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Antecedents of Task Innovation: The role of Management Information Systems

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Abstract

In the current economic crisis, organizations' information processing capabilities are challenged by additional and diverse demands. In this context, banks attempt to develop and apply more sophisticated and comprehensive Management Information Systems (MISs), in order to exploit their innovation competences and build a sustainable competitive advantage. This paper explores the antecedents of task innovation, reflected on (MIS) effectiveness, which was operationalised by the Competing Value Model (CVM). CVM synthesizes four different schools of management in order to measure IS effectiveness: open system (OS), human relations (HR), internal process (IP) and rational model (RM). Drawing from a sample of 186 bank employees in Greece, a structural model has been built and estimated using Partial Least Squares. Findings reveal that the HR component characterized by interpersonal communication, group decision making, team collaboration and personalization is the most important predictor of task innovation (TI). The RM dimension of MIS effectiveness based on optimizing, goal setting and forecasting has an indirect effect on HR via the OS and IP elements. The rest MIS effectiveness components (OS, IP) are indirectly associated with task innovation, through HR dimension.

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Keywords: MIS effectiveness; Competing values framework; task innovation; banking.

1. Introduction

Productivity, innovation, quality and flexibility of services improvement at the individual and organizational levels have emerged as key advantages for organizations to survive and excel in this global financial crisis [1,2] and have been extensively researched in numerous studies with the aid of computational methods [3 – 17]. Under

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the pressure of cost reductions, firms' information processing capabilities are challenged by additional and diverse demands, in an attempt to develop and apply more effective MISs [18, 19]. Even though the impact of MIS on performance is widely acknowledged, previous researchers exploring their direct and indirect association concluded to rather mixed and confusing results [20, 21].

Among the various benefits of MIS is their capability to provide a broad range of information about multiple dimensions of the firm's operations [3,5], thus supporting decision-making and performance achievement [1, 22, 23] and facilitating the work of end users. Focusing on the banking sector, organizations suffer from achieving different levels of MIS effectiveness, leading to different levels of work outcomes, such as task innovation.

This paper aims to investigate the impact of different MIS effectiveness dimensions on task innovation by utilizing the Competing Value Model (CVM).

After this introductory section MIS effectiveness built on the CVM is being reviewed. This is followed by a presentation of the research methodology, including the questionnaire design and sampling. Statistical analyses and results are following and at the end, conclusions and managerial implications are discussed.

2. Management Information Systems Effectiveness

The management of information technology plays a crucial role, especially in service sectors such as banking, which build their competitive advantage on credibility and information. Despite the absence of consensus on a standard definition of MIS in information systems literature, Davis and Olsen [24] have suggested a commonly cited definition, according to which MIS is "an integrated, user machine system providing the necessary information to support core functions of the firm such as operations, management, and decision making".

Despite the fact that MIS efficiency is relatively easy to define and measure, it is considered more difficult to operationalize MIS effectiveness sufficiently. Moreover, the lack of a relevant theory and the discord on a definition of MIS effectiveness exacerbate confusion and vagueness [25].

This leads to an examination of the organizational effectiveness literature in order to define MIS effectiveness. Unfortunately, there is no consensus on a universally accepted organizational effectiveness theory, because of the inherently high-level abstraction of this concept.

The competing values model (CVM) initially developed to measure organizational effectiveness by Quinn and Rohrbaugh [26] has been selected in this study because it was qualified as the most suitable basis to develop the MIS effectiveness construct. CVM shares wider acceptance among academics as it has been validated by an increasing number of researchers not only as a model of organizational effectiveness, but also as a measurement instrument for other organizational phenomena. CVM has also been utilized as a device for mapping organizations' profiles and conducting comparative analysis [27]. Furthermore, CVM provides a set of tools and techniques to practitioners in order to develop and sustain more desirable profiles of effectiveness.

CVM emphasizes the competing tensions and conflicts across two primary axes, which form a four quadrant model. The first axis extends from flexibility and change to control and order. The second reflects the conflict between the internal focus and external focus. Thus, the intersection of these two dimensions defines the following four models or archetypes: open system (OS), human relations (HR), internal process (IP) and rational model (RM).

