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The Evolution of the Impact of E-business Technology on Operational Competence and Profitability in the Economic Downturns

(Full Paper Submission)

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ABSTRACT

Examining the evolution of the e-business technology impact on operational competence and profitability, we find that e-business technology has a positive effect on operational competence that decreases over the time, and that the portfolio of operational capabilities has a positive impact on profitability that becomes more significant over the time.

KEYWORDS: E-business technology, Operational capabilities, Business value of information technology

INTRODUCTION

Firms invest millions of Euros in information technology (IT) to build process capabilities and increase their competitiveness. However, not all IT investments generate the expected results (Carr, 2003). As the current economy worldwide turns downward, this situation demands managers to carefully (re)assess all their IT investments.

The majority of past research focused on IT impact on the supply chain management activities through a cross-sectional design (Devaraj et al, 2007). What remains unclear is whether and how IT investments impact on a broad set of operational capabilities and performance over the time. Considering that IT and operational capabilities, their relationship and effect on firm performance can be dynamic, this seems to be a significant gap that needs to be filled.

This research focuses on e-business technology (one type of IT capability investment). E-business technology can improve the firm's operations management system by enabling the real-time interchange of information across the supply chain (Setia & Patel, 2013). However, e-business technology has become commoditized and can be affordable for the most of firms, which can reduce its potential to create operational advantages over the time (Carr, 2003). How does evolve the e-business technology effect on the firm's operations management system over the time? We believe our field needs to provide an answer to this research question.

The operational capabilities of the firm can be refined through time and experience. In this sense, early developers of operational capabilities through early investment in e-business technology can achieve a greater competitiveness based on a higher time and experience to develop their operational capabilities. Do early e-business technology investments imply differences in the operations management impact on the firm's competitiveness over the time? This also seems another interesting research question that needs to be answered.

Drawing on the IT-enabled organizational capabilities perspective (Benitez-Amado & Walczuch, 2012) and the operational capabilities-based theory (Peng et al, 2008), the main goal of this study is to examine the evolution of the impact of e-business technology on operational competence and profitability. To achieve this goal we use the structural equation modeling (SEM) technique with an innovative panel data set for the period 2008-2010 on a sample of 154 large firms in Spain. The empirical analysis suggests that the e-business technology positive effect on operational competence decreases over the time, while the positive impact of operational competence on profitability increases over the time.

THEORY AND HYPOTHESES

IT-enabled Organizational Capabilities Perspective and the Operational Capabilities-based Theory

The IT enabled-organizational capabilities perspective has argued that one of the key mechanisms through which IT capability investments influence firm performance is by developing organizational/process capabilities, such as business flexibility or new product development (Benitez-Amado & Ray, 2012). This study builds on the IT-enabled organizational capabilities to conceptualize e-business technology and to link theoretically e-business technology to operational competence and profitability.

Operational routines are patterns of activities/processes that a firm performs at the operations level, which can lead to superior firm performance. Operational capabilities are the firm's proficiency in using a collection of interrelated operational routines to solve operational problems and implement the operations strategy (Peng et al, 2008). The theory of operational capabilities provides a strong theoretical framework to conceptualize e-business technology and operational competence, and to link these constructs both among themselves and to profitability. Figure 1 presents the conceptual model.

