

# Organizational Success Factors in the Implementation of Big Data Analytics for Customer Relationship Management

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**Abstract** - Big Data Analytics (BDA) is a promising tool for customer relationship management (CRM). This research develops an integrative model of success factors for implementation of BDA for CRM. Factors including technology infrastructure, management, human resources, organizational readiness, cost, environmental factors, organizational processes (positive), and barriers (negative) were identified through the literature, and tested in a survey of marketing and technology managers, BDA specialists and top managers in firms that have implemented BDA (n = 212). Structural equation modelling (SEM) was used to investigate the proposed model. Analysis indicated that all seven factors had the expected relationship to BDA implementation success for CRM. The strongest effects were observed for human resources. This implies that organizational factors like HR, perhaps even more than technology infrastructure, influences success. The contribution of this research is in the development of a formal success model for BDA implementation in the CRM domain.

**Keywords** - big data analytics; customer relationship management; organizational capabilities; organizational success model

## I. INTRODUCTION

Big data analytics (BDA) is a major paradigm shift in business analytics. Big data refers primarily to datasets which are characterized by what some authors term the “three Vs” or volume, variety, and velocity [1]. By this, it is meant that first of all, big data is big, with the total amount of data totaling in the terabytes or petabytes. Big data is also typically unstructured and highly heterogeneous, rather than fixed into a single structured format. Finally, big data is generated rapidly and at high volume, requiring rapid analysis to provide useful information [1]. This poses a particular challenge for firms attempting to generate value from their approaches to use of big data [1]. Reference [2] argued that firms need to rapidly and constantly adapt their processes, stakeholder interests and organizational models if they are going to be successful in using big data analytics. However, organizations often cannot achieve this level of value generation from their big data resources, largely due to misunderstanding of big data resources or poor integration of BDA tools into the decision making process [3]. Thus, failure rates may be particularly high.

The objective of this research was to evaluate the organizational success factors at play in the implementation and effectiveness of Big Data Analytics (BDA) strategies for Customer Relationship Management (CRM). Marketing and CRM are some of the most common ways that firms use BDA to leverage their organizational resources and capabilities and recognize value from these activities [4] [5] [6] [7] However, as observed by several previous studies [3] [8] implementations of BDA are not guaranteed to be successful. Despite understanding that organizational factors affect the implementation and use of BDA, there has been

little research into the role that organizational factors play in the successful implementation specifically for CRM.

This research aims to fill this gap in the literature. To do so, a review of the literature, including BDA and its role in business, in CRM and implementation factors in BDA for CRM, is presented, followed by the conceptual model. The methodology is explained. Results of the Structured Equation Modeling (SEM) process are then presented and discussed prior to the conclusion.

## II. LITERATURE REVIEW

There are several key issues in the literature that relate to the role of BDA in CRM and its success. The literature review encompassed BDA and its role in business generally, followed by its specific use in CRM. It then evaluated organizational success factors for BDA implementation success. These factors are used to construct the conceptual framework of the research.

### A. Big data Analysis (BDA) and Its Role in Business

Big Data Analytics (BDA) is an extension of the traditional use of Business Intelligence (BI) or Business Analytics (BA), adapted both to account for the volume, variety, and velocity of big data and to generate insights that cannot be found in traditional BI [8]. The core elements of BDA include a technological platform for collection and analysis of heterogeneous and unstructured data and data mining algorithms, which are used to generate insights from this data [8]. The process of BDA can be modelled as a process of *data discovery*, in which the data (input) is subjected to a process of gathering, selection, preprocessing;

data analysis or data mining; and outputs that evaluate and interpret the data [8].

BDA is one of the technological capabilities that is increasingly being used by large firms to leverage resources like the opportunity to collect raw data and existing and new Information Systems (IS) infrastructure and capabilities for innovation and competitive advantage [5]. One author noted that BDA both increases revenue and decreases customer acquisition costs, generating higher profits [9]. However, implementation of BDA is not straightforward, and organizations can face significant challenges [3]. Some of these challenges include data challenges, process challenges, and management challenges. Some key areas where BDA has been employed include logistics and supply chain management, and Customer Relationship Management (CRM) and other marketing activities [1] [9].