Exploring the inertial impact of organizational culture on IT implementation, Cooper [28] developed an instrument based on CVM, for the measurement of MIS effectiveness. This construct is founded on distinctive criteria in relation to the varying capabilities of different MIS types, as interpreted by an in-depth examination provided by academics and MIS experts. A multidimensional scaling technique was applied to derive the MIS experts' perceptions mapping and to confirm the clustering of MIS attributes on the following four quadrants proposed by CVM:

- OS is linked with flexibility and external orientations, and favors MIS capabilities that enhance environment scanning for opportunities and threats, filtering information, promoting doubt and argument, and fostering interorganizational alliances.
- HR is characterized by flexibility, morale, teamwork and participation values. MIS capabilities of this quadrant facilitate member dialogue, participation, and development. The MIS possesses attributes that promote interpersonal communication, conferencing and cooperation through systems such as electronic mail and group decision support, in an attempt to achieve cohesion and commitment. Regarding this model, MIS capabilities tend to build or reinforce group collaboration, job satisfaction, involvement and development through educating and instructing processes. For example, personalized or user controllable systems fall in this category.
- IP is marked by control and internal orientations and supports MIS capabilities, which are typically accounting oriented. It also establishes organizational wide measurement and control processes and procedures. Internal monitoring (e.g. accounting reporting), internal controlling (e.g. budgeting) and documentation (e.g. record keeping) are highly valued.
- RM is focused on organizational planning, directing, goal setting and external orientation. This quadrant puts special emphasis on uncertainty reduction and operations research, such as modeling, optimizing (e.g. revenue maximization) and forecasting.

The objective of the present study is the investigation of the impact of MIS effectiveness on task innovation. It is expected that each MIS effectiveness archetype will be associated with task innovation reflecting characteristics of the relative archetype. For example, IP will be related to task innovation by providing the necessary infra-structure and control to document and diffuse successful innovative actions, while OS archetype will provide input information from environment scanning and promoting experimentation. The HR component will cultivate the required morale, personal involvement and commitment to foster innovation, while the RM aspect of MIS facilitates planning, directing and goal setting. We thus hypothesize:

H1: MIS effectiveness is significantly and positively related to task innovation.

3. METHODOLOGY

3.1. Questionnaire design

The field research was based on a structured questionnaire, built on existing validated scales. The MIS effectiveness construct was proposed by Cooper [28], and its validity was confirmed by several scholars [29]. Likewise, the instrument of Doll and Torkzadeh [30] for measuring task innovation has been adopted, which has been conceptualized and used in previous empirical studies [1]. All items were anchored in a seven-point Likert scale. The research instrument was tested twice before it was released. Firstly, it was examined by one branch executive from twelve different bank branches (four from small, four from medium and four from large banks). Secondly, it was handed to academics for in depth discussions. This process was fruitful, since they confirmed the cognitive relevance of the questionnaire to banks.

3.2. Sampling

The field research was conducted using a structured questionnaire in a cross-sectional sample of banks in Athens. The field research was focused on the banking sector, since MISs are considered as the foundation of their core information competence to build their competitive advantage.

Sixteen (16) different banks and forty two (42) bank branches participated in the survey. The survey respondents' selection was based on their affiliation to MIS, regardless of their hierarchical position, in order to ensure a level of MIS effectiveness awareness. From the initial sample of 400 employees, 186 valid

questionnaires were gathered, thus achieving a response rate of 46.5%, which is considered to be satisfactory for this type of empirical research.

The 27% of the sample were small banks, 23% medium and 50% large. The 60% of the respondents were males. The 34% of the respondents aged between 25 and 35 years old and 29% were between 36 and 45. The 34.4% of the sample had working experience between 6 and 10 years and 30.1% had more than 20 years of experience. The demographics of our sample converge with other studies in the banking sector, in the city of Athens [31].

