepts related to cross-organizational value-chains in pre-defined periods of time, i.e., a specific communicative action (genre), in a business process.

As already stated, this means that the results of genre analyses give overall knowledge about the present state of operational activities. It also hints of the state of organizational information management related to the information concepts, occurring in business processes. The information management level, in turn, complements the genre analysis by providing extensive information about the state of information management and related (future) requirements, as well as the knowledge of the usage of contemporary information systems, applications, and technologies underneath. Both of these aspects are modeled on the ontology level.

To support the principles described above, the ontology level complies with the division presented in (Abecker et al. 1998) where knowledge of the information creation context is linked to information content through generic information characteristics (Figure 1). Thereby, the ontology level consists of three ontologies that together aim at describing different kinds of information sources with their respective structure, access, and format properties. The enterprise ontology is aimed to provide information about business process specifications on different abstraction levels. Basically, the process models derived from genre analysis are obtained into enterprise ontology descriptions (genre instances represent communication events and, further, actors in business processes). The domain ontology, for one, presents the content of information concepts and their semantics as well as the relation to the overall organizational information resource. The information ontology, in turn, provides links between the enterprise and domain ontologies, addressing generic concepts and attributes that apply to all kinds of information within an enterprise.

Table 1 shows the role of ontologies in relation to data elements described earlier in the context of process industries (see Kilpeläinen et al. 2006). As Table 1 shows, ontology and metadata descriptions, i.e. RDF graphs constrained with OWL ontologies (see Manola and Miller 2004) to specify the concepts and/or properties (the ontology) used in metadata descriptions, together constitute a knowledge base, but with some differences compared to a traditional knowledge-based system. URIs are used as a reference mechanism so that metadata descriptions can be distributed and the annotation of a multitude of resources becomes possible. Thus, it is possible to enforce consistent ontologies and practices for metadata annotations within an organization, alleviating the challenges of logical contradictions in ontology descriptions.

		Enterprise ontology	Information ontology	Domain ontology
<b>Know- ledge- base</b>	<b>Ontology layer</b>	Metamodel for business process models	Metamodel for information categories in organizational communication	Domain concepts for a given domain
	<b>Metadata layer</b>	Business process models, i.e., business process specifications	Genres as well as information creation and utilization contexts	Equipment configurations and field information used in measurements in process industries
<b>Data layer</b>		Execution logs from a workflow management system	Document contents, metadata values, and database transactions related to genre instances	Measurement and other context specific data

Table 1: Data layers in the ontology level in GOBIAF

### Enterprise architecture level

The enterprise architecture level is graphically represented as a 3\*4 matrix with architecture views (business, information, application, and technology architectures) on the x-axis, and levels (enterprise, domain, and information system/operative levels) on the y-axis in line with FEA (CIO Council 1999) and EA Management Grid (Hirvonen and Pulkkinen 2004). Further, architecture dimensions presented on the z-axis provide different abstraction levels, viewing the total architecture description grid. In contrast to FEA and EA Management Grid, the level of abstraction of the architecture dimensions can be altered from the so-called traditional dimension (business, information, application, and technology architectures) to the BIA dimension where business and information architectures are mapped together (z-axis). The total EA contains BIA and systems architecture (SA), which consists of application and technology architectures. The organizational levels (y-axis) are included in all the dimensions to support decision-making taking place in different hierarchical levels in an organization.

The traditional dimension is intended to provide somewhat holistic and abstract information concerning the specific cells in the grid, for example in the form of organizational business and IT strategies as well as architecture design principles. That is to say, the traditional dimension is perceived as a starting point in formulating the scope of the total BIA/EA development process. According to some architectural models, this kind of an activity is referred to as process specification. The difference is that the grid in the traditional dimension, which is perceived as the ultimate architecture in (Hirvonen and Pulkkinen 2004), is used here as a common framework (or lexicon) of reference for EA initiatives to adopt the required way of thinking to be successful in EA development. In addition, the traditional dimension defines the contents of distinct cells in the BIA dimension (see Goethals 2006). It can also be said that the traditional dimension facilitates the construction

of actual, domain analysis based architecture descriptions in the other dimensions. Thereby, information presented in BIA and EA dimensions can only be used to describe the baseline as well as the target EA.

