Toward an Understanding of Business Intelligence Systems Success: A South African Study

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Abstract: This study investigates the success factors of business intelligence (BI) systems across three employment groups in South Africa. The three categories of employment groups are: top management, middle management, and operational staff. Based on a review of literature grounded on the DeLone and McLean model, a research model was proposed. This study hypothesized that information quality, system quality, service quality, user quality, user satisfaction, and individual impact are factors that might contribute to the success of BI systems among the different employment groups in South Africa. The proposed model was validated using responses taken from 211 BI users. The managerial implications of the findings are that differentiated BI implementation strategies aimed at specific employment groups might improve success rates, as opposed to a single broad-brush strategy for all end users. The paper concludes by discussing the limitations of the study, which should be addressed in future research.

Keywords: business intelligence; information systems success; South Africa; DeLone and McLean

1. Introduction

A business intelligence (BI) system refers to a collection of technology and applications that are used to improve decision-making in organisations (Wixom and Watson, 2010). BI systems enable organisations to make well-informed business decisions, and can therefore be regarded as a source of competitive advantage (Ranjan, 2009). However, BI systems are an expensive investment. Recently many companies have invested significantly in BI systems in order to exploit the potential benefits of these systems (Kappelman, Johnson, McLean and Torres, 2016). Arnott and Pervan (2014) point out that worldwide spending on BI systems was approximately US$13 billion in 2012. However, the benefits gained from BI investment are often disproportional to the scale of the investment (Mudzana and Maharaj, 2015).

Some researchers report that the failure rates for BI systems are between 30% and 59% (Dresner Advisory Services, 2012; Hwang and Hongjiang, 2007), whereas Gartner reports that the failure rates could be as high as 70% of BI implementations (Gartner, 2012). Yet, few studies have studied the success factors of BI systems in general and in South Africa in particular.

Given the scarcity of documented success factors of BI systems specific to South Africa, the problem that this study seeks to address is the lack of guidance for managers in South Africa regarding how best to assess the post-implementation success of BI systems. To address this problem, the research focuses on identifying the factors that contribute to the success of BI systems in South Africa from the perspective of different employment groups. This is relevant because a failure to address this problem might hinder the successful adoption of BI systems in spite of all its reported benefits. Furthermore, knowing how different groups of employees perceive BI success may help practitioners to design more effective BI implementation strategies and offer guidance for management intervention. DeLone and McLean (2003) support this view, stating that an assessment of the success or effectiveness of information systems (IS) is essential if the value and usefulness of IS management activities and IS investments is to be understood.

A BI system has many users, ranging from top management to middle management and operational staff. These different employment groups usually have different objectives. Olszak and Ziemba (2007) observe that at the strategic level, BI allows for setting up and monitoring of organisational objectives. This can be done by using performance dashboards or comparative reports. In contrast, at the tactical level, BI systems support decision-making within functional units such as marketing, sales and capital management (Olszak and Ziemba, 2007). At the operational level, BI systems enable users to perform ad hoc analyses and answer questions related to a functional unit's ongoing operations (Olszak and Ziemba, 2007). However, there is very little

Reference this paper: Mudzana T and Maharaj M, "Toward an Understanding of Business Intelligence Systems Success: A South African Study" *The Electronic Journal Information Systems Evaluation Volume 20 Issue 1 2017, (pp24-38)* available online at www.ejise.com

evidence concerning the views of the employment groups on BI system success. The study seeks to contribute to closing this gap.

This research extends the DeLone and McLean IS success model by exploring the success of BI systems in South Africa among different employment groups. This study focuses on the individual level of analysis. At the individual level of analysis the focus is on the users' perception of the utility of the BI system. The study contributes to a growing literature base on IS success in South Africa, offering quantitative evidence of BI systems' success in South Africa from different employment groups' perspectives. It is anticipated that the results will also provide guidance to practitioners of BI systems.

The rest of this paper is organized as follows: The next section reviews extant literature on IS success. Section 3 presents the research model of the study. Section 4 describes the research methodology used in the study. Section 5 presents and discusses the findings of the study. Finally, the conclusions and limitations are discussed in Section 5.

2. Literature Review

Prior studies in IS success have been mainly based on the work of DeLone and McLean (1992). The DeLone and McLean (1992) model suggested six major factors of IS success, namely: system quality, information quality, use, user satisfaction, individual impact, and organisational impact. The DeLone and McLean (2003) model addresses the weaknesses of the original model identified in the literature, by adding the success dimensions of service quality, and net benefits.