4. RESULTS

4.1. Partial Least Squares approach

Data were analyzed through path modeling using the partial least squares (PLS) approach and the SmartPLS software [32]. The variance-based PLS procedure is a latent variable modeling technique that incorporates multiple dependent constructs and it is considered to be useful in investigating descriptive and predictive relationships [33] particularly with samples of less than 200 participants [34]. A strong advantage of the PLS approach when compared to covariance-based structural equation modeling is its ability to deal with situations where knowledge about distribution of the latent variables is restricted, requirements about the closeness between estimates and the data should be met and sample size is too small [35]. Besides, a minimum sample size that is (1) ten times the number of items comprising the most formative constructs, or (2) ten times the largest number of structural paths directed at a particular construct in the inner path model is recommended [36]. In this research the measurement model consists of reflective indicators exclusively. Therefore, only the second criterion is relevant. The dependent variable with the largest number of predictor variables is task innovation. This number is four. Thus, sample size should be at least 40. Based on this recommendation the sample meets the sample size requirements of PLS.

A PLS model should be developed in two stages: the measurement model and the structural model [37]. The measurement model examines the relations between manifest variables (MV) and latent variables (LV). The measurement model is focused on the evaluation of the validity and reliability of the constructs in the model. Individual item reliability is assessed by examining respective items' loadings on their respective latent construct [38].

The Bartlett sphericity testing on the degree of correlation between the variables ($p<0.001$) and the Kaiser–Meyer–Olkin (KMO) index verified the appropriateness of the sample. Composite reliability (CR) [38] and Cronbach's alpha [40] were calculated to assess the reliability of scales. CR is preferred over Cronbach's alpha because it provides a better estimate of variance shared by the respected indicators, using items' loadings obtained within the nomological network [41]. All constructs exhibited CR and Cronbach's alpha greater than the minimum acceptable level of 0.70 [42, 43], as illustrated in table 1.

The average variance extracted (AVE) criterion is adopted for the estimation of scales' convergent validity [42]. AVE value of a latent variable should be higher than 0.50, in order to explain more than half of the variance of its indicators on average [37]. As shown in table 1, all scales met this criterion. In addition, convergent validity of a scale may be assessed by examining the factor loadings of the items on the model's constructs. High items' loadings on their underlying construct and lower loadings on unrelated constructs designates convergent validity. Items' loadings of 0.70 or higher provide evidence for convergent validity [44]. However, other scholars suggested that factor loadings might be acceptable at the value of 0.55 [45]. In our study, factor loadings of all items on their respective associated constructs are equal or greater than 0.70, while their loadings on unrelated constructs are less than 0.4.

In particular, the Open System dimension of MIS effectiveness consisted of items referring to environmental scanning and filtering, inter-organizational linking, doubt and argument promoting. The Human Relations issues

of MIS comprised items referring to interpersonal communicating and conferencing, group decision supporting, and personalized systems. The Internal Process dimension consisted of items referring to internal monitoring, internal controlling, record keeping, optimizing, precision and reliable systems. The Rational Goal model dimension embraced items such as modeling, forecasting, sensitivity analysis and integrated systems.

Table 1. Results of reliability, convergent and discriminant validity analysis of all scales.

	AVE	CR	Cronbach's Alpha	Com-munality	Redund-ancy	HR	IP	OS	RM	TI	R^2	CV-Com-munality	CV-Redund-ancy
HR	0.751	0.938	0.917	0.7514	0.3436	0.867	-	-	-	-	0.767	0.606	0.558
IP	0.763	0.958	0.951	0.7431	0.5551	0.765	0.874	-	-	-	0.756	0.664	0.541
OS	0.766	0.907	0.846	0.7656	0.4335	0.816	0.636	0.875	-		0.573	0.514	0.428
RM	0.759	0.950	0.938	0.7289	-	0.844	0.864	0.757	0.871	-	-	0.633	-
TI	0.686	0.867	0.770	0.6861	0.2785	0.705	0.631	0.631	0.657	0.828	0.526	0.369	0.334

The Kaiser–Meyer–Olkin (KMO) indicator was calculated to assess sample size adequacy. The minimum acceptable level is 0.5. Bartlett's test of sphericity is significant at $p<0.001$ for all scales. Valid N= 186.

