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Melissa Hartsink

Frank van Outvorst

Matthijs ter Braak

Benny ME de Waal

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Does Quality Influence the Required Capacity of Business Information Management? The Case of Agriculture

MELISSA HARTSINK, FRANK VAN OUTVORST, MATTHIJS TER BRAAK & BENNY M.E. DE WAAL

Abstract In order to be able to optimise the usage of IS/IT services within an organization, the Business Information Management (BIM) role is pivotal. Many organizations struggle to determine what the required number of staff for the BIM department should be. In earlier research a preliminary model to determine the required capacity of BIM was designed. In this paper the model is validated within a specific industry: the agricultural sector. From a sense that quality of IS/IT services might influence the relationship between the determining factors in the model and the required capacity for BIM, also research is conducted to analyse if quality of IS/IT service interferes with determining the required BIM capacity. As part of a literature study seven aspects of quality were found which provide a good overview of the quality of the IS/IT service within an organization. These seven aspects were included in a survey which had 37 respondents from organizations within the agricultural sector. Data was collected about a set of eight determining factors that were taken from prior research and about quality of IS/IT. Based upon these data correlations were tested. The first connections were tested by using Pearson's product-moment correlation coefficient which showed a significant correlation between several factors and the number of FTEs. After which a multiple regression-analysis was done to check if the number of FTEs for the executive processes would increase or decrease when the number of business processes increases or decreases. The quality of the IS/IT service doesn't seem to influence the relationship between the several factors and the number of FTEs investigated in this research. This research shows that the quality of IS/IT service has no influence on determining the required capacity of a BIM department.

Keywords: • Quality • Business Information Management • Capacity • Agriculture • Quantitative research •

CORRESPONDENCE ADDRESS: Melissa Hartsink, University of Applied Sciences Utrecht, Utrecht, The Netherlands, e-mail: melissa.hartsink@student.hu.nl. Frank van Outvorst, University of Applied Sciences Utrecht, The Lifecycle Company / ASL / BiSL Foundation, Research Centre for Innovation and Business, Utrecht, The Netherlands, e-mail: frankvanoutvorst@hotmail.com. Matthijs ter Braak, University of Applied Sciences Utrecht, Utrecht, The Netherlands, e-mail: matthijs.terbraak@student.hu.nl. Benny ME de Waal, PhD, Assistent Professor, University of Applied Sciences Utrecht, Research Centre for Innovation and Business, Utrecht ,The Netherlands, e-mail: benny.dewaal@inter.nl.net.

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1 Introduction

The relevance of information technology (IT) is still growing. Usage of information systems (IS) and IT services is increasingly penetrating into the core of organizational performance and expenditure on IS/IT is high (e.g. Göbel, Cronholm and Seigerroth, 2013). As a consequence of this the demand for business information management (BIM) as an instrument to govern, direct and control the use of information technology and information systems from a business perspective is growing as well (Johnsson, 2017). In many organizations the responsibilities of business information management are concentrated into a BIM department. To optimize the usage of IS/IT within a company it is necessary to have an adequate number of personnel within the BIM department to let the BIM processes work accordingly. Even though this seems obvious, many organizations struggle to determine the required number of staff of their BIM department. Without an adequate number of staff, there is a risk that the BIM department can't perform the BIM role adequately and cannot meet the expectations. BIM managers are seeking for an instrument that helps them determine the required BIM capacity and the relationship with the quality of IS/IT services. This is also visible in the agricultural sector. There is a lot of demand for improved agricultural technologies such as fertilizing, seeding and cropping techniques (Aker, 2011). Therefore the agricultural sector is interested in finding out how many budget they should allocate for BIM. Earlier research indicated that a set of 20 ICT factors can help to determine the capacity within a BIM department (Van Outvorst, De Vries and De Waal, 2016). More recent research from 2018 shows that eight of these factors are relevant for collecting in an easy way data about these factors (Van Outvorst, Meijnen, Timens, Walenbergh, & De Waal, 2018). Therefore, in this research we look for relationships between these ICT factors and the required capacity of BIM and the influence of the quality of IS/IT services on these relationship.

The following section of this paper discusses the theoretical background of the capacity of the BIM department and the quality of IS/IT. After that the research method and findings are presented. This paper ends with conclusions and discussion.