Information presented in the BIA dimension is obtained from ontology descriptions, reflecting all the relevant aspects of the domain at hand. To be specific, information provided in ontology descriptions describes the relation between activities and actors in business processes (enterprise ontology) and significant information concepts (domain ontology). As the ontology level (see the discussion before) describes different kinds of information sources with their respective structure, access, and format properties and ontology descriptions are the only mechanism for presenting information in the BIA dimension, ontologies can be taken as an architecture description language in BIA. Thereby, a knowledge base of RDF graphs constrained with OWL ontologies provides a coherent information representation mechanism that seems to be missing in the domain of EA.

Ontology descriptions are described on the Information System/Operative Level in the form of knowledge base (Table 1). To provide BIA information on the Domain Level, the abstraction level of presented information is increased to provide more holistics in the descriptions. That is, where Information System/Operative Level was intended to provide detailed information about, for example, the activity level operations in business processes, the Domain Level focuses on operations described in the business unit level. In other words, only the ontology layer (Table 1) is presented on the Domain Level. Further, the Enterprise Level is achieved by further increasing the level of abstraction, aiming to produce aggregated business and information requirements in which an enterprise is interested especially in a strategic sense. In contrast to the Domain Level, the Enterprise Level integrates the unit-specific descriptions, showing the semantics between unit-specific information concepts through which the possibilities for data level integration can be evaluated. Architectural descriptions on this level need, in many cases, declarative explanations that can be augmented afterwards to the traditional dimension to show the semantics between the architectural dimensions that, in turn, increase the readability of the descriptions.

## **APPROACH LEVEL COMPARISON TO EARLIER RESEARCH**

This section compares the presented BIA-driven approach for EA development with the existing body of EA literature. Thus, we will next provide an approach-level comparison in which we consider several elements (goals, guiding principles and beliefs, fundamental concepts, and principles for EA development process) as the most essentials of which to bring forth the characteristics of specific architectural models (Table 2). In addition, we discuss the overall contribution of the BIA-driven approach with regard to the others. A thorough comparison with the jungle of architectural approaches or models is, however, not attempted here. Instead, Business Application Architecture (BAA, Pienimäki 2005) and Service-Oriented Architecture (SOA, Arsanjani 2004) were chosen as the points of comparison for a number of reasons. Firstly, BAA is one of the first architectural models that satisfy the need to approach the total EA development from a specific single point of view. Thus, BAA is, as BIA, an aspect of total EA. Secondly, SOA has recently emerged as an architectural design paradigm, attracting a great deal of discussion in the field mainly because of its business-driven approach for architecture development. Thirdly, the models are well documented. Altogether, all the models should be taken as approaches with a specific and diverging mindset, providing a basis for EA development. In fact, the similarities and differences in the mindsets are of special interest in the approach-level comparison provided hereof.

The fundamental aim of BAA is to develop competitive IT architecture from the perspective of business critical applications. Even though BAA uses an application-driven approach in EA development, it does not explicitly state the way the total EA is, or even should be achieved. Therefore, based on the fact that BAA builds upon some famous IT architectures, it is intrinsic that the hard and soft sides of an organization remain separate due to the lack of a connective element between them. SOA, for one, builds on defining the business critical assets, which are referred to as services, to be able to provide organizational knowledge for reuse through application integration. In particular, SOA is a mechanism for defining business services and operating models and, thus, provide a business-driven structure for IT to deliver in compliance with actual business requirements (Patrick 2005) and to support horizontal business processes (Channabasavaiah et al. 2004). However, where SOA is aimed to provide integration on both information and method levels, BIA concentrates merely on information level integration. To be specific, BIA is capable of linking all the (explicit and implicit) heterogeneous business critical information (i.e., different naming practices) together. In contrast, BAA relies on commercial-off-the-shelf (COTS) applications and their potential to provide harmonized management and communication of desired information to a reasonable extent. Thus, the orientation behind the approaches is slightly different.