Discriminant validity of the measurement model was examined through the AVE test [42] and cross loadings criterion [46]. Discriminant validity has been achieved when square root of the respective AVE of each construct exceeds the correlations between the factors making each pair [42]. In that case, each LV shares more variance with its own block of indicators than with another LV representing a different block of indicators. Table 1 also displays the correlation matrix for the constructs. The diagonal of the matrix contains the square roots of the AVEs which provide a metric comparable to a correlation. The diagonal elements are greater than the off-diagonal elements in the corresponding rows and columns, thus the results demonstrated adequate discriminant validity for all constructs in our research model.

The nonparametric bootstrapping procedure [46, 47] using 200 subsamples was conducted to evaluate the structural model and particularly, the statistical significance of all parameter estimates. Given that PLS makes no distributional assumptions for parameter estimation, it does not produce any kind of fit indices like TFI, RMSEA or CFI provided by covariance based SEM. The PLS structural model is mainly evaluated by R-square of endogenous LV [46], effect size (f2) [48], Goodness of Fit index (GoF) [49] and by using the Stone-Geiser Q-square test for predictive relevance [50, 51]. R-square values of 0.67, 0.33, and 0.19 for endogenous LV have been characterized as substantial, moderate and weak respectively [46]. Results confirmed almost substantial r-square values in our study, as shown in table 1.

Effect sizes were determined by a method proposed in [48] and adopted in [52] in PLS path models. Similarly, f^2 values of 0.02, 0.15, and 0.35 have been characterized as small, medium, and large effects, respectively [48]. The Goodness-of-fit (GoF) index [49] was employed to evaluate the overall fit of the model. GoF represents an index for validating the overall PLS model and it is normed between 0 and 1, where a higher value indicates better path model estimations. GoF for our model is 0.695, meaning that the model is able to take into account 69.5% of the achievable fit.

The Q-squares statistics evaluate the predictive relevance of the model, whereas a score higher than 0 means that the model has predictive relevance [35]. In the present study, two kinds of Q-squares statistics are estimated, namely: (a) cross-validated communality (H2j) and (b) cross-validated redundancy (F2j). By employing the blindfolding procedure, H2j reflecting the capacity of the path model to predict the manifest variables (MVs) directly from their own LV [49], and F2j estimating the capacity of the path model to predict the endogenous MVs indirectly from a prediction of their own LV using the related structural relation [46], were calculated by

cross-validation. In accordance to effect size (f2), the q-square values of 0.02, 0.15, and 0.35 signify small, medium, and large predictive relevance of certain LV, evaluating the relative impact of the structural model on the observed measures for the latent dependent variable [37]. In our study, all values indicate strong predictive relevance of the relevant LV.

4.2. Results

The path relationships (standardized regression coefficients) of the model were estimated performing SmartPLS. The bootstrap procedure was used to obtain t-statistics in order to evaluate the significance of the parameters. The results of the parameter estimation are shown in Fig. 2. No serious problems of multi-collinearity exist between the independent variables as the Variance Inflation Factors (VIF) are far below the 3 points limit suggested in Social Sciences literature.

