Towards a Classification Framework for Very Large Business Applications

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Abstract. Classification of business application has significant effects for industry practice as well as for applied research. A correct classification of a business application leads to a better knowledge of the relevant characteristics and significantly helps in estimating several effects while planning, developing and maintaining the application. This paper provides a comprehensive classification framework for the quite new research area of Very Large Business Application (VLBA). The framework has been constructed by using the morphological method. From this classification framework, four different types of VLBA have been identified by their distinct characteristics. This result helps practitioners as well as scholars to gain a deeper and more distinct understanding of the relevant factors of VLBA.

1 Introduction

Nowadays almost all businesses run at least one business application. Such business applications usually support at least one business processes. However, business applications vary according to different dimensions. These dimensions reach from organizational dimensions (e. g. the amount of business processes they support) towards the technical dimensions (such as the software architecture). Today business applications usually support a large portion of the enterprises whole business. They handle a lot of data and frequently involve mission critical processes. They are also often used by a multitude of users within their daily work activities. To better differentiate the variety of business applications, a suitable operationalization is necessary. In 2005, the first chair for business informatics at the Otto-von-Guericke-University-Magdeburg introduced the term Very Large Business Application (VLBA) hence. Early on the chairs at the University of Oldenburg and the Technical University of Munich adopted the term for their curricula. Although early papers already introduced the term [Gr07],

[GK08], the body of literature on VLBA remained quite narrow. Presumably the rather fuzzy differentiation amongst seemingly similar terms such as business applications and large business applications is one of the reasons of this scarcity. In order to strengthen the concept comprehension, a more detailed operationalization is necessary. This should allow a better differentiation as well as a more meaningful layout of the future research.

The paper is structured as follows: in section 2, we give a brief overview on the research design of the paper. In section 3, we display the current research background on the main topics business applications and VLBA, in particular. In section 4, the classification framework is established by providing a morphological box. In section 5, the morphological box is discussed in the context of classic business applications and four different types of VLBA are identified. The paper concludes in section 6 with a summary on the work and an outlook on future research.

2 Research Design

To generate a comparative framework for business applications, first a classification is developed. A classification for a particular object is developed in two steps: first, the object has to be divided into its determining characteristics. Second, values have to be determined, which correspond to the respective characteristics [En71]. In this research, we derive characteristics and their corresponding values from two sources. First, we conducted a comprehensive literature research in the relevant areas.

Second, we conducted semistructured interviews with academic and industry experts in the area of information systems and computer science. These interviews had been analyzed on certain keywords, which determine a certain characteristic or a certain value of a characteristic. Keywords, which were not identified by the literature study, have been added to the list of characteristics and their corresponding value. At this point, the classification consists of 51 characteristics, grouped in 8 characteristics classes.

Subsequently, we used the list of characteristics and their corresponding values as a basis for the development of a morphological box according to the morphological method proposed by Zwicky [Zw89]. To achieve this, we strengthen the list of characteristics by using a reduction aligned with the DELPHI method [Se79]. This step reduced the former list of characteristics to 22 characteristics grouped in 5 characteristics classes. In the third research step, we identified typical business application by using the typological method [Kn72]. In particular, we derived four different types of VLBA with certain specific characteristic values.

3 Current Discussion on VLBA

The term “Very Large Business Application” (VLBA) was first introduced by Rautenstrauch in 2005 [Ra05]. Rautenstrauch claimed that there is a need for software engineering in business informatics as a supplement to traditional software engineer-

ing for considering the specific needs in the field of business informatics (e.g. in terms of integration engineering methodology or project management into software engineering). Rautenstrauch named this special kind of software engineering VLBA.

A first definition of a VLBA was provided by Grabski et. al [Gr07]. According to their definition, a VLBA is fundamentally a business application, but distinguishes from them in three essential characteristics. First, a VLBA supports at least one business process. This claims the strategic importance of a VLBA for an organization. Regarding Jehle et. al, a VLBA is therefore a distributed system [Je08]. Second, there are no regional, organizational, cultural and technological boundaries. While these aspects draw an interesting picture on the meaning of "very large", it is almost impossible to find any practical example for an information system covering these characteristics. Finally, a VLBA may be implemented by application systems as well as by system landscapes. This puts emphasis on the flexibility in the implementation of large information systems. In [GK08], Grabski & Krüger defined VLBAs as research topic of business informatics. VLBAs are therefore not only systems, but also a research area. Research in this field focuses on system landscapes and software architectures. Because VLBAs are strongly related to information systems (IS) [Gr07], research in the context of VLBAs focuses further on the elements of an IS: people, tasks and technology. In addition to that, the relations between the dimensions (people-tasks, people-technology and tasks-technology) are of particular importance.