2 Theoretical Background

2.1 Required capacity of BIM

Based on earlier research on the required capacity (meaning the required number of staff for the BIM department) for the BIM function, three main categories were classified which could have influence on the required capacity: 1) complexity of the user organization, 2) complexity of the BIM department, and 3) complexity of the information systems landscape (Van Outvorst, De Vries & De Waal, 2016; Achmea et al, 2009; Quint Wellington Redwood, 2014; Van der Pols, 2009; Rakhorst, 2013). Further research showed that within these categories eight factors appear to be the ultimate set that affects capacity (Van Outvorst, Meijnen, Timens, Walenbergh and De Waal, 2018). These factors are:

- Number of users of IS/IT;
- Number of Stakeholders involved with IS/IT;
- Size of IT projects;
- Number of IT projects;
- Number of Processes that are supported by IS/IT;
- Number of applications;
- Functional stability of the applications;
- Technical stability of the applications.

2.2 Quality of IS/IT

The quality of information systems and supporting or underlying IT services (IS/IT services) has so far been mentioned in research (Van Outvorst, Meijnen, Timens, Walenbergh and De Waal, 2018) but was not yet tested to full extent. According to Van der Pols et al. (2012) business information management controls the quality of IS/IT services by execution of one of the BIM processes: the process of demand management. This process aims at having the information systems connect to the business processes in terms of employees/end users, information to be used in the business processes, the process flow of the organization and the environment of the organization. Johnsson (2017) describes that information services provide the necessary information to an organization. Information services consist of 3 components: functionality, data & technology and support of the business processes. Quality of support of the business processes is one of the four aspects that are commonly examined when managing the information service and is determined by the need for information. Taale (2004) states that there are four aspects that can be distinguished on which a qualitative judgment about IS/IT services can be made: 1) the information provided, 2) the information-processing process as part of the relevant system, which must provide qualitatively sound information, 3) the design and development process that provided the information management system in this case as a product, and 4) the way in which the management and maintenance of the information management system are embedded in the organization. Delen and Rijsenbrij (1990) have a description of the quality aspects that are recognized for assessing an information system. They categorized four quality aspects: 1) Process - development of the information system, 2) Static - intrinsic properties of the information system and documentation, 3) Dynamic - functioning of the information system for the user, and 4) Information - as output. The ISO 25010 standard (SYSQA B.V., 2012) state that three perspectives exist for IS/IT quality management: 1) Quality of Use, 2) Product Quality, and 3) Data Quality. Looijen and Van Hemmen (2017) state that quality of information systems is determined by the requirements and prerequisites that an information system must and should meet. In order to establish if the requirements are met business information management must measure if the formal qualitative and quantitative quality standards are met. A reference model for this can be found in ISO 20000 according to Looijen and Van Hemmen (2017).

The NOREA (Nederlandese Overheid Referentie Enterprise Architectuur) model (Van Bienen, Noordenbos & Van Der Pijl, 1998) offers an overarching model for the quality of IS/IT services. This model states that there are seven aspects of quality. Measuring these aspects provides a proper overview of the extent of the quality of IS/IT services. The following seven aspects are defined:

- Effectiveness: The extent to which IS/IT services are in accordance with the requirements and goals of the end users and to the extent of which an object contributes to the organization objectives, as laid down in the information strategy;

- Efficiency: The relation between the realized costs and the budgeted costs for the IS/IT services. The budgeted costs are the costs that are intended to realize the desired performance level of the IS/IT services;
- Exclusiveness: this is the extent to which only authorized persons or equipment use IS/IT services through authorized procedures and limited powers;
- Integrity: this is the extent to which the data within the IS/IT services are in accordance with the depicted reality;
- Verifiability: this is the extent to which it is possible to obtain knowledge about the structuring (documentation) and operation of the IS/IT services;
- Continuity: this is the extent to which the IS/IT services are continuously available and data processing can proceed undisturbed;
- Controllability: this is the extent to which the IS/IT services management can be controlled so that they can meet the requirements.

