

# STUDY OF BUSINESS INTELLIGENCE SYSTEM QUALITY

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**Abstract** - IT has made remarkable progress over the last years. Business intelligence systems have been developing as an important part of IT. Enterprises often fail to realize importance and necessity of implementation of business intelligence solutions. This paper will deal with approach for assessment of business intelligence in enterprises, based on maturity models. The significance of this paper is in development of new conceptual research models which do not apply the usually thesis on maturity models.

**Keywords** - Business intelligence, information logistics, maturity model, scientific research design.

## I. USE OF QUANTITATIVE ANALYSIS FOR DEVELOPMENT OF BUSINESS INTELLIGENCE CAPABILITY MATURITY MODELS

Since the term business intelligence was first used its meaning has greatly changed and widened. This term is usually used for applications related to business intelligence and for tools used for development of such applications, it is also used for online analytical processing systems (OLAP) [1][2].

Maturity models represent widely accepted technique for guidance of enterprises based on the best practice. [3], [4]

	Rohner 2009]. Each dimension of a maturity model is further determined by number of characteristics (practice, measures, activity) on each level [Fraser and co-authors 2002].
<b>Level</b>	Levels are archetypal conditions of assessment subject's maturity. Each level should have different characteristics (of practice, measures and activities according to dimensions) which may be empirically tested [Nolan 1973].
<b>Maturity principle</b>	Maturity models can be continuous or based on phases. Continuous models enable assessment of characteristics on different levels, while phase models facilitate assessment of characteristics of different elements which have to be on the same level of maturity [Fraser and co-authors 2002]. Therefore, in continuous models, maturity may be determined as sum of individual results or an individual level in different dimensions may be determined. On the other hand, phase model clearly specifies set of goals and key practices that should be implemented to achieve certain level.
<b>Assessment</b>	Approaches to be used for maturity assessment purposes are qualitative (interviews) or quantitative (questionnaires with Likert scale).

TABLE I  
 MATURITY MODEL CHARACTERISTICS [5], [6], [7]

Characteristics	Description
<b>Assessment of maturity subject</b>	Maturity models enable assessment of maturity of various systems, most often from the field technology [Popovic and co-authors 2009], processes [Chrissis and co-authors 2003; Paulket and co-authors 1993b], perssonel and labour [Curtis and co-author, 2010] and project management or knowledge management [Crawford 2006; Paulzen and co-authors 2002].
<b>Dimensions</b>	Dimensions are specific capabilities of an area describing different aspects of assessment subject maturity. Dimensions should be finite and distinctive at the same time [Mettler,

Data analyzed in this study have been collected by using online questionnaires. Assessment objective is to apply maturity model in practice, and to see its application in real situations.

## II. SITUATIONAL MODEL OF BUSINESS INTELLIGENCE SYSTEM MATURITY

Lately, various systems for assessment of business intelligence systems maturity have been developed. To analyze impact of different contextual factors on business intelligence maturity models, four models of business intelligence for two contextual factors have been developed in this paper. Two important factors have been determined: enterprise size and environment. These two

factors may be observed from two perspectives, with enterprise size being an internal, and environment an external factor .

Enterprise size implies resources base which have impact on business intelligence system, actually information available to business intelligence systems .

Environment implies business competition, and all business situations the enterprise operates. Data necessary for the analysis have been obtained from online questionnaires.

TABLE II  
SAMPLE CHARACTERISTICS

<i>Type of industry</i>	<i>Abs.</i>	<i>%</i>	<i>Employees</i>	<i>Abs.</i>	<i>%</i>
Service	39	55	1-50	6	8
Non-service	29	41	50-500	15	2
Not available	3	4	500-1000	5	7
Total	71	100	1000-5000	12	1
					7
<b>Examinee function</b>	<b>Abs.</b>	<b>%</b>	5000-10000	9	1
Business	10	14	10000-50000	15	2
IT	36	51	More than 50000	4	6
Mixed	23	32	Not available	5	7
Not available	2	3	Total	71	1
					0
					0
Total	71	100			

In regard to enterprise size, the same have been divided into small (less than 1000 employees) and large. There are five degrees of division .

In smaller enterprises decentralized structure is currently in use, without any possibility for standardization. The fact is, nevertheless, that business intelligence is already developed in small and medium-sized enterprises, but it is only used by the top management of small and medium sized enterprises.