Arndt and Krüger did a terminological approach to the term VLBA [AK10]. They draw parallels to other systems in business informatics and computer science as well as other scientific disciplines that deal with the term "very large". In particular, they have identified VLSS (very large scale systems), ULS (ultra large scale systems), VLIS (very large information systems) and LSDIS (large scale distributed information systems). Furthermore, they used the terms "system landscape" and "business application" in order to get to a profound definition of VLBAs. They analyzed the "Very Large Databases", "Very Large Mainframe Systems", "Very Large Sparse Systems", "Very Large Biological Systems", "Large Biomolecular Systems" and "Very Large Ising Systems/Models". They pointed out that "very large" is a relative term that cannot be determined absolutely. But the term not only describes the relative size of a system, but also refers to the actual state and target state of a system. In combination with the characteristics of system landscapes (e.g. they are historically grown) and business applications, they extend the definition of Grabski et. al [Gr07], but are still using it as a basis for their extension.

4 Classification Framework

This section summarizes our investigations on VLBA characteristics and their values. We have investigated existing characteristics and values in literature as well as a snapshot of experts' ideas. As a result we created an extended classification morphological box which consolidates our findings from both literature and experts interviews. As a third step, we analyzed the results and reduced the characteristics by using DELPHI technique. Finally, we summarized the results in a consolidated morphological box.

4.1 Characteristics derived from the literature review

In the organizational theory of economics, all business processes are mainly concentrated in one singular information system. Looking at the area of business informatics, the concept is extended to multiple information systems, which support the business processes of an organization. Beside this, information systems may also be used in an inter-organizational context [Kr05]. Following this, business applications have to be seen in an intra-organizational and inter-organizational context. We align our findings to the definition of WKWI (Wissenschaftliche Kommision Wirtschaftsinformatik), where "… information and communication systems are socio-technical systems embracing human and machinery components with the aim of optimal provisioning of information and communication regarded for economic criteria" [WG11].

Following Arndt and Krüger, four different types of information systems were identified, which provide different characteristics. VLSS (very large scale systems) are mainly described by key performance indicators, namely lines of code, development time, headcount for administration, number of transactions per day and number of database entries [AK10]. ULSC (ultra large scale systems) feature several characteristics like decentralization, different concurring requirements, heterogeneous and changing elements and vanishing frontiers between human and technology. They can be measured by certain figures like lines of code, data amount, amount of activities, number of connection, number of hard- and software elements, number of systems aims and the perceived aim of the user, number of processes, interactions and behavior characteristics, number of overlapping application areas and number of stakeholders [No06].

According to Arndt and Krüger, Very Large Information Systems (VLIS) consists of many subsystems which provide on its own simple functionality but handle an enormous amount of data and are conceived for a permanent usage and further development [AK10]. The last term of super-sized information systems – Large Scale Distributed Information Systems (LSDIS) – describes a research field of a so called center at the University of Georgia. Topics of concern are semantic web, semantic web services and processing.

As shown above the linguistic term "very large" is not sharply defined, but for the term "business application" a broad consent exist. For this reason the contribution of this paper – the classification approach of a VLBA – is founded on existing literature about business applications. In relation to the classification framework presented in this paper, most of the characteristics of the classification box were derived from Müller's morphological box of business application systems' standardization [Mü04] which is an extension of Mertens' work on information system characteristics [HN09]. Even though most of the characteristics and values are derived from Müller's work, but Müller centered his work on business applications and ERP systems rather than VLBAs. Table 1 lists all adapted characteristics from Müller's morphological box.

Main area (umbrella)	Characteristic
Integration	object, scope, direction, automation degree
Standardization	concept, standardization level, type of interface
Organization	organization type, organization units, coordination mode, application field [FT00]
IS of close sense	supported type of processes [renamed], type, type of information [extended values]
Architecture	Platform Dependency [renamed]
IT infrastructure	system landscape [renamed], hw/sw compatibility, architecture [extended values]

Table 1: Characteristics derived from Müller [Mü04]

In addition to that, we integrated the findings of Fellner & Turowski [FT00]: In their presented classification framework for business components, some of their characteristics were transferred to the classification box of a VLBA. Table 2 lists these characteristics.