2.3 Conceptual model

Earlier research (Van Outvorst, De Vries and De Waal, 2016) describes the responsibilities and roles of the BIM function based upon the Business information Services Library (BiSL) (Van der Pols et al 2012). The number of staff required to fulfil these responsibilities and roles is defined as our dependent variable. According to Van der Pols (2017) the BiSL framework defines three levels of responsibilities of BIM: 1) operational level: daily support of usage of information systems and determining new developments of information systems; 2) steering level: demand and contract management and management of time and money and 3) executive level: business governance of IS/IT.

This paper investigates the influence of specific ICT factors on this required BIM capacity. In the conceptual model these are modelled as eight independent factors (see Figure 1). As explained earlier, the relationship between the eight factors and the required capacity can be influenced by the level of quality of IS/IT services. In the conceptual model this is depicted as a moderating variable.

In the next section we describe how the research was conducted to test our conceptual model.

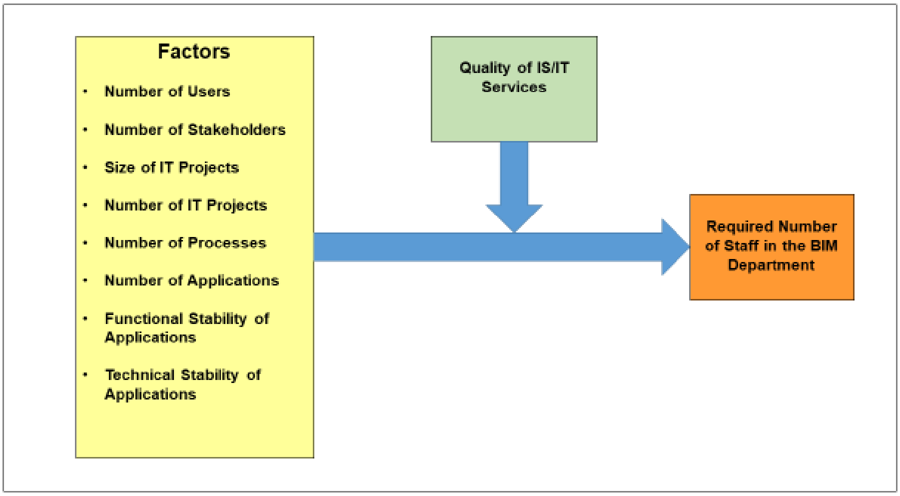

Table 2: Comparison of different leading international oncology inforamtion systems (OIS) in Australian context

3 Research method

3.1 Data collection

To investigate the influence of quality of IS/IT service on the relation between the eight relevant determining factors and the required capacity of BIM a survey was sent to 39 different companies of which 37 participated in the research. The companies were selected through the personal network of one of the researchers and convenient sampling. The data was collected in November 2018. All the organizations were located in the agriculture sector or were closely connected with this industry. For example, one ICT company was contacted that developed special software for the agriculture sector. The size of the organizations ranged of 1 to 5000 FTE's. The business functions of the respondents were all related to IT/IS management and the respondents were familiar with the concepts in the questionnaire.

3.2 Operationalization of quality of IS/IT service

The questions about the 8 determining factors were based upon the survey from previous research (Van Outvorst et al, 2018), although some questions were made more specific, in order to get unambiguously comprehensible questions. An important supplement to the survey was the addition of questions about the quality of IS/IT services. In the theoretical part of this paper we found seven aspects of quality of IS/IT services. By measuring these seven aspects within an organization, the IS/IT quality can be measured. The seven aspects were converted to seven questions to be measurable within organizations. The questions could be scored on a scale of 1 to 10. The questions were (translated from Dutch):

- Effectiveness: which grade would indicate to what extent the IS/IT quality is in line with the requirements and objectives of the users and the entire organization?
- Efficiency: which grade would indicate the extent to which the budgeted costs of the quality of IS/IT services correspond to the realized costs?
- Exclusivity: which grade would indicate the extent to which only authorized persons use IT processes through authorized procedures?
- Integrity: which grade would indicate the extent to which the quality of IS/IT service is in accordance with the reality depicted?
- Verifiability: which grade would indicate the extent to which it is possible to obtain knowledge about the documentation and operation of the IS/IT?
- Continuity: which grade would indicate the extent to which the IS/IT service is continuously available without the progress being disrupted?
- Controllability: which grade would indicate the extent to which the quality of IS/IT can be controlled , so that the IS/IT service can continue to meet the requirements set?