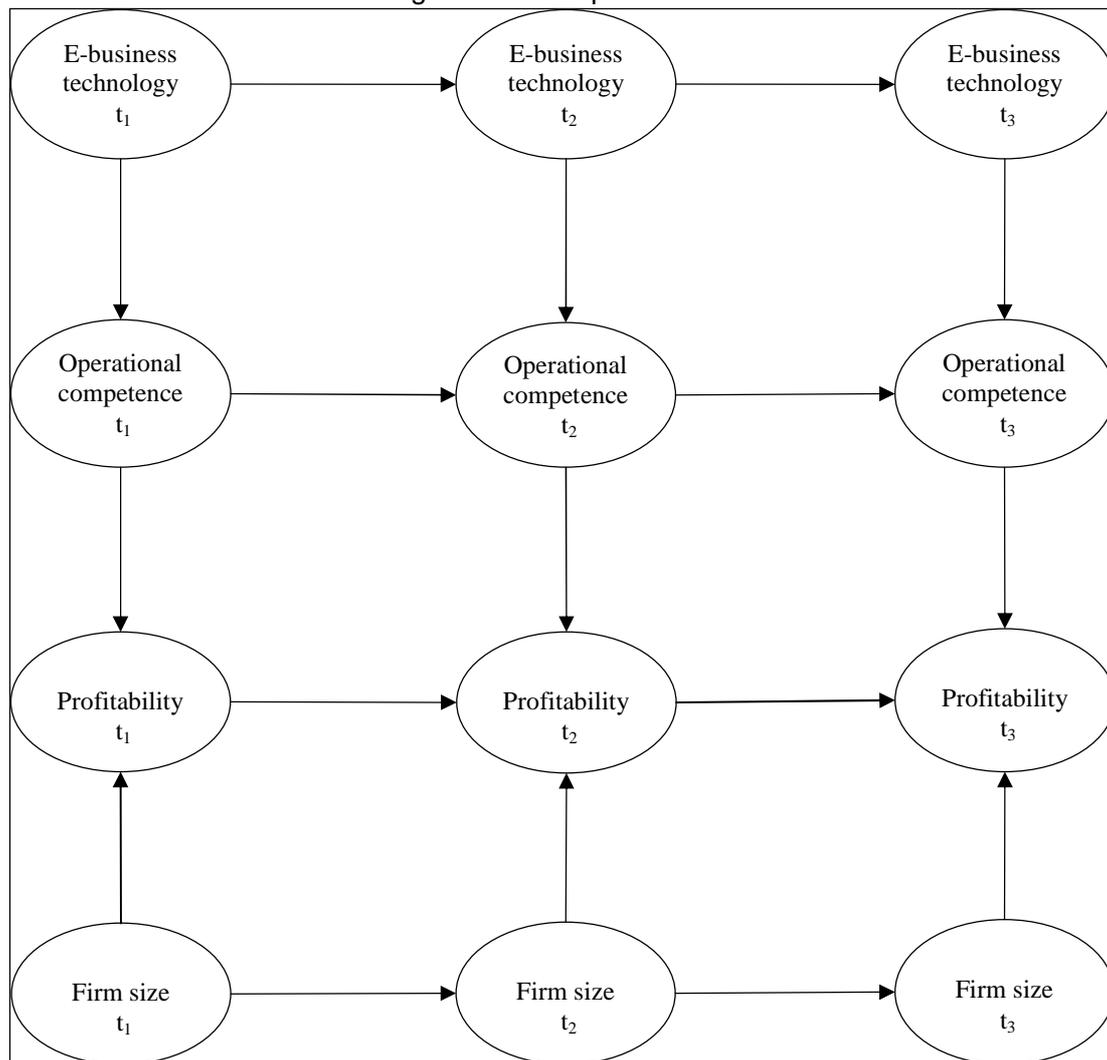
Conceptualization of E-business Technology, Operational Competence and Profitability

E-business technology capability is the firm's proficiency in leveraging its web/Internet-based technologies to acquire/provide accurate, timely, reliable and secure information from/to key users at the operations level (Devaraj et al, 2007).

Operational competence refers to the firm's proficiency in exploiting its portfolio of operational capabilities (Setia & Patel, 2013). Based on the work of Tatikonda et al. (2013), and Benitez-Amado and Llorens-Montes (2014) we focus on a portfolio of operational capabilities that determines operational competence, composed of inventory turnover, gross margin, employee productivity, operational talent management and operational excellence. Inventory turnover refers to the firm's proficiency in maintaining fast flows of materials/products in the operations management system while successfully meeting the customer demand. Gross margin is the

firm's proficiency in managing/estimating proper product margins. Employee productivity refers to the firm's proficiency in stimulating the personnel to achieve a higher individual performance. Operational talent management is the firm's proficiency in recruiting (sourcing, attracting, selecting), getting on board, developing and retaining operational talent (Benitez-Amado et al, 2013). Operational excellence refers to the firm's proficiency in developing and executing operations routines to manufacture/supply products agilely to the market. This study focuses on firm profitability to assess the firm's business benefits.

Figure 1: Conceptual model



The Evolution of the Impact of E-business Technology on Operational Competence and Profitability

E-business technology can enable the development of operational competence by facilitating the improvement of inventory turnover, gross margin, employee productivity, operational talent management and operational excellence. E-business technology enables firms to share real-

time information along the supply chain to facilitate replenishment and maintains fast flows of materials/products that increases inventory turnover (Devaraj et al, 2007).

E-business technology can also enable the firm's proficiency in managing successful product margins. Web-based technology enables the firm to real-time interchange accurate and timely information on product cost and demand with upstream suppliers and downstream customers which in turn can better manage the product margins (Sanders, 2007). Similarly, e-business technology can also be leveraged to increase employee productivity. The firm's web-based communication networks (e.g., email, Intranet) enable the employees to access to a more heterogeneous/diverse knowledge (e.g., information about the manufacturing process/other employees) and learn to perform multiple tasks, which increase the employee productivity (Aral et al, 2012).