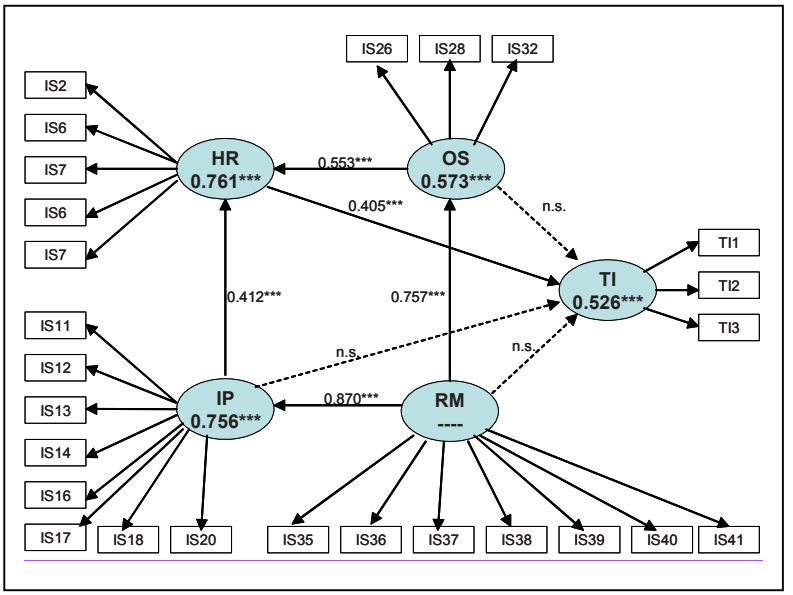

Figure 1. Structural model of MIS effectiveness and task innovation.

These results provide empirical support for the hypothesis that MIS effectiveness exerts a significant impact on task innovation. Among the four components of MIS effectiveness, human relations (HR) emerged as the most important predictor of task innovation (TI), while MIS effectiveness contributes to a substantial proportion of the variance in the TI (52.6%). In particular, only human relations (HR) aspect of MIS effectiveness directly influences task innovation (β=0.405, $p<0.001$). HR is focused on interpersonal communication and cooperation through systems supporting group decision making, reinforcing team collaboration and fostering job satisfaction, involvement and commitment. These attributes facilitate creativity, autonomy as foundations of task innovation.

On the other hand, the rational model (RM) dimension of MIS effectiveness has an indirect effect on HR via open system (OS) and internal process (IP) elements. RM aspects of modeling, optimizing, goal setting and forecasting contributes toward external oriented features of OS and stability focused elements of IP. Thus, the rest MIS effectiveness components (OS, IP, RM) are indirectly associated with task innovation, through HR dimension. IP effectiveness is based on internal monitoring and controlling as well as the documentation of all procedures, sharing the internal orientation of HR. Similarly, OS favors MIS capabilities that enhance filtering

information, promoting doubt and argument, and fostering inter-organizational alliances, sharing with HR the flexibility aspect.

5. Discussion and Conclusions

The aim of the present study was to examine the perceived impact of four MIS effectiveness archetypes (open system, human relations, internal process and rational) on task innovation, by providing empirical evidence from banks in Greece.

Results provide empirical support for the hypothesis that MIS effectiveness exerts a significant impact on task innovation. Among the four components of MIS effectiveness, human relations (HR) emerged as the most important predictor of task innovation (TI), while the rest MIS effectiveness components (OS, IP, RM) are indirectly associated with task innovation.

Moreover, the study applied the partial least squares path modelling method which has significant advantages in terms of dealing with complex models and studies with many variables. This research demonstrated that the method works well in a field study and in exploratory research. Given that PLS works with a complex model, small sample sizes and violations of the normal distribution assumption it could be a powerful tool for MIS researchers who deal with complex path models, particularly in studying socio-technical aspects of IT.

Knowledge acquired from this study can potentially benefit bank managers and information systems' practitioners who currently work with MIS implementation in countries such as Greece. The strong influence of human relations elements on the development of task innovation suggests that MIS systems should be focused on capabilities facilitating interpersonal communication and cooperation through systems, fostering group decision making, reinforcing team collaboration and cultivating job satisfaction, personal involvement and commitment. Thus, MIS practitioners should built systems enhancing the relevant effectiveness dimensions; those are MIS capabilities supporting involvement, communication and self-development (HR), followed by filtering information and environment scanning (OS) as well as internal controlling, monitoring and documentation and stability (IP) at the expense of modelling, optimizing and forecasting (RM).

Nevertheless, there are several potential limitations of this study. Because of limited budget, the need to depend on the restricted area of Athens emerged, but given that the response rates in all banks were high and similar, we maintain that findings were not compromised by the sampling strategy. Another potential limitation was due to the cross-sectional nature of the survey design. Furthermore, relevant literature suggests that other elements of the internal environment of the firm such as absorptive capacity of technology, business strategy [53], culture [53], stress [55, 56] and leadership may exert a significant influence on the successful development of task outcomes [57]. Thus, future research needs to adopt a more holistic view in order to explore their interplay.

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