Large enterprises are noticeably oriented towards centralized management and business intelligence is available on all management levels. In technical and infrastructural sense, there is great progress towards centralization and implementation of adequate information systems.

Within larger enterprises a third level may be added, that would represent the top of large enterprises, which is a high level in this field. Management of such enterprises is completely oriented towards business intelligence solutions. Business operation of these enterprises is based on IT solutions, and the management constantly works on improvement of technological solutions and follows new IT standards. Such enterprises are often sponsored by manufacturers of IT solutions, and this also contributes to greater technological development.

On the fourth level are enterprises that base their business operations entirely on business intelligence,

which is used by high level and medium level managers in the enterprise .

To achieve the highest, fifth level all business operations have to be based on business intelligence, and that would include enterprises of all sizes and all levels in the enterprise organizational structure.

### III. MEASUREMENT OF BUSINESS INTELLIGENCE MATURITY

The goal of this part of study is to determine the approach to measurement of business intelligence system maturity in organizations, and thus perform operationalization of our existing business intelligence model.

New principle for assessment of maturity has been found. According to it maturity is assessed based on 25 items, and organizations are divided into 5 levels of maturity. Data often show that instead of 5 maturity levels there are only 3 levels. Studies also show impact of business intelligence on enterprise's business benefits. The fact is that increase of business intelligence results in increase of enterprise business benefits.

TABLE III  
OVERVIEW OF EXISTING MODELS OF BUSINESS INTELLIGENCE MATURITY[8]... [21]

no.	Name (year)	Source	Origin
1.	Watson et al. (2001)	[Watson et al. 2001]	Science
2.	SAS (2004, 2009)	[Hatcher, Prentice 2004; Sas Institute 2009]	Practice
3.	Eckerson (2004, 2009)	[Eckerson 2004; Eckerson 2009]	Practice
4.	SMC (2004, 2009)	[Chamoni, Gluchowski 2004; Schulze et al. 2009]	Practice
5.	Cates et al. (2005)	[Cates et al. 2005]	Science
6.	Dataflux (2005)	[Dataflux 2005]	Practice
7.	Sen et al. (2006, 2011)	[Sen et al. 2011; Sen et al. 2006]	Science
8.	HP (2007, 2009)	[Henschen 2007; Hewlett 2009]	Practice
9.	Gartner (2008)	[Rayner, Schlegel 2008]	Practice
10.	Teradata (2008)	[Töpfer 2008]	Practice
11.	BIDM (2010)	[Sacu, Spruit 2010]	Science
12.	EBIMM (2010)	[Chuah 2010]	Science
13.	Lukman et al. (2011)	[Lukman et al. 2011]	Science

Data for analyzing of data in this part of study have been obtained by using online questionnaires.

TABLE IV  
 SAMPLE CHARACTERISTICS

Industrial sector	n	%	Employee s	n	%
	o.			o.	
Automotive	1	12.	1-250	2	21
Services	2	21.	251-1000	9	9.
Financial services	1	18.	1001-5.000	1	17
Public	7	5	5.001-10.000	6	.4
IT and communication	4	4.3	> 10.000	1	10
Retail and wholesale trade	1	16.		3	38
Other industries	5	3		5	.0
	7	7.6	Not available	2	2.
	1	19.	Total	9	10
<b>Total</b>	9	10			

Organizations on a higher level of business maturity are able to generate greater business benefits than organizations on a lower level of business intelligence system maturity [1]. The manner of measurement of business maturity by using 25 items may be used in further empirical researches.

#### IV. BUSINESS INTELLIGENCE MATURITY – DEVELOPMENT OF STRATEGIC TOOL BASED ON THEORY OF INFORMATION SYSTEMS SUCCESS AND MATURITY POSSIBILITIES

In order to understand information systems such as business intelligence systems concepts have to be developed [2].

The objective of this research project is to connect practical and academic knowledge.

The project's goal is to monitor maturity development from theoretical basis, through practical skills to development of an instrument for measuring of maturity.