The model argues that system quality, information quality, and service quality, will individually and jointly affect user satisfaction and use (DeLone and McLean, 2003). Accordingly, the more frequently that users find they are content with the IS, the more users will use the IS, and this determines the benefits that users obtain from the IS. The benefits then strengthen the users' intention to use, their actual use, and their satisfaction with the IS (DeLone and McLean, 2003).

Many researchers have applied the DeLone and McLean (1992, 2003) models to evaluate various types of applications. Table 1 shows some empirical research applying the DeLone and McLean (1992, 2003) IS success model. The table illustrates the validity of applying the model in different contexts.

Table 1: Empirical Research Applying the DeLone and McLean (1992, 2003) models

Authors	Application	Methodology	Major Findings/Recommendations
Rai et al. (2002)	Student information system	Quantitative	IS success models must be carefully specified in a given context. Future research should examine how IS success models perform in different contexts, including settings ranging from strictly voluntary to strictly involuntary use, and recommend refinements as appropriate.
Stockdale and Borovicka (2006)	Tourism companies' websites	Pilot study	Developed an instrument based on DeLone and McLean's (2003) updated model to evaluate tourism companies' websites. Suggested further examination of the instrument for further refinement.
Wu and Wang(2006)	Knowledge management system(KMS)	Quantitative/SEM*	Empirical results provide considerable support for KMS success model with some modifications.
Lin (2007)	Online learning system(OLS)	Quantitative/SEM	System quality, information quality and service quality had a significant effect on actual use OLS use through user satisfaction and behavioural intention to use OLS.
Brown and Jaykody (2008)	Online retail sites	Quantitative	User intention to continue using an online retail site is directly influenced by perceived usefulness, user satisfaction and system quality. User satisfaction is directly influenced by service quality and

Authors	Application	Methodology	Major Findings/Recommendations
			perceived usefulness, while perceived usefulness is directly influenced by trust and information quality. Trust in online retailer is directly influenced by service quality and system quality.
Wang (2008)	e-commerce system	Quantitative/SEM	Intention to reuse is affected by perceived value and user satisfaction, which, in turn, are influenced by information quality, system quality and service quality.

* SEM = structural equation modelling

Literature also provides evidence that there are very few studies in the context of BI systems, especially in South Africa. This study attempts to address the existing information gap. The factors of system quality, information quality, and user satisfaction have been included in most of the prior studies. This may indicate that they are vital to measuring IS success and need to be included in measuring BI success model. The researchers therefore use the IS success theory as a lens through which to explore the success of BI systems in South Africa.

3. Research Model

A BI system is a special type of IS. Therefore, in this study, the BI success model is based on prior IS success studies. The DeLone and McLean (1992, 2003) model has been used widely in many other studies on IS success (Stockdale and Borovicka, 2006; Wang and Liao, 2008). This study proposes a model of BI success based on the DeLone and McLean (2003) model.

The model suggests that the core IS success measures of information quality, system quality, service quality, user satisfaction, and individual impact are success factors in a BI system. User quality is an additional factor specifically relevant to BI. The study model proposes that information quality, system quality, service quality, and user quality singularly or jointly have an effect on user satisfaction and on the individual impact of a BI system.

The following are the differences between the DeLone and McLean (1992, 2003) model and the proposed model:

- The 'use' dimension was excluded from the research model. The DeLone and McLean model received considerable criticism concerning this dimension (Seddon, 1997). IS use is not essential in BI system success because it is not the use of the BI system that is under scrutiny; rather, it is the impact of that use which is being scrutinised (Hwang and Xu, 2008).
- In the updated DeLone and McLean (2003) model, individual impact and organisational impact are combined into a new construct called 'net benefits'. Individual impact refers to the effect of the system on the behaviour of the end user (Seddon, 1997), and organisational impact refers to the influence on the organisational performance. This study focuses on the individual level of analysis, therefore the net benefits construct is replaced by the 'individual impact' construct.
- The user quality factor is added to the research model. Chaveesuk (2010) argues that most of the available studies in BI concentrate on technological and operational features and there is not enough study focusing on human factors.

The six chosen factors will now be discussed by examining each in turn.

3.1 Information Quality

In this study, information quality refers to the desirable features of the information produced by the BI system (Petter, Delone and McLean, 2008). The information quality factor from the DeLone and McLean model (2003) is used to explore the influence of information quality on BI systems' success among the different employment groups. Wang, Storey and Firth (1995) suggest that information quality is important for business success. Many other studies (Haley, 1997; Thomann and Wells, 1999; Rudra and Yeo, 2000; Wixom and Watson, 2001; Shin, 2003; Nelson, Todd and Wixom, 2005; Hwang and Xu, 2008; Holsapple and Lee-Post, 2006; Lin, 2007) have also identified information quality as vital for success.