### B. BDA for Customer Relationship Management (CRM)

CRM was one of the first practical applications of BDA identified [10]. CRM is one of the core capabilities of many firms, and BDA enables firms to derive insights from the multiple streams of heterogenous customer data that they generate on a regular basis [10]. Retailers have had particularly strong outcomes from the use of BDA, especially retailers like Target that have access to customer data through customer loyalty card programs which track purchases and online retailers like Amazon, which can access diverse data streams including browsing behavior data and customer recommendation data [11]. It is also possible for retailers to integrate other types of data, such as social media data, to generate even stronger insights than those available from their own customer data [6]. Social CRM depends on big data to integrate information about social interactions with more traditional forms of customer data such as order data. This enables firms to employ CRM strategies that are relevant to customer preferences and interactions [6]. Such data can be classified under the marketing mix, enabling activities like customer segmentation and profile and establishing marketing strategies [4].

### C. Organizational Factors in Effective Use of BDA for CRM

Not all organizations have the same success in the use of BDA – in fact, many organizations fail to effectively implement BDA strategies effectively or to use BDA to generate innovation or other insights. Several BDA models and theories have been proposed that identify factors that could influence implementation. Table 1 summarizes different types of organizational factors and barriers that could influence BDA for CRM.

Reference [7] identified three second-order factor clusters that contributed to BDA capabilities. These authors used a capability-based view of the firm, arguing that there were three capability clusters, including infrastructure flexibility, management capabilities, and personnel expertise capability.

Their model did show significant outcomes for each of the capabilities they included. Reference [3] identified three factor clusters, including data characteristics, process challenges, and management challenges. (This research does not incorporate the data challenges because the main concern is specifically the organizational (management and process) factors.

Other authors have taken organizational process views on implementation success. Reference [5] identified three distinct segments in its survey of large firms employing BDA, which were mainly defined by their organizational approach. The *Leaders* employed a structured, collaborative approach to effectively innovate using BDA. *Strivers* can use BDA effectively to some extent but may not effectively identify all areas where they could use the tool. *Strugglers* tend to be risk-averse, have high organizational barriers, and therefore do not effectively use BDA for innovation [5]. Thus, the effective use of BDA for innovation depends strongly on the extent to which organizations are structured, collaborative, and broad-ranging. While it is not clear that these results apply directly to CRM, it is possible that these factors do. This is also true for a study that investigated BDA in Human Resource Management (HRM) perspective [12]. These authors showed that factors including change readiness, employee resistance and employee readiness influenced implementation success. Other study found additional organizational factors [13]. These authors used a technology-organization-environment framework to identify a total of 26 distinct factors that contributed to big data implementation [13]. These factors do not address successful implementation, however, but rather the initial implementation process.

There have been a few case studies that have identified specific factors. One of these case studies investigated implementation in a cement firm, finding several processes and organizational leadership and culture factors that influenced the outcomes of BDA implementation [14]. Another study, which incorporated Delphi studies with case studies, found that a data-driven organizational culture that facilitated response to change was required [15].

There are two key issues with these studies, which argues for additional research. The first is that these studies do not directly address CRM. The second is that none of the models have been widely adopted, which calls for further investigation into organizational capabilities and their role in effective implementation [16]. This is a complex area that requires substantial further development [16]. These studies leave substantial room for further development of a success model for BDA implementation in CRM, recognizing that organizations that implement CRM tools are not necessarily typical for BDA applications. The studies reviewed here point to shared characteristics of BDA success, but they also identify some of the unique factors that could affect CRM specifically (Table 1). These factors are summarized in Table 1.

This research employs an integrative model that includes many of the components identified by the previous authors summarized below (excepting the data characteristics, as this research focuses on the organizational and management factors). These factors include technology infrastructure, management, human resources, organizational readiness, cost, environmental factors, organizational processes and barriers.