When comparing the approaches to a traditional EA taxonomy, BAA seems to be the most technical-oriented approach. Even though BAA clearly states the importance of business critical applications in managing business critical information, it focuses on information already managed in digital formats. Even if SOA is also an IT architecture, its direction of development is different and closer to BIA because, according to general SOA principles, business requirements must drive technology decisions. Thereby, SOA can be regarded as a business-driven approach to IT architecture, supporting the integration of business to IT as a set of linked and repeatable business tasks. This, for one, act as a baseline for achieving a service-oriented EA. Furthermore, while SOA

focuses on business process harmonization, which is the prerequisite in providing standard services, BIA seeks for better awareness and management of the (content of) information concepts that occur in those processes. Thereby, BIA represents another extreme in approaching EA development by exploiting the high cohesion of business (processes) and information needed to operate the business as the baseline. To be specific, BIA focuses on both explicit and implicit business information (Figure 1). Thus, information systems, if there are any, used for managing the information are perceived as a metadata field in describing the total information concept.

BAA	SOA	BIA
Goals		
To define a set of business critical applications required to manage information and to support business functions within an industrial segment.	To define loosely coupled and interoperable services to ensure quick, easy, and economical adaptability of IT systems to support rapidly changing business needs with improving operational efficiency within and between organizations.	To support the development of holistic information management principles in geographically dispersed environments where business processes cross the boundaries of a number of business units within and between organizations.
Guiding principles and beliefs		
Available critical enterprise applications (COTS) set the constraints for both business application and enterprise architecture development. In addition, as a consequence of selecting the application-driven approach, technology infrastructure issues are handled mainly driven by business application architecture.	Contemporary IT infrastructures can not cope with the speed of changing business requirements. Thus, existing infrastructure (i.e. implementation and access mechanisms) should be covered by a service-based interface through which all communication takes place. Interoperability issues between heterogeneous information systems are, then, no longer an issue.	Business processes today are decentralized. Therefore, it is not obvious what the communication and, consequently, the basis for EA descriptions within the business units is. When the aim is to integrate all the business information together, an analysis of the business information used in business operations should be the baseline for EA development.
Fundamental concepts and tools		
Business application architecture, business application classification model, reference model for the BAA development process	Web services, interfaces, SOAP, UDDI, WSDL, XML, BPEL	Genres, ontologies, business information architecture, open and semi-structured information need interviews
Principles for the EA process		
Existing EA frameworks are suitable for dealing with entire EAs, but they are not suitable as such for analyzing one element of an EA in detail. Thus, we should select business critical elements from an EA and focus on them. BAA is developed bottom-up through waterfall-like steps.	Combination of a top-down, business-driven approach with a bottom-up approach, leveraging legacy investments. SOA implementation requires business process and service harmonization, capsulation of legacy systems, and interface design. Thus, technology maturity must be high in terms of SOA technologies.	The issues in GOBIAF are approached top-down mentally but the EA definition process takes place in bottom-up, iterative fashion. The EA development process consists of levels in the GOBIAF, showing the semantics between them. Applying the concepts of GOBIAF in parallel attains a synergy in overall EA development.

Table 2: The results of an approach-level comparison of selected architectural models

Due to the diverging orientation behind the models, the concepts and tools used to support the architecture development process are different. In GOBIAF, the aim of ontology descriptions as an architecture description language is to describe all the information concepts within business processes and model the semantics between them, bringing the business process model and information management levels (Figure 1) together regardless of business unit boundaries. In a similar way, SOA uses high-level languages (i.e. BPEL) to define and support orchestration of fine-grained services into coarser grained, loosely coupled business services. BAA, in turn, uses a business application classification model to decrease the overlap in application portfolios and, consequently, to reduce maintenance costs. As BAA is based on graphical representation mechanisms in architecture development that do not provide metadata annotation (i.e. business application classification model), ontologies and SOA technologies seem to provide better solutions for cohesive architecture descriptions. However, the form of ontological descriptions in GOBIAF can be regarded to be more expressive and, hence, usable when compared to mere structured documents used in SOA. This is because technical-oriented SOA descriptions (i.e. program code in XML format) do not provide extensive domain knowledge in the way ontologies does by relying on domain-specific concepts and their semantics. Further, as XML is used as a protocol for exchanging business data, its binding to business process information (i.e., the information creation and utilization contexts) is weak.