Various studies have found a significant positive relationship between information quality and user satisfaction at the individual unit of analysis (Holsapple and Lee-Post, 2006; Lin, 2007; Halawi, McCarthy and Aronson, 2007; Leclercq, 2007; Kulkarni, Ravindran and Freeze, 2006; Wu and Wang, 2006; Almutairi and Subramanian, 2005; Hunton and Flowers, 1997).

Other researchers have found a significant positive relationship between information quality and individual impact at the individual unit of analysis (Seddon and Kiew, 1994; Santos, Takaoka and de Souza, 2010).The hypotheses suggested are therefore as follows:

H1: Information quality is positively related to user satisfaction in a BI system.
H6: Information quality is positively related to individual impact in a BI system.

3.2 System Quality

In this study, system quality refers to the desirable features of the BI system (Petter et al., 2008). System quality has been analysed in many other studies and identified as an important factor for IS success (Seddon, 1997).

Several researchers found a positive relationship between system quality and user satisfaction at the individual level of analysis (Iivari, 2005; Leonard and Sensiper, 1998; Nonaka and Takeuchi, 1995). Other researchers have confirmed a positive relationship between system quality and individual impact (Goodhue, 1995; Seddon and Kiew, 1994; Wixom and Todd, 2005).The hypotheses suggested are therefore as follows:

H2: System quality is positively related to user satisfaction in a BI system.
H7: System quality is positively related to individual impact in a BI system.

3.3 User Quality

Skilled users are vital to the effectiveness of a BI system (Sakaguchi and Frolick, 1997; Wixom and Watson, 2001; Hwang et al., 2004). If users are not appropriately trained, this results in a cost to the use of the BI system (Salmela, 1997). Bearing this in mind, the user quality construct was used in the Almabhou et al. (2012) study to explore the influence of user quality on BI systems success among the different employment groups. In this study, the following hypotheses are suggested:

H4: User quality is positively related to user satisfaction in a BI system.
H9: User quality is positively related to individual impact in a BI system.

3.4 Service Quality

Service quality refers to the level of support that the BI users receive from the service provider. Measures of service quality include responsiveness, accuracy, reliability, technical competence, and empathy of the personnel staff (Petter et al., 2008). Studies indicate that, in general, service quality has a positive influence on user satisfaction (Iivari, 2005; Gelderman, 2002; Wu and Wang, 2006; Halawi et al., 2007; Seddon and Kiew, 1996; McGill, Hobbs and Klobas, 2003; Almutairi and Subramanian, 2005).

However, other researchers found no significant relationship between service quality and user satisfaction (Benard and Satir, 1993). At the individual level of analysis, the association between service quality and individual impact has moderate support (Petter et al., 2008). The following hypotheses were tested in this study:

H3: Service quality is positively related to user satisfaction in a BI system.
H8: Service quality is positively related to individual impact in a BI system.

3.5 User Satisfaction

The user satisfaction construct from the DeLone and McLean (2003) model was used to examine the influence of user satisfaction on BI systems' success among the different employment groups. In this study, user satisfaction refers to the perception of the BI system by BI users, in relation to what the end user expects upon first use of the system (Seddon, 1997). Many other researchers (DeLone and McLean, 1992; Doll and

Torkzadeh, 1998; Gatian, 1994) have recognised that user satisfaction is one of the most frequently used measures of IS success.

According to Bharati (2003), if a system meets the requirements of the end users, their attitude towards the IS will be positive. User satisfaction was found to be positively related to individual impact (Gelderman, 1998; Law and Ngai, 2007; Yoon and Guimaraes, 1995; Torkzadeh and Doll, 1999; Vlahos and Ferratt, 1995; Ang and Soh, 1997). In this study, the following hypothesis is tested:

H5: User satisfaction is positively related to individual impact in a BI system.

Figure 1 shows the research model developed for the study.