–TABLE I. SUMMARY OF ORGANIZATIONAL FACTORS IN BDA

Factor Cluster	Factors	Authors
Technology Infrastructure	Connectivity Compatibility Modularity	[7]
	Appropriateness Complexity Technology Resources	[13]
Management	Planning Investment Coordination Control	[7]
	Understanding of the problem Project mapping Project team Visualization techniques	[14]
	Management support Decision-making culture Business strategy orientation	[13]
	Top management support Project championship	[14]
Human Resources	Technical Knowledge Technology Management Business Knowledge Relational Knowledge	[7]
	Human Resources Organizational/IT structure	[15]
Organizational Readiness	Technological readiness Trading partner readiness Organizational/IT structure Data-driven culture	[13]
Cost	Cost of adoption Business resources	[13]
Environmental factors	Regulatory environment Uncertainty/risk Institutional trust	[13]
Organizational Processes	Structured implementation Collaboration	[5]
	Developing organizational model	[2]
	BDA process	[3]
Barriers	Risk aversion	[5]
	Stakeholder interest Traditional business model	[2]
	Organizational change readiness Employee readiness Employee resistance	[12]

D. Conceptual Framework and Hypotheses

Figures 1 and 2, see Appendix, present the conceptual framework of the study, which was based on the research framework. Hypotheses of the study are summarized in Table II. These hypotheses argue, in brief, that technology infrastructure, management, human resources, cost, environmental factors and organizational processes have a positive effect on implementation success, while barriers have a negative effect on implementation success.

TABLE II. HYPOTHESES

Hypothesis	Proposed Relationship
1	Technology Infrastructure → Implementation Success (+)
2	Management → Implementation Success (+)
3	Human Resources → Implementation Success (+)
4	Cost → Implementation Success (+)
5	Environmental Factors → Implementation Success (+)
6	Organizational Processes → Implementation Success (+)
7	Barriers → Implementation Success (-)

III. RESEARCH METHODOLOGY

The primary data was collected using an online survey. The survey was collected from BDA technical specialists, technical managers, marketing managers, and top managers in organizations that had implemented BDA for CRM within the past two years (n = 212). The survey (attached in the Appendix) used five-point Likert scales to evaluate agreement on statements that evaluated each of the factors identified above. This approach was selected because it allows for evaluation of somewhat subjective factors [17]. The sample size of the study is adequate given typical rules of thumb for the selected analysis approach, which typically requires a minimum sample of 200 members [18].

Analysis was conducted using a SEM approach. This approach was selected because it is a useful way to identify the structure of latent variables and the relationship of these latent variables [19]. Confirmatory Factor Analysis (CFA) was used to validate the measurement model, with factor loadings of less than 0.6 and R<sup>2</sup> lower than 0.4 being removed from the measurement model based on standard rules of thumb regarding model validation [19].

Following validation of the measurement model, the structural model was evaluated using standard goodness of fit measures, also summarized in Table III. The convergent and divergent validity of the CFA model was assessed using CR, AVE, and MSV, with reliability tested using CR and Cronbach’s alpha, with standard measures presented below [20]. Each of these values have a rule of thumb threshold which is required to prove validity and reliability of the model. (These value thresholds are summarized in Table 2.) The regression outcomes were used to accept relationships between observed values in this round of the analysis. Regression relationships were accepted at p < .05.

TABLE III. RELIABILITY AND FIT MEASURES

Model Characteristic	Acceptance Criterion
<i>Model Validity</i>	
Convergent Validity	AVE > .5
Discriminant Validity	MSV < AVE
<i>Model Reliability</i>	
Internal Reliability	$\alpha \geq .7$
Composite Reliability	CR $\geq .6$
<i>Model Fit</i>	
Root mean square error	RMSEA < .08
Goodness of fit index	GFI > .90
Comparative fit index	CFI > .90
Chi-square/degrees of freedom	Chisq/df < 3

#### IV. FINDINGS AND DISCUSSION

The findings of the measurement model and CRM process are presented below. This is followed by a discussion with the literature that evaluates the performance of the model.