Main area (umbrella)	Characteristic
Integration	degree, primary adaption mode
Standardization	domain [renamed]
Architecture	type of federation [renamed], state

Table 2: Characteristics derived from Fellner & Turowski [FT00]

4.2 Additional characteristics through expert interviews

In order to enrich the VLBA classification framework, we interviewed experts asking them their idea about "What is a VLBA?" requesting a clear explanation for each used term (see Section 2). Then we analyzed the result so that new important characteristics which are not covered by or found in literature could be excerpted for the list. Table 3 enumerates the attributes extracted from expert opinions.

Main area (umbrella)	Characteristic
Organization	business-critical; factor of success
Architecture	data- and functional redundancies, maintenance strategy
IT infrastructure	client type
Quantifiable characteristics for system sizing	[complete main area]

Table 3: Characteristics derived from expert interviews

4.3 DELPHI reduction

The summation of the previous two steps had led to a comprehensive classification framework, that includes a long list of characteristics and values. Due to the nature of

this method, the resulted box contained some duplications and unclear characteristics and values so we applied the DELPHI method to strengthen our result.

First we asked our group of experts to highlight each characteristic and its values using a set of colors as shown in Table 4. The aim was to measure the importance of each characteristic and value for a VLBA based on the experts' opinions. Since the question was about any VLBA so multiple selections with the same color for more than one value of the same characteristic was allowed.

RED	Less appropriateness & importance for a VLBA
Yellow	Middle appropriateness & importance for a VLBA
Green	Highly appropriate & important for a VLBA
Gray	Delete from the box
White	Not appropriate for a VLBA

Table 4: Colors used in first round of strengthen the VLBAs' classification morphological box

All the results were consolidated into one new box and a second round of expert discussion was conducted with a smaller group of experts. In this second round four main steps were carried out:

1. Analyzing the result
2. Agreement on the degree of appropriateness and importance of the characteristics and their related values
3. Finding an umbrella for each characteristic, and
4. Deleting the duplications.

Finally, a fine tuning final discussion round with a group of experts was carried out. The box was reshaped again and the experts agreed use the gray color scale to ease positioning as shown in Table 5. In addition, all characteristics with no distinguishing effect on VLBAs have been eliminated (e.g. all characteristics under the standardization umbrella).

Gray 50%	Highly appropriate & important for a VLBA
Gray 25%	Less appropriateness & importance for a VLBA
White	Not appropriate for a VLBA

Table 5: Colors scale used in the final VLBAs' classification morphological box

4.4 Morphological box

Table 6 presents the final result of the VLBAs' classification morphological box. This box is a first attempt to help categorizing whether an information system or business application is a VLBA or not.

Characteristic		Values						
Integration	Object	system landscape	business application	components	Services	middleware		
	scope (as organizational aspect)	internal	super-company	inter-company	prosumer			
	primary adaptation mode	core changes	customizing	plug-in system	configuration			
	process automation degree	non	semi-automated	highly automated				
Organization	granularity of organization units	single company	multi corporate enterprise	network company	company	division	department	role
	business-critical; factor of success	not business critical	minor impact on business	severe impact on business	highest impact on business (mission-critical)			
	supported type of processes	primary	Secondary					
	task type	operative	tactical	strategic				
Architecture	platform dependency	dependent	independent					
	type of composition	integrated	federated					
	application state	non persistent	persistent	stateless				
	data & functional redundancies	yes	No					
Infrastructure	system landscape	homogeneous	heterogeneous					
	Architecture	client-server	peer-to-peer	SOA				
Quantifiable characteristics for system sizing	business process change reaction time	low	middle	high				
	daily number of executed transactions	low	middle	high				
	number of user	low	middle	high				
	amount of served users Simultaneously	few	mid-sized	many				
	number of software dependencies / grade of centralization	few	medium	many				
	effort to obtain fast response time	low	medium	high				
	amount of database data	small	medium	large				
	number of used external system Interfaces	low	middle	high				

Table 6: Morphological box for VLBA

This classification box is meant to be as understatement for further discussion. Knowing that a broadly accepted imagination of a VLBA is still missing this classification box can be used to check if a business application has VLBA characteristics or even is a VLBA (based on our classification box).