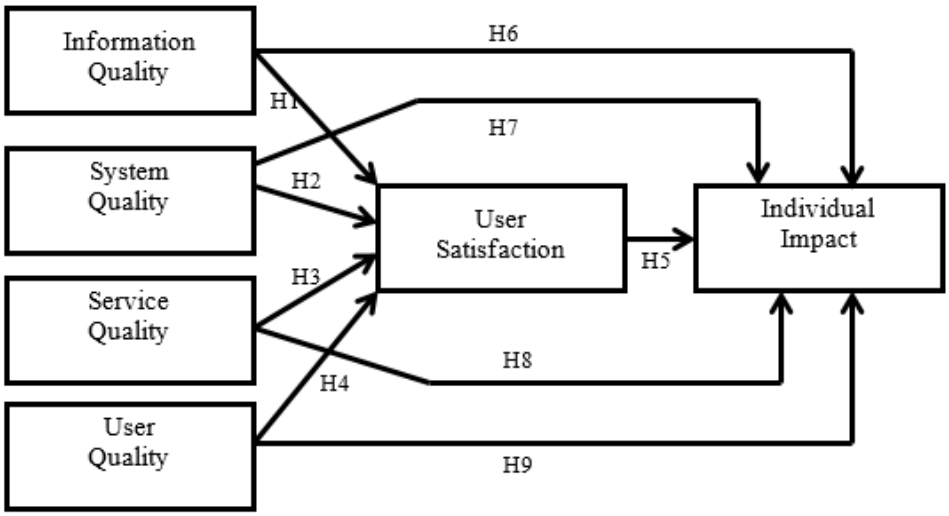

Figure 1: BI System Success Model

3.6 Individual Impact

Individual impact refers to the effect of the BI system on the behaviour of the end user (Seddon, 1997). This can be contrasted with organisational impact, which refers to the influence on the organisational performance such as operating cost reduction, overall productivity gains, increased sales, increased market share, increased profit, return on investment, return on assets, net income to operating expense ratio, increased work volume and product quality (DeLone and McLean, 1992).

4. Research Methodology

The quantitative approach is considered to be a better approach than the qualitative approach in terms of generalisation (Johnson and Duberley, 2000). For this reason, the study utilises a quantitative research design using a questionnaire. This approach is also consistent with many other studies that adapted the DeLone and McLean model in various contexts (Wang, 2008; Brown and Jaykody, 2008; Lin, 2007).

The hypotheses used in the study were obtained from literature on IS success and adapted for the BI context (see Figure 1). A questionnaire instrument was developed and then used to collect data from BI system users in South Africa. The data was analysed using Structural Equation Modelling (SEM). The instrument design, sample design, pilot study, data collection and data analysis procedures, as well as ethical considerations will be discussed in this section.

4.1 Instrument Design

The survey instrument design was based on the BI success model proposed (see Figure 1). The questions in the study were modified from related prior studies of IS success. Table 2 shows the constructs of the survey instrument. The instruments were modified to suit the context of BI.

Table 2: Instruments used to measure BI success dimensions

Measure	Number of Items	Source
System Quality	8	DeLone and McLean,1992 Watson and Wixom, 2001 DeLone and McLean, 2003
Information Quality	7	DeLone and McLean,1992 Watson and Wixom, 2001 DeLone and McLean, 2003
User Quality	3	Wixom and Watson, 2001
Individual Impact	7	Hou, 2012 DeLone and McLean,1992
Service Quality	4	Yoon and Suh, 2004
User Satisfaction	3	DeLone and McLean, 2003

The questionnaire of the study was divided into two parts. The first section of the questionnaire concerns the demographic information of the participants of the study. Seven items that the researcher developed measure participants' profiles; these items are race, gender, age, qualifications, length of service, role, and industry.

The second part of the questionnaire addresses the dependent as well as the independent variables of the study. The main dependent variables are user satisfaction and individual impact. The main independent variables are system quality, information quality, user quality and service quality. All items on the questionnaire were measured on a five-point Likert scale from strongly disagree to strongly agree.

4.2 Sample Design

The target population for this study was limited to the perceptions of end users of BI systems of listed companies on the Johannesburg Stock Exchange (JSE). Companies listed on the JSE but with head offices located in countries outside South Africa, were not included in the list. This exclusion was made in order to ensure a uniquely South African perspective of BI systems' success.

A major challenge was to locate a single listing of end users of BI systems. In the absence of any official lists, the researcher used various means of identifying and compiling a list of end users of BI systems. Various BI vendors, BI consulting companies, BI vendor user groups and JSE-listed companies were approached; however, many companies were unwilling to share this information.

Based on the resulting list of end users, a random sampling technique was employed to distribute the questionnaire to the participants. Sample size was an additional issue to be considered, because it is not always possible to survey the whole population. Since the exact size of all BI end users in South Africa is unknown, it was not possible to calculate a sample size. However, the researcher made use of statistical analysis techniques that were intended to be used in the study to guide in the sample size.