One important question to consider, especially when investigating the principles for the EA development processes, is the costs of applying and deploying the approaches. In GOBIAF, 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, as stated. Thereby, early resource investments may provide savings in the later stages of EA development, implementation, and maintenance. In case of SOA, a great deal of discussion has arisen to describe its convenience of application.

However, as the actual architecture specification and the overall mindset of SOA may be regarded as its advantages, the need for high-level technology maturity in terms of SOA technologies cause problems in the implementation phase in practice. Furthermore, regarding legacy systems, SOA may require encapsulation that can be an expensive, heavy, and long-lasting task as such. In addition, independent (reusable) services must be represented as business tasks that can, then, be dynamically composed to form new business applications and process flows. However, the socio-technical structure of an organization may not support this kind of an alignment. In addition, it is not rational to think that all business critical assets can be expressed as services.

## SUMMARY AND CONCLUSIONS

In this paper, we build on findings derived from recent literature and from practical experiences, addressing the importance and usefulness of the soft side of organizations to act as a baseline in EA development. In the literature, a business information driven approach is, however, remained somewhat unexplored because most of the contemporary EA models are focusing on evaluation and development of technical aspects of total EA. The technical orientation may, however, be problematic because business is supposed to be accommodated to constraints IT poses. Further, contemporary EA models seem to focus on representing existing resources and information already managed in digital formats. However, there are whole bulks of business information that is not expressed in explicit formats but is, nevertheless, essential part in assessing organizational activities and requirements in general. Thus, when business information is used as the baseline for EA development few issues have to be taken into consideration. The first one is how to differentiate business information from its initial contexts in an efficient, extensive, and standard way. The second problem is how the semantics between the derived information set can be presented and, third, mapped to EA descriptions. The paper demonstrates how not just communication genres complement ontologies but also how genre-based ontologies complement EA descriptions, providing synergy between them to address the issues mentioned above. The core concepts and the generic steps of development process, defining the GOBIAF are presented in the paper. Further, the architecture level of the GOBIAF and the usage of ontologies as an architecture description language are specified.

The main reason for using ontologies instead of traditional enterprise architecture description mechanisms derives from the assumption that most contemporary enterprises do not develop information systems internally anymore. Instead, they acquire and integrate enterprise application packages to form a desired backbone for their enterprise. Thereby, without a formal and abstract method to describe organization-wide business information requirements, enterprises may not have control over their architectural descriptions because they have to adopt information and process models embedded in the software packages. Thus, the usage of ontologies as an information system independent enterprise architecture description language brings several advantages especially when an organization is planning to alter its actual structure and processes reported in the baseline EA. In addition to advantages in describing semantics between information concepts, ontologies also provide a shared vocabulary and point of reuse when collaborative information systems are developed based on derived architecture descriptions. This stems from the fact that enterprise models such as an ontology are, in contrast to EA, executable entities, describing EA from different points of view. Thereby, the use of ontologies in EA descriptions makes them truly valuable, not just as general blueprints of reference after completing the architecture but also in actual implementation of solutions to achieve greater efficiency. In practice, ontologies in architecture descriptions seem to provide a tool to bind the soft and hard sides of an organization closer together and, consequently, to decrease the possibility of the traditional business/IT alignment problem.

In contrast to building upon harmonized business services that are derived through rigid business process modeling and harmonization as SOA does, BIA focuses on both explicit and implicit information concepts realized in those processes. The general implication of the approach level comparison between BIA, BAA (Pienimäki 2005) and SOA (Channabasavaiah et al. 2004) is that BIA seems to be more specific in describing abstract information concepts, concentrating on business critical information concepts, and their semantics when compared to the others. As an example, if the principles of GOBIAF are applied to SOA, SOA assembles the semantically related information concepts to form services, providing organizational knowledge for reuse. In fact, as SOA is more like an enterprise model than an EA, SOA would act as an implementation mechanism for BIA descriptions. This would mean, in practice, that business processes are described by BPEL and interfaces for web services are provided for contemporary information systems. Contrary, genres and ontologies could be utilized in the context of SOA and BAA development for reaching extensive domain knowledge in a practical, effective, and efficient way. In conclusion, BIA seems to contribute as a shared mechanism to support business information based strategic and operational thinking, forcing dispersed business units to define, evaluate, and manage local business information in a collective and harmonized way.

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