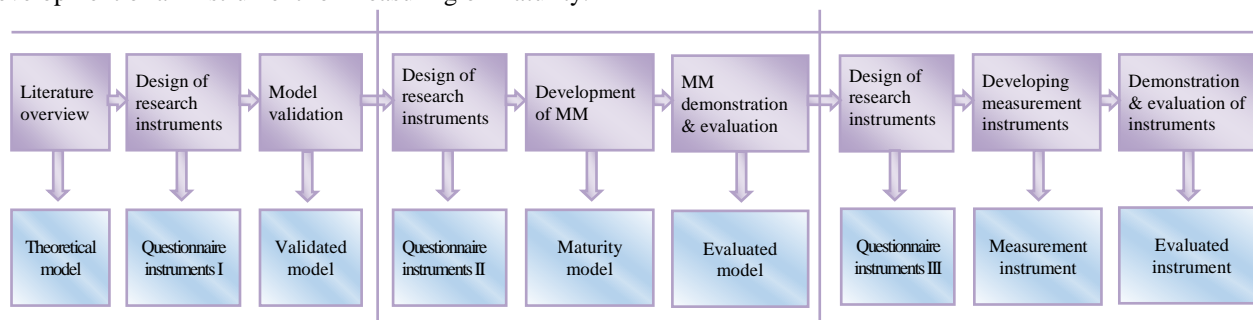


Fig. 1 Research design [4]

In the first phase of research literature related to the project's subject is reviewed. Theoretical basis explain the connection between development of business intelligence and output in enterprises and organizations.

In the second phase maturity model is being developed. It provides guidelines on the manner the

scientific intelligence is to be improved in order to increase output in organizations.

In the third phase instruments for measurement and control of business intelligence system maturity are developed. In this last phase control is being conducted by sampling and measuring of maturity level by using the instrument that has been created.

Data for this project (testing of maturity model) have been obtained at a scientific conference. Forms were usually filled in by executive managers and other members of organizations' management.

The main objective of this study is to establish adequate basis for development of business intelligence maturity model. Data show that they are completely adequate for the subject of the study, therefore the study may be based on this maturity model.

Obtained results may be observed from both practical and scientific point of view. In practical sense they help increase of business intelligence and organization productivity. In terms of science, the model may serve as basis in further studies of business intelligence.

#### V. EVALUATION OF BUSINESS INTELLIGENCE MATURITY. RELIABILITY PERSPECTIVES MODEL

In order to show that the conducted studies are applicable in practice and contribute to development of business intelligence, and increase of organization's productivity, reliability model that would document this needs to be developed.

In this section, maturity model and measurement instrument will be evaluated. Evaluation is divided into two parts. In the first part, reliability of the maturity model and instrument for its assessment are evaluated, and in the second part these researches are assessed from the point of view of their usefulness.

Data for this analysis have been obtained at a business intelligence practitioners conference.

Once the data were analyzed it has been concluded that the first step research shows that the reliability of the maturity model and its measurement instrument is satisfactory. Second step research also shows that the model is useful from the practitioner's point of view, with small limitations which do not compromise the model's efficiency.

VI. HOW WELL DOES THE BUSINESS INTELLIGENCE MODEL ASSESS THE ORGANIZATIONAL REALITY

To evaluate the model and determine the model's maturity level, research has been performed in four organizations. Obtained data have been analyzed, and then compared with the results obtained by the maturity model measurement instrument.

The goal of research is to show that the results obtained concur with the maturity measurement instrument results.

To perform evaluation it is necessary to choose appropriate enterprises as a sample. The sample should contain enterprises of all five levels defined earlier. For the data to be relevant as much as possible random sampling should not be applied. Sampled enterprises perform different activities in order to make the research more general. Four groups of organizations were chosen according to their similarity, and then one organization was chosen from each group. The groups from which organizations were chosen are: medium maturity of business intelligence in organization, organization on medium maturity level, but with advance in operational areas, organization with high level of function maturity and one organization with low level of business intelligence maturity.

TABLE V  
ORGANIZATIONS – CASE STUDY CANDIDATES

<i>Maturity scenario BI</i>	<i>Number of employees</i>	<i>Turnover</i>	<i>Industry</i>
Low maturity	7.000	2.7 billion euros	Primary materials
Medium maturity	10.600	2.3 billion euros	Wholesale and retail trade
Medium maturity with progress in operational areas	21.000	3.4 billion euros	Mechanics
<b>High maturity</b>	62.600	20.7 billion euros	Financial services

VII. CONCLUSIONS

The research shows that the results obtained are satisfactory, however, certain limitations have been discovered regarding our research approach. Limitations are reflected in the fact that the results obtained by our business maturity measurement instrument cannot be compared with the results of other instruments.

In this manner we have demonstrated that the conducted research was effective in measuring the business maturity, but that its precision cannot be determined in relation to other researches' measurement instruments.

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