SEM was used in the present study to test the proposed hypotheses; a sample size of at least 200 was determined to be suitable for SEM (Harris and Schaubroeck, 1990; Hair, Tatham, Anderson and Black, 1998).

4.3 Pilot Study

A pilot study was conducted before the main study. The purpose of the pilot study was to check whether the respondents would be able to understand the questions and instructions of the questionnaire. The respondents for the pilot study were four IS professionals. Minor wording changes were made to the final questionnaire as a result of the pilot study.

4.4 Data Collection and Analysis Procedure

The questionnaire was the main data collection instrument of this research. This method was effective because it allowed the researcher to easily collect data from a large number of respondents. In total, 211 useable questionnaires were received.

Data analysis for this study was performed using the program 'SPSS/Amos for Windows'. Simple descriptive data analysis was conducted to gain a greater understanding of the data, and of each construct. Other data tests were performed to assess non-response bias and common method bias.

SEM was used in the present study to test the proposed hypotheses. SEM is a statistical technique that utilises a confirmatory approach to the examination of a theory framework bearing on some aspect (Byrne, 2001). The analysis stage followed a two-step process as suggested by Hair *et al.* (2010). The first step involved assessing the measurement model for goodness-of-fit, construct reliability, and construct validity. The second stage involved testing the structural model to examine the results of the hypothesised relationships between constructs.

4.5 Ethical Considerations

For this study, an ethical clearance application was completed and approved by the Research Office of the University of KwaZulu-Natal to conduct the study. The University of KwaZulu-Natal Higher Degrees Committee's code of research ethics was adhered to.

Participation in the study was voluntary. The respondents were assured that the data collected would be used for research purposes. The questionnaire contained a covering letter outlining the purpose of the study, and including the estimated time to complete the questionnaire.

5. Results And Discussion

5.1 Demographic Profile

Table 3 shows the demographics of the valid 211 respondents. A majority of the responding professionals were male (57.3%), 53.1% of respondents were between 31 and 40 years of age, and 34.6% of respondents were between 41 and 50 years old. Over 50% of the respondents reported having had more than five years of experience in their current role.

Table 3: Profile of Respondents

		Percentage
Gender	Male	57.3
	Female	42.7
Age	21-30	5.7
	31-40	53.1
	41-50	34.6
	51-60	6.6
Years in Current Service	1-5 years	31.8
	6-10 years	49.3
	>10 years	19.0
Education Level	Matric	3.8
	Diploma	37.9
	Bachelor's Degree	49.3
	Master's Degree	9.0
Employment Group	Top Management	4.7
	Middle Management	18.5
	Operational Staff	76.7
Industry	Financial Services	41.0
	Telecommunications	35.0
	Retail	4.0
	Manufacturing	12.0
	Media, Entertainment and Leisure	8.0

The employment groups were top management with 10 respondents, middle management with 39 respondents and operational staff with 162 respondents. A majority of the respondents were from the financial services sector (41%) and the least number of respondents came from the retail sector (4%).

5.2 Reliability of Constructs

The results of the reliability tests are shown in Table 4. The results show that the value of Cronbach's alpha for all constructs was higher than 0.7. This suggests that the questionnaire and its constructs are suited to the study (Hair et al., 2006).

Table 4: Reliability Tests

Factor	Items	Cronbach Alpha
System Quality	8	0.780
Information Quality	7	0.702
User Quality	3	0.733
Individual Impact	7	0.885
Service Quality	4	0.834
User Satisfaction	3	0.735

5.3 Non-Response Bias

To test for non-response bias, the respondents were divided into two groups, early and late respondents, with 171 and 40 members respectively. Table 5 shows the statistics for the two groups.

Table 5: Group Statistics

	Wave	N	Mean	Std. Deviation	Std. Error Mean
Usersat	First wave	171	4.4873	.48135	.03681
	Second wave	40	4.3500	.68750	.10870
Userqual	First wave	171	4.2378	.45944	.03513
	Second wave	40	3.8917	.70967	.11221
Sysqual	First wave	171	4.2646	.43594	.03334
	Second wave	40	4.2531	.40479	.06400
Indimpact	First wave	171	4.0409	.64309	.04918
	Second wave	40	3.7821	.73557	.11630
Servqual	First wave	171	4.5930	.39281	.03004
	Second wave	40	4.4100	.61760	.09765
Infoqual	First wave	171	4.5322	.33835	.02587
	Second wave	40	4.4583	.32412	.05125

Late respondents were those who returned the questionnaire after a reminder was sent, and early respondents were those who answered and returned the questionnaire before any reminders were sent. The two groups were compared according to responses on user quality, systems quality, user satisfaction, systems quality, service quality, and individual impact. To test the differences between early and late respondents, a t-test for equality of means was used. The results are summarised in Table 6.