##### A. Findings

*A1. Measurement Model.* The measurement model indicated that all of the proposed latent variables were consistent with the established criteria for validity and reliability (Table IV). These factors can be compared to the reliability and fit measures (Table III). As this comparison shows, the goodness of fit of the model was adequate.

There were several items eliminated during the validation of the measurement model, as indicated in the appendix. However, since all of the latent variables were identified, the analysis stage continued to the process.

TABLE IV. VALIDATION OF THE MEASUREMENT MODEL

Latent Variable	Alpha	AVE	CR	MSV
Barriers (4 items)	.782	.561	.605	.402
Cost (3 items)	.757	.602	.602	.530
Environment (3 items)	.744	.684	.671	.601
Human Resources (6 items)	.812	.691	.683	.632
Management (9 items)	.917	.702	.721	.650
Organizational Processes (3 items)	.791	.564	.601	.450
Technology Infrastructure (3 items)	.768	.582	.602	.500
Implementation Success (3 items)	.703	.502	.607	.435

*A2. Structural Model.* Goodness of fit was adequate for the structural model for all the factors identified (RMSEA = .04; GFI = .94; CFI = .93; Chisq/df = 2.2). Therefore, although the model could not be described as an excellent fit, it did meet the established criteria for fit and therefore analysis could continue.

The structural model could be described as moderately strong (R<sup>2</sup> = .491). This indicates that the latent independent variables explained 49.1% of the variance in the outcome variable (Implementation Success). The factor loadings are all above 0.6, indicating that all of the latent variables

identified were significant in Implementation Success. The R<sup>2</sup> values show that the individual latent variables accounted for between 7% and 11% of the variance in the outcome, depending on the measure. As predicted, Barriers had a negative relationship to Implementation Success. Therefore, all seven hypotheses were accepted.

##### B. Discussion

This research validated the integrative structural model developed to identify organizational factors in implementation success for BDA in CRM. The integrative model was based on several previous studies, which had identified one or more of these factor clusters [2] [3] [5] [7] [12] [13] [14] [15]. Typically, these previous authors were not focused on CRM applications for BDA, but instead were investigating a general application of the technology or were examining areas such as innovation. Thus, this research does represent a contribution to the literature in that it identifies a broad set of organizational factors that could influence implementation.

This research has made progress toward an integrated model of organizational success, but there are more opportunities for development. Of the factors that were identified as significant, most came from three models, which included [5] [13] and [7]. The other studies typically had relatively smaller number of relevant factors. This suggests that a more parsimonious organizational model could be constructed, which did not rely on a widely variant set of factors. It is also possible that there could be a slightly different component structure, which could be determined using a different approach. This research has therefore contributed to an under-investigated area of understanding for BDA [16]. This research model could be tested using additional research.

#### V. CONCLUSION AND RECOMMENDATIONS

This research was undertaken to identify organizational factors in successful implementation of BDA systems for CRM success. This is an inherently complex problem because of multiple factors, including organizational capabilities and resources, the technological complexity of big data itself and its characteristics, and the need to adapt the organization to big data. However, previous studies had not investigated this question for CRM, leaving a significant gap in the literature. This research identified several organizational factors that influenced successful implementation of BDA for CRM. These factors included technology infrastructure, management, human resources, organizational readiness, cost of implementation, environmental factors, organizational processes associated with the implementation, and barriers. Of these, the first six were positive influences, and the final factor was negative. The outcomes showed that these organizational factors were a significant influence on whether the organization could

effectively implement CRM. Thus, this research did contribute to the literature in an area where so far there has been limited research. The major implication of these findings for organizations implementing BDA for CRM is that there must be a data-driven approach, management buy-in, appropriate human resources and other capabilities available prior to implementation to ensure success.

There are some significant limitations to this research. One of these limitations is that the study did not investigate how implementation success was measured or what type of system was implemented. This was necessary because of the wide technical variance between BDA implementations and the wide choice of tools available, and because the goal of this study was to specifically not investigate the technical implementation details. However, it does mean that there could be various, disparate types of systems included in the study. The research also only investigated organizations that have implemented such systems. This could exclude organizations that considered by rejected the tool or whose implementation failed or was abandoned. Thus, there is still more research to be done in this area.