All questions were designed by the junior researchers independently and were reviewed by the senior researchers on comprehensibility. Assuming that all aspects are equally important, the quality of IS/IT service was calculated as the mean of the scores on the seven aspects.

4 Results

In this section the results of the survey will be presented. In Table 1, the outcomes of each variable are indicated.

Table 1: Results of variables

Variable	Average	Standard deviation	Minimum value	Maximum value	Mode	Skewness
Capacity operational processes	4,68	4,82	0,20	20	2 (1)	1,71
Capacity executive/ steering processes	2,65	2,55	0,20	13	2 (1)	2,39
Capacity all processes	7,47	7,00	0,00	28	4	1,70
Number of users	138,05	248,87 (2)	1,00	1400	15	3,88
Number of stakeholders	37,06	90,75 (2)	1,00	500	10	4,39
Size of IT projects	2,01	0,44	1,10	2,70	2	-0,49 (7)
Number of IT projects	5,39	5,26	0,50	25	3	1,86
Number of processes	49,61	74,19 (2)	1,00	300	5	1,90
Number of applications	14,58	13,27	2,00	70	5	2,60
Functional stability of applications	8,01	10,38	0,50	50	2	2,33
Technical stability of applications	4,94	6,96	0,00 (3)	30	2	2,96
Quality of IS/ IT service	6,97 (5)	0,96 (4)	4,00	9	7	-0,55 (6)

1. In Table 1 several interesting findings can be seen: The mode is two for the number of FTEs for operational processes, but also for the number of FTEs for steering and executive processes. Most of the organizations have 2 FTEs;
2. Especially the number of users, but also the number of stakeholders and processes, show a large deviation. The number of users, stakeholders and processes are very different per organization;
3. At least one organization has IS/IT that is always available;
4. The standard deviation is not large for the quality of IS/IT;
5. The average figure of the total quality of the IS/ IT service management is 7;
6. The variables 'size of projects' and 'all quality aspects' have a value between -1 and 1 in relation to the distribution. These variables have a reasonable to good normal distribution.

To answer the research question on the relation between the eight factors of ICT and the required capacity of Business Information Management function, we first performed a Pearson correlation analysis on the data from the 37 organizations. The results of the test are shown in Table 2.

Table 2: Correlations between eight factors of ICT and the capacity of Business Information Management

	Capacity operational processes	Capacity of executive/steering processes	Capacity of all BIM processes
Number of users	0,189	0,121	0,168
Number of stakeholders	0,176	0,130	0,168
Size of IT projects	**0,398***	0,254	**0,375***
Number of IT projects	0,019	0,049	0,020
Number of processes	**0,430***	0,229	**0,378***
Number of applications	**0,344***	0,191	0,297
Functional stability of applications	**0,351***	0,100	0,274
Technical stability of applications	0,101	0,138	0,109

The findings show a moderate significant relationship between respectively Project size (0.40), Number of processes (0.43), Number of applications (0.34), Functional stability of applications (0.35) and the Capacity of operational processes. The overall Capacity of BIM processes has only a moderate significant relationship with Project size (0.38) and Number of processes (0.38). The capacity of strategic and steering processes has no significant relationships with the eight factors of ICT. All the significant relationships can be interpreted as mere moderate, according to statistical research theory (Field, 2013).

As described above, the main hypothesis that was tested concerns the relationship between the eight factors of ICT and the capacity of the BIM function and the moderating effect of quality of IS/IT services. Assuming linearity, we can model this hypothesis into a regression equation in which quality of IS/IT services is a pure moderator, influencing the shape of the relationship between the eight factors of ICT and the capacity of the BIM function (cf. Sharma, Durand, and Gur-Arie, 1981). The regression model can be written as:

$$\text{Capacity of BIM function} = \alpha + \beta 1 \text{ ICT Factor}_n + \beta 2 \text{ ICT Factor}_n \times \text{quality of IS/IT service} + \varepsilon$$

From this equation, it is to be expected that the main effect of an ICT factor (ß1) will be not significant, and we also explored whether the interaction effect between an ICT factor and quality of IS/IT service (ß2) had an additional (net) significant effect, in accordance with the hypotheses. Before presenting the subsequent results of the regression analyses, we checked that both the dependent variables (capacity of the BIM function) and the independent variable (ICT factors) were normally distributed. The basic descriptions of the variables are in Table 1.