Table 6: Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Usersat	Equal variances assumed	7.997	.005	1.487	209	.139	.13733
	Equal variances not assumed			1.197	48.311	.237	.13733
Userqual	Equal variances assumed	20.412	.000	3.824	209	.000	.34615
	Equal variances not assumed			2.944	46.919	.005	.34615
Sysqual	Equal variances assumed	.466	.496	.152	209	.879	.01149
	Equal variances not assumed			.159	61.986	.874	.01149
Indimpact	Equal variances assumed	1.898	.170	2.228	209	.027	.25879

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
	Equal variances not assumed			2.049	53.798	.045	.25879
Servqual	Equal variances assumed	16.132	.000	2.349	209	.020	.18298
	Equal variances not assumed			1.791	46.634	.080	.18298
Infoqual	Equal variances assumed	.707	.401	1.252	209	.212	.07383
	Equal variances not assumed			1.286	60.515	.203	.07383

There was no statistically significant difference between the early respondents and the late respondents for service quality, system quality, information quality and user satisfaction. However as shown in Table 6, user quality and individual impact appear to be the factors affected by the non-response bias, for they both report a significant difference of mean. Despite this significant difference, both respondents and non-respondents still fall under 'strongly agree' and 'agree' – which implies that the difference is statistical, but in terms of opinion, the answers are homogenous.

5.4 Common Methods Bias

Since the independent and the dependent variables were measured from the same questionnaire, there was a potential for common methods bias. To test for common methods bias, Harman's single factor test was used. The Harman 1 factor test was conducted to determine if the first principal component explains less than 50% of the total variance.

Table 7: Harman1 Factor Test Results

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.700	17.814	17.814	5.700	17.814	17.814
2	4.581	14.315	32.129			
3	2.635	8.235	40.364			
4	2.439	7.621	47.984			
5	1.721	5.378	53.362			
6	1.654	5.167	58.529			
7	1.299	4.059	62.589			
8	1.028	3.211	65.800			
9	.843	2.634	68.434			
10	.788	2.463	70.897			
11	.782	2.442	73.339			
12	.731	2.285	75.625			
13	.687	2.148	77.773			
14	.663	2.073	79.846			
15	.645	2.016	81.862			
16	.583	1.823	83.685			
17	.540	1.688	85.373			
18	.506	1.580	86.953			
19	.478	1.494	88.447			
20	.442	1.381	89.829			
21	.429	1.342	91.170			
22	.400	1.251	92.421			
23	.360	1.125	93.546			
24	.340	1.062	94.608			
25	.321	1.003	95.611			
26	.307	.958	96.569			

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
27	.296	.925	97.495			
28	.250	.780	98.274			
29	.233	.727	99.002			
30	.159	.498	99.499			
31	.101	.316	99.816			
32	.059	.184	100.000			

Table 7 indicates that only 17.814% of the total variance is explained when the first factor is extracted. In other words, a significant amount of variance is explained by the factors which were not extracted. This suggests that common methods bias is not an issue in this study.

5.5 Measurement Model

One of the aims in the application of the SEM approach is the assessment of the goodness-of-fit. Hair et al. (2006) suggest that SEM has no single statistical test which could best describe the strength of the model's predictions. In this study, the initial measurement model showed a Chi-square of 911.332 which is significant (p =.000) at 453 degrees of freedom. The CMIN/DF was 2.012 and falls in the recommended range of less than 5. The initial measurement model did not have a good fit with GFI of .807, AGFI of .776, TLI of .829, and CFI of .844 below the threshold, which is .90. In addition, RMSEA of .069 and PCLOSE = .000. This poor fit is caused by two variables overlapping with each other. The variables user satisfaction and service quality are over correlated (r=1.12).

In the final measurement model, service quality was removed, owing to its overlap with user satisfaction. The final measurement model showed a Chi-square of 400.322 and a p value of p =.001 at 319 degrees of freedom. All the following indices fall within the recommended range CMIN/DF of 1.255, GFI of .877, AGFI of .854, TLI of .948, CFI of .953, RMSEA of .05 and PCLOSE of .994.

The measurement model was further assessed for convergent validity. The values ranged from 0.4 (for service quality) to 0.60 (for information quality). According to Fornell and Larcker (1981), the convergent validity is satisfactory when the factors have an average variance extracted (AVE) greater than or equal to 0.5. The range is above the suggested threshold of 0.50 for five constructs except service quality.