When multiple values of a characteristic are highlighted then different kinds of VLBA instantiations might exist: the shade of grey hereby underlines the appropriateness and importance for a VLBA (see Table 5). Two business applications in an organization might be considered as an example: one system is an ERP system, the other is a supply chain management (SCM) system. The ERP system runs stand alone, the SCM is integrated into the application landscape concerning the organization and its suppliers. In our comprehension, a VLBA normally is an integrated system. But the fact that a system runs independently might not be a disqualifier for a VLBA. Although it is atypical in reality to have very large scaled/sized stand-alone systems there might me stand-alone VLBA instantiations so the ERP system could still be a VLBA when other characteristics matches.

In addition to that, if the ERP system handles exclusively simple business processes or the system has to be fully reinstalled for maintenance purposes it cannot be considered as a VLBA anymore. Non-highlighted values in our classification contribution are designated for VLBA disqualifiers.

5 Discussion

The main idea of the provided classification framework is to gather all possible characteristics that differentiate a VLBA as a subset of business application according to definitions of IT experts of the business application area. As a result, there are three categories of characteristics which have to be considered:

- Application (A)
  Technical characteristics describing technical requirements of a Business Application and system landscape; This category contains the group characteristics “integration”, “architecture“, and „infrastructure“. These kinds of characteristics answer the question: what technical characteristics a VLBA should have?

- Business (B)
  Business and organizational characteristics describing the relevance of the business application for an enterprise; This category contains the group characteristic “organization“. They answer the question: how far is the relevance of a business application for an enterprise to meet its business objectives?

- Countable (C)
  Quantifiable usage of characteristics for system sizing. The characteristics measure the volume of a business application at its productive phase and show how big and fast a system expands and reacts by daily usage in a company. This

category contains the group characteristic “quantifiable usage characteristics for system sizing “.

The most important question now is how to define a business application as a VLBA based on the evaluated characteristics delivered by the morphological box shown in Table 6. To answer this question we propose four kinds of business application classes depending on their hit ratio related to the listed characteristics.

1. VLBA: is a business application which contains all characteristics of categories A (application), B (business), and C (countable) with high value.
2. Partial VLBA: is a business application which matches most characteristics of categories A, B, and C with high value.
3. Potential VLBA: is a business application which matches mostly the characteristics of category A and matches few or most characteristics of categories B and few of C. A potential VLBA is a business application which fulfills technical requirements for a VLBA but would not exploit one's full potential.
4. Non VLBA: is a business application which matches few characteristics of all categories.

Based on above listed classes a Business Application can now be classified into VLBA, Partial VLBA, Potential VLBA or no VBLA. Furthermore, it is important to take into account that this rough classification of VLBA is just meant to demonstrate the key idea of this classification approach rather than to claim shared acceptance. There are many aspects which have to be further discussed and analyzed. For example, weighting of different characteristics are not considered yet. This means that all characteristics have the same importance value. Another aspect is the aspect of the variety and selection of provided characteristics. The provided characteristics are extracted from different definitions of business application, different literature sources as well as experts knowledge. Therefore, further empirical studies and questionnaires are needed to validate those characteristics.

6 Summary and Outlook

Aim of this paper was providing a comprehensive classification framework for Very Large Business Application (VLBA). To achieve this, a broad literature study has been conducted to identify specific characteristics and their corresponding values. These first results have been reduced by assign an adopted DELPHI method, including experts’ opinion on the derived characteristics. Bases on this result, a morphological box has been developed to serve as a classification framework. While discussing this classification framework, four different types of VLBA have been identified.

This result has several implications for industry practice as well as further research. In an industrial context, the classification framework helps companies to identify the complexity of business applications and/or information systems landscape. This complexity identification helps companies to estimate the risk in undertaking changes in the business applications and to ensure an appropriate risk and change management. For further research, die results helps at first to structure the complex research field

for VLBA. By identifying the key factors for VLBA, further research is able to focus on these issues and to concentrate on providing specific solutions, which may be embedded into the broader context of VLBA research by applying the classification framework.

Next research steps are the evaluation of the classification framework against industry applications and market classification. Furthermore, the classification framework for VLBA should be aligned with other classification frameworks for business applications to identify possible overlapping and differences. This may lead to a global classification for every type of business application and/or information system landscapes as reference classification.

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