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**APPENDIX: Figures 1 and 2**

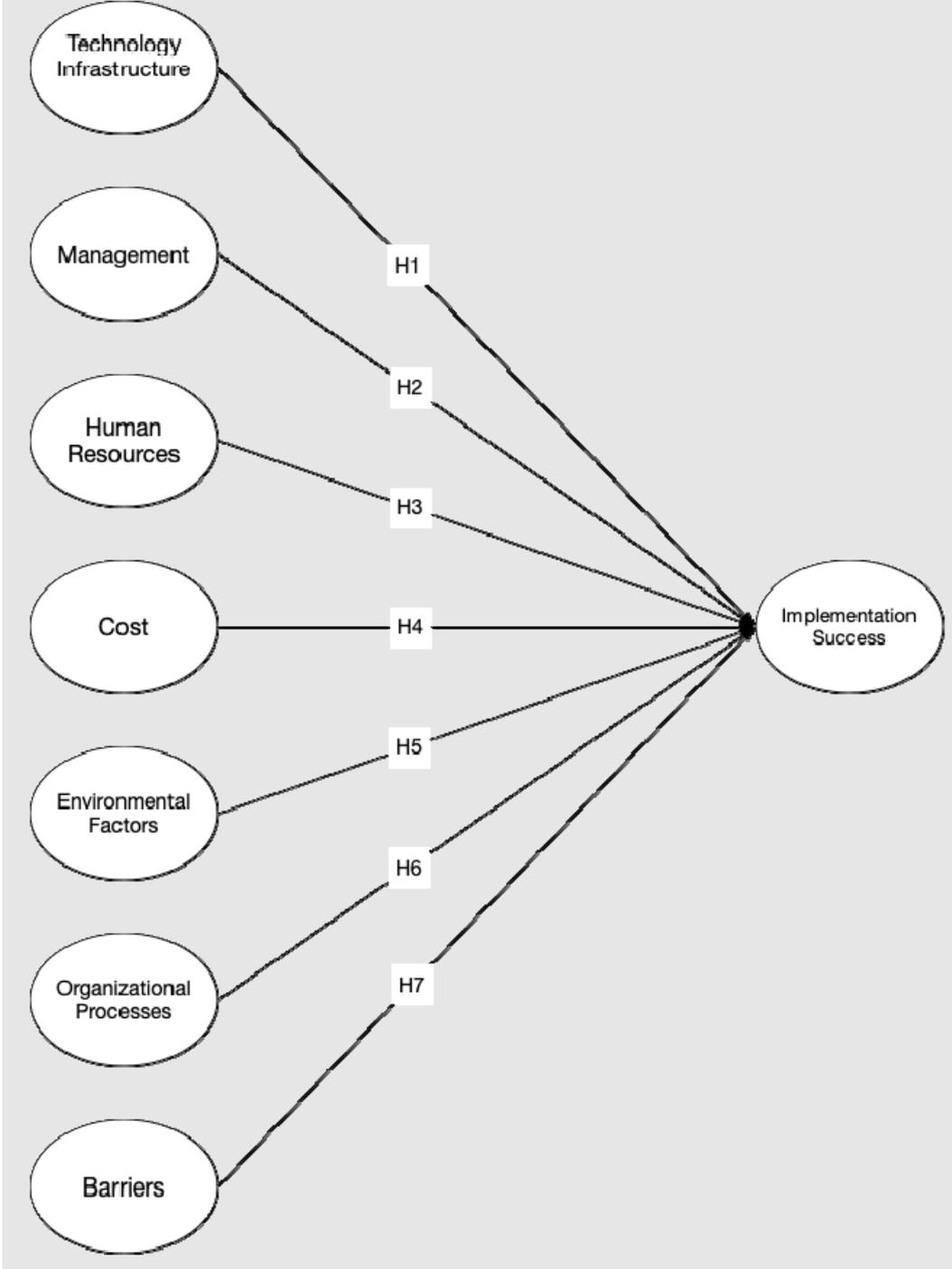