Given that more than four indices are satisfactory, it can be concluded that the final measurement model has a good fit. Therefore the structural model was developed and tested based on this model.

5.6 Structural Model

To explore the difference between the different employment groups, the study sample was divided into three models. The focus was on the variations in the structural model since the measurement model had already been validated.

The employment groups were as follows: group 1 was top management with 10 respondents, group 2 was middle management with 39 respondents, and group 3 was operational staff with 162 respondents. The analysis was only applied to group 3 and group 2 data, as the top management group did not meet the minimum threshold for analysis. In the following section, the analysis of the groups is presented.

Figure 2 shows the structural model results for the middle management group.

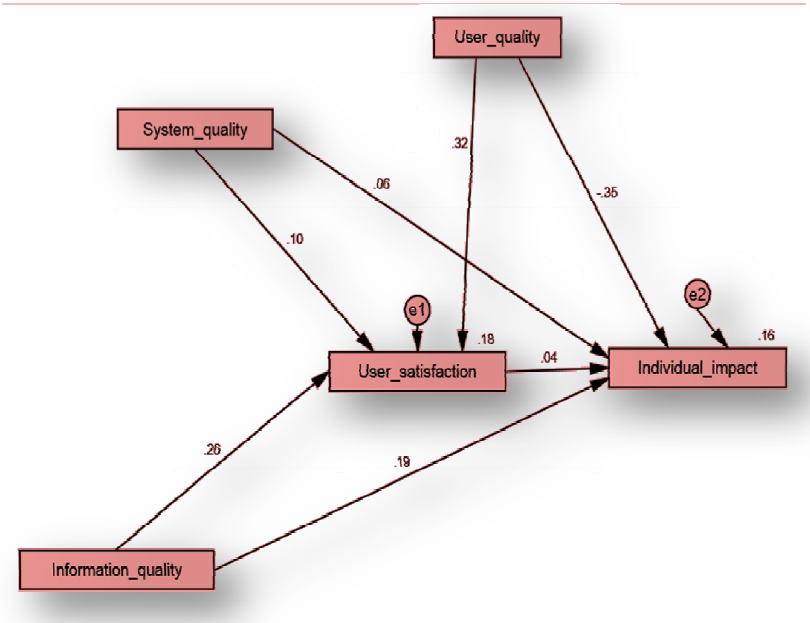

Figure 2: Structural Model for Middle Management

Two paths are significant for the middle management group. There is a positive relationship between user quality and user satisfaction, meaning that when user quality increases by one standard deviation which is .532, its impact on user satisfaction will also increase by .168.

There is a negative relationship between user quality and individual impact, meaning that when user quality increases by one standard deviation, which is .532, its impact on individual impact decreases by .233. User quality is the only significant predictor of the model for middle management group.

Figure 3 shows the structural model for the operational staff.

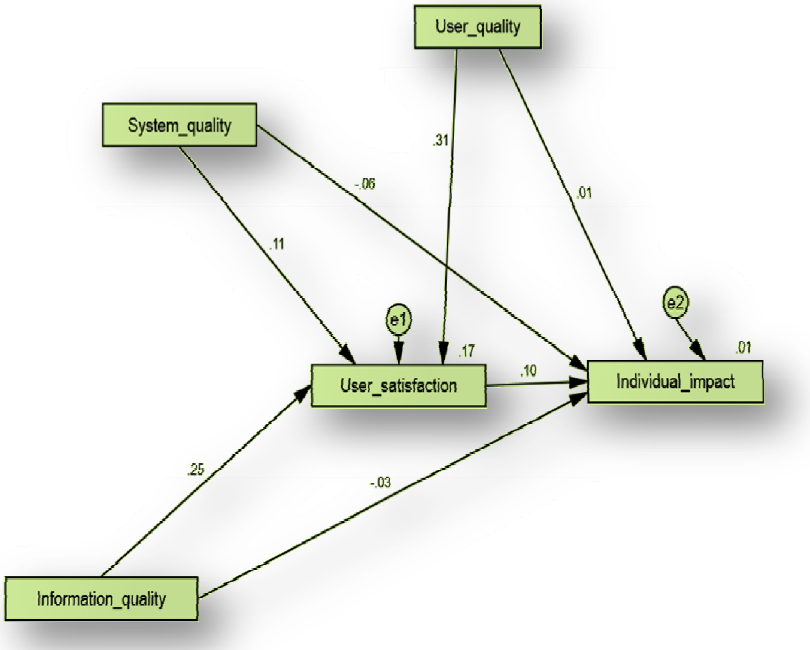

Figure 3: Structural Model for Operational Staff

Although only two paths are significant, all the relationships on the structural model are positive. This means that when user quality increases by one standard deviation, which is .532, its impact on user satisfaction will also increase by .163. The second significant path for the operational staff group is that of information quality and user satisfaction (β = .25, p =.000). This is a positive association; as the quality of information increases, the level of user satisfaction increases.