Table 3: Regression analysis: Predictive power of ICT Factors and Capacity of BIM function for IS/IT Quality Management (N=37)

	Operational Capapcity		Executive/Steering Capacity		Total Capacity	
	Coefficient	p	Coefficient	p	Coefficient	p
Users	-1.25	.37	-.23	.88	-.93	.52
Users x Quality	1.45	.30	.35	.81	1.10	.45
Stakeholders	-2.50	.29	-.95	.70	-2.14	.38
Stakeh x Quality	2.68	.26	1.08	.66	2.31	.35
Size	.37	.24	.21	.54	.34	.30
Size x Quality	.03	.93	.05	.88	.04	.91
Projects	-.18	.87	-.43	.69	-.31	.77
Projects x Quality	.20	.85	.48	.65	.33	.76
Processes	-.68	.68	-1.49	.41	-1.02	.55
Processes x Quality	1.11	.51	1.73	.34	1.40	.42
Applications	.35	.77	-.13	.92	.19	.88
Appl x Quality	-.01	.99	.33	.79	.11	.93
Functional stability	2.39	.08	.93	.53	1.98	.16
Func x Quality	-2.05	.13	-.83	.57	-1.72	.22
Technical stability	-.08	.96	.22	.90	.05	.98
Tech x Quality	.18	.92	-.08	.96	.07	.97

Before the regression models were applied, the potential problem of multicollinearity was investigated by computing VIF factors for each predictor in the regression model. Although in some cases correlations between independent variables were relatively high, VIF factors in most of the models didn't exceeded 5 – a commonly applied rule of thumb (Hair, et al., 1998; Rogerson, 2001). The results of the regression analyses to test our hypotheses are presented in Table 3.

From Table 3, we can see that in none of the regression models, one of the determining factors has a significant effect on the capacity of the BIM function. It also appears that the interaction effect of quality of IS/IT services on the capacity of the BIM function is not significant. This means that quality of IS/IT services doesn't have an influence on the relationship between a determining factor and capacity of the BIM function. In conclusion, these results don't support the hypothesis, that quality of IS/IT services has influence on the relationship between the determining factor and the capacity of the BIM function.

5 Discussion

In earlier research a predictive model was defined. After having a qualitative review on this model and the defined determining factors we had a first quantitative validation of this model in the research which is discussed in this paper. We found that some of the determining factors show a significant correlation with the number of staff needed. This is a promising result compared to previous research (Achmea et al, 2009; Quint Wellington Redwood, 2014; Rakhorst, 2013). These studies were based on more ICT factors and used complex models to estimate the required number of BIM staff. The findings in our research indicate that this is possible with few factors. An influence of a moderating effect of quality of IS/IT services was not found in this research. However, due the limitations of our dataset more research is needed in the agricultural section as well in other industries. Another issue for further research is also to analyse the level of education of the employees as a moderating factor.

6 Conclusion and Limitations

Studies from past years have shown that eight factors determine the BIM-function (Van Outvorst, De Vries and De Waal, 2016). During this research, these eight factors were tested in 37 organisations. An important adjustment to this research is that a distinction is made between different levels of activities performed by the BIM function. Because of this distinction, several factors have a significant correlation with the capacity of the BIM function. The factors 'number of processes', 'size of projects', 'functional stability' and 'number of applications' have a significant correlation with the number of staff. The factors 'number of processes' and 'size of projects' can also be seen in the correlation between the total number of staff for all BIM responsibilities.

In addition, the influence of quality of IS/IT on the relationship between a determining factor and the capacity of the BIM function was investigated during this research. This research shows that quality of IS/IT services has no influence on this relationship. However, it is uncertain if the grades for quality of IS/IT services are realistic. One respondent could be more optimistic in his answers than the other. Also, in the calculations all aspects of quality were weighed equally. There was no possibility for the respondents to add different weights to the various quality aspects.. Another limitation of this study is the small size of the sample. This has negative consequences for representativeness, and also the quality of data. The skewness of some variables were too high and also the VIF factor was by some variables too high. These aspects may have influenced the results.

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