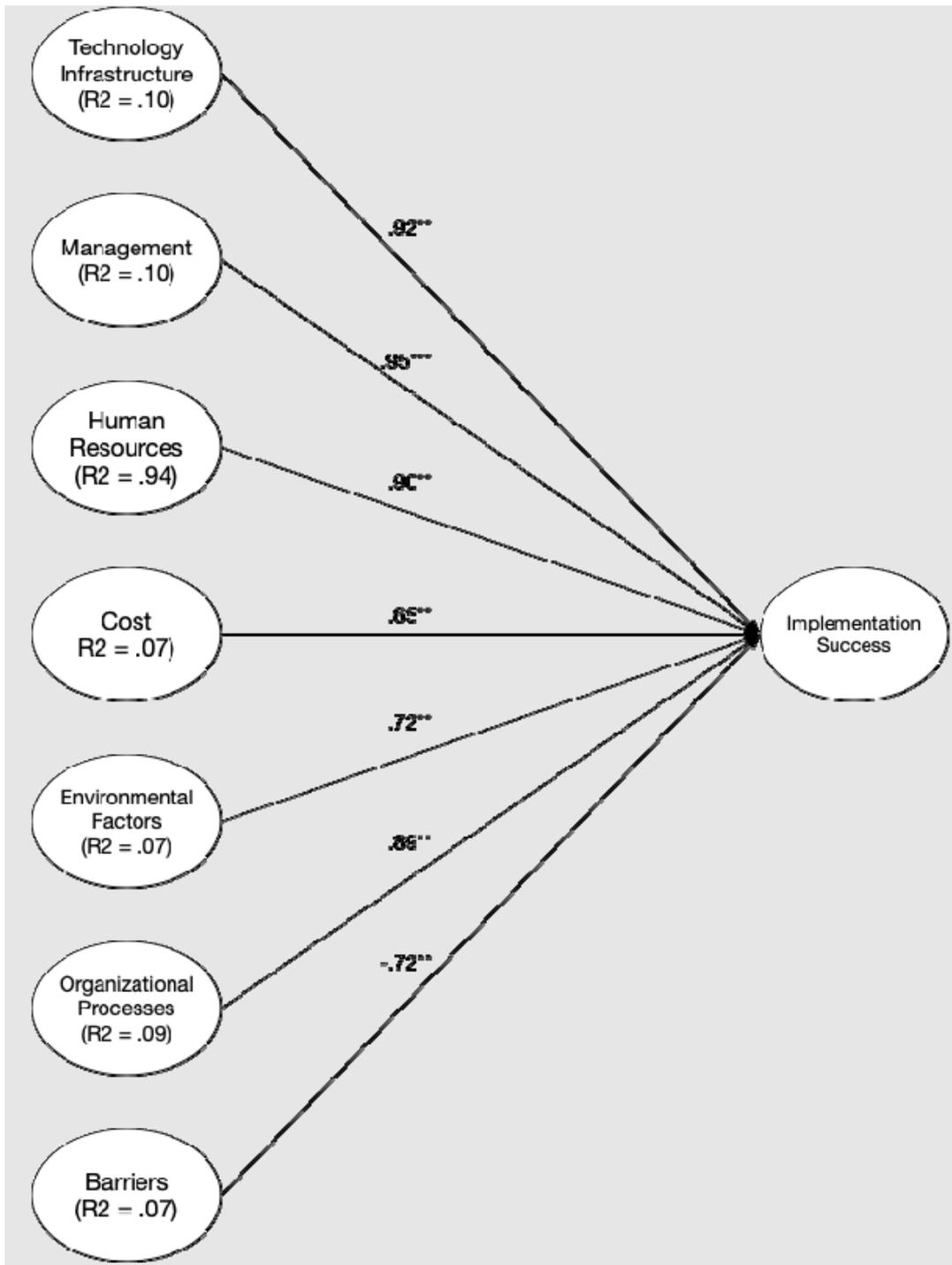


Figure 1. Conceptual framework



Note: \* p < .05 \*\* p < .01 \*\*\* p < .001

Figure 2. Structural model