The data analysis revealed that the structural models differed slightly between employment groups. There are only two significant paths in both employment groups. In both operational staff and middle management, there is a positive relationship between user quality and user satisfaction in a BI system. The result suggests that both employment groups view user quality as an important success factor.

As the user quality levels increase in both employment groups, the user satisfaction levels of the BI system increase. This finding is consistent with prior studies (Sakaguchi and Frolick, 1997,Wixom and Watson, 2001; Hwang et al., 2004) which found that skilled users are crucial to the success of a BI system. Therefore stakeholders need to pay attention in promoting user quality of BI systems. This can be done by ensuring that the users from all employment groups have business skills, technical skills, and analytical skills. User quality did not influence individual impact positively in both employment groups. One way of explaining this result is that the two employment groups are highly skilled and are likely to take their skills for granted; therefore they do not see the impact of their skills on the job performance.

The second significant path for the operational staff is that of information quality and user satisfaction. This is a positive association: as the quality of information increases, the levels of user satisfaction increases. Poor information quality can impact negatively on a company. The results of this study are consistent with the results of prior studies (DeLone and McLean, 2003; Holsapple and Lee-Post, 2006; Lin, 2007; Chiu et al., 2007; Halawi et al., 2007; Leclercq, 2007; Kulkarni et al., 2006; Wu & Wang, 2006; Almutairi and Subramanian, 2005; Hunton and Flowers, 1997).

The results also support the findings of Wixom and Todd (2005), in that when users believe that the quality of the information provided by the BI system is favourable, they are more likely to be satisfied with it. Therefore, this study further provides support for the theory that the higher the quality of the information of the BI system, the more satisfied the users will be with the BI system.

5.7 Implications

This study could have important implications for both researchers and practitioners. First, the study extends the DeLone and McLean model success by refining it to be more suited to BI, specifically in the context of South Africa. The study results confirm that some previously theorised IS success relationships (DeLone and McLean, 2003; Petter et al., 2008) hold true in the BI context.The results therefore contribute to the research on BI systems as well as to the research on IS evaluation in general.

Second, the study suggests that employment groups play a small but significant role in determining BI system success. Hence, practitioners may utilise the results of this study and apply them to different employment groups. As an example, an organisation may identify the employment groups and then map BI functionality to each employment group. Furthermore, the study enables practitioners to understand the pitfalls of BI adoption and the reasons why adoption can be problematic, thus allowing practitioners to take a more proactive approach when new solutions have been developed.

6. Conclusion

This research paper examined the success of BI systems from different employment groups' perspectives. This study draws on the DeLone and McLean model of IS success. A field survey was conducted in South Africa to test the proposed model. Seven out of nine hypotheses were tested. Two hypotheses were not tested as a result of overlap in the initial measurement model.

The findings of this study reported different results in each employment group. The results suggest that both employment groups view user quality as an important success factor. In both groups, the results indicate that the factors making up BI success are all interrelated. However, not all of the original hypotheses of the study were supported. Among the operation staff employment group, the study found a positive relationship

between user quality and user satisfaction in a BI system. Information quality was also found to be positively related to user satisfaction. Among the middle management employment group, the results indicate that there is a negative association between user quality and individual impact. However, there was a positive association between user quality and user satisfaction in a BI system.

Although the differences between the employment groups were small, the results from this study provide some evidence of differences between employment groups in terms of perceptions of BI success. The results of the study might suggest that practitioners might need to differentiate their BI system organisational strategies according to employment groups. In practical terms, the results of the study may serve as a useful tool for developing these organisational strategies. These strategies might involve ensuring that BI systems conform to the way employment groups work, instead of forcing employment groups to conform to the way the BI systems function.

This study has some limitations which should be taken into consideration in future studies. First, because the independent and dependent variables were measured in the same questionnaire, common methods bias may have been introduced. A future study might consider measuring the independent and dependent variables separately. Another limitation was that this study was limited to South Africa. Therefore care needs to be taken when generalising the results of the study.

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