E-business technology can also improve the management of operational talent. Through e-business technology, the firm acquires/provides accurate and timely information from/to the market to recruit and get on board outstanding operational talent to design and integrate its talent base. For example, Cortefiel (an apparel manufacturer in Spain) uses web-based social media tools such as LinkedIn, Facebook and Twitter to recruit operational managerial talent that fits the profile needed in designing its talent base. Web-based technology enables the firm to implement scheduling and workplace flexibility activities to retain operational talent, and to provide reliable information on goals completion, performance appraisal and career planning to develop and retain operational talent (Benitez-Amado et al, 2013). Finally, leveraging web-based business applications (e.g., operational module of an enterprise resource planning) enables to better execute the operational routines and manufacturing/supplying products agilely to the markets to pursue the operational excellence.

We also predict that the positive effect of e-business technology on operational competence can decrease over the time for two reasons. First, additional investments in e-business technologies (after investments in prior periods) can diminish the operational marginal returns (Aral et al, 2012). Second, e-business technology has been commoditized and can be affordable for the most of firms. Consequently, follower firms can learn to invest in e-business technology and develop e-business technology capability, which can convert e-business technology into a non-unique capability and its effect on operational competence can decrease over the time (Carr, 2003). We therefore hypothesize that:

Hypothesis 1 (H1): E-business technology has a positive effect on operational competence that decreases over the time.

We also argue that operational competence has a positive impact on profitability. The firm's proficiency in maintaining fast flows of materials/products can save costs to increase the firm's profitability (Tatikonda et al, 2013). Since firms can develop different proficiencies in managing/estimating product margins, this operational capability can generate differences in firm's profits and profitability, thus indicating that it is rational to expect a positive impact of gross margin on profitability. Higher employee productivity and better firm's proficiency in recruiting, getting on board, developing and retaining operational talent reduce costs and increase revenues, which in turn increases business benefits and profitability (Ahmad & Schroeder, 2003). Finally, by developing operational routines to achieve operational flexibility, the operational excellence can increase profitability (Beach et al, 2000).

Because of the firm's proficiency in exploiting its portfolio of operational capabilities is the core of the firm's business model and this proficiency can be refined through experience, we expect that positive impact of operational competence on profitability increases over the time.

Hypothesis 2 (H2): Operational competence has a positive impact on profitability that increases over the time.

Although not stated as formal hypotheses, we expect that e-business technology, operational competence, profitability and firm size (control variable) in one period should affect the same construct in a subsequent period (Johnson et al, 2006). For example, since current business benefits are influenced by prior business benefits (i.e., the so-called 'halo effect'), we can also expect that profitability obtained in the prior period affects the profitability in the subsequent period (Santhanam & Hartono, 2003).

RESEARCH METHODOLOGY

Sample and Data

The proposed model is tested with an innovative secondary data set collected from a sample of 154 manufacturing and service large firms in Spain for the period 2008-2010. We randomly selected 154 manufacturing and service firms located in Spain included in the MERCO database in 2006 and 2007. This database includes a well-known ranking and evaluation of corporate reputation and employer brand of a significant number of firms in Spain and Latin America. Our sample can be considered as representative of the manufacturing and service large firms located in Spain. We started the data collection by gathering data from MERCO database. After that, we used the name of firms included in MERCO database to collect additional information from SABI and Actualidad Economica databases and the firm's websites.

Measures

We check the absence (0) or presence (1) of a set of 26 e-business technology services (see Table 1 of the Appendix) with information collected from the firm's website. We measure e-business technology through the number of e-business technologies that each firm possesses. This measure ranges from 0 to 26.

Operational competence is a formative construct determined by inventory turnover, gross margin, employee productivity, operational talent management and operational excellence. Inventory turnover, gross margin and employee productivity are measured through inventory turnover, gross margin and operating revenue per employee respectively (Tatikonda et al, 2013), with information collected from SABI database. We measure operational talent management through the score (from 0 to 10000) achieved by each firm in employer brand, with information collected from MERCO database. Operational excellence is measured through the rate of sectoral operational excellence (Benitez-Amado et al, 2013), with information collected from Actualidad Economica database.

We measure profitability through return on assets with information gathered from SABI database. We control for firm size through the natural logarithm of number of employees (Zhu & Sarkis, 2004), using information collected from SABI database. Since the constructs e-business technology, profitability and firm size are estimated through a one-indicator measure, their

specification as formative or reflective leads to identical results. All variables are measured for the years 2008 (t_1), 2009 (t_2) and 2010 (t_3).

EMPIRICAL ANALYSIS

We use the SEM technique and the partial least squares (PLS) method of estimation to test the hypotheses and examine the mediation effects involved in the proposed model. It is appropriate to use this method of estimation in this study for two reasons: (1) PLS has been employed in prior research and its usage is increasing, and (2) this method is particularly advisable in models that include formative constructs and use secondary data (as the proposed model). We use the statistical software package SmartPLS 2.0.M3 (Ringle et al, 2005). To estimate the level of significance of weights, loadings and path coefficients we use the bootstrapping algorithm with 500 subsamples (Petter et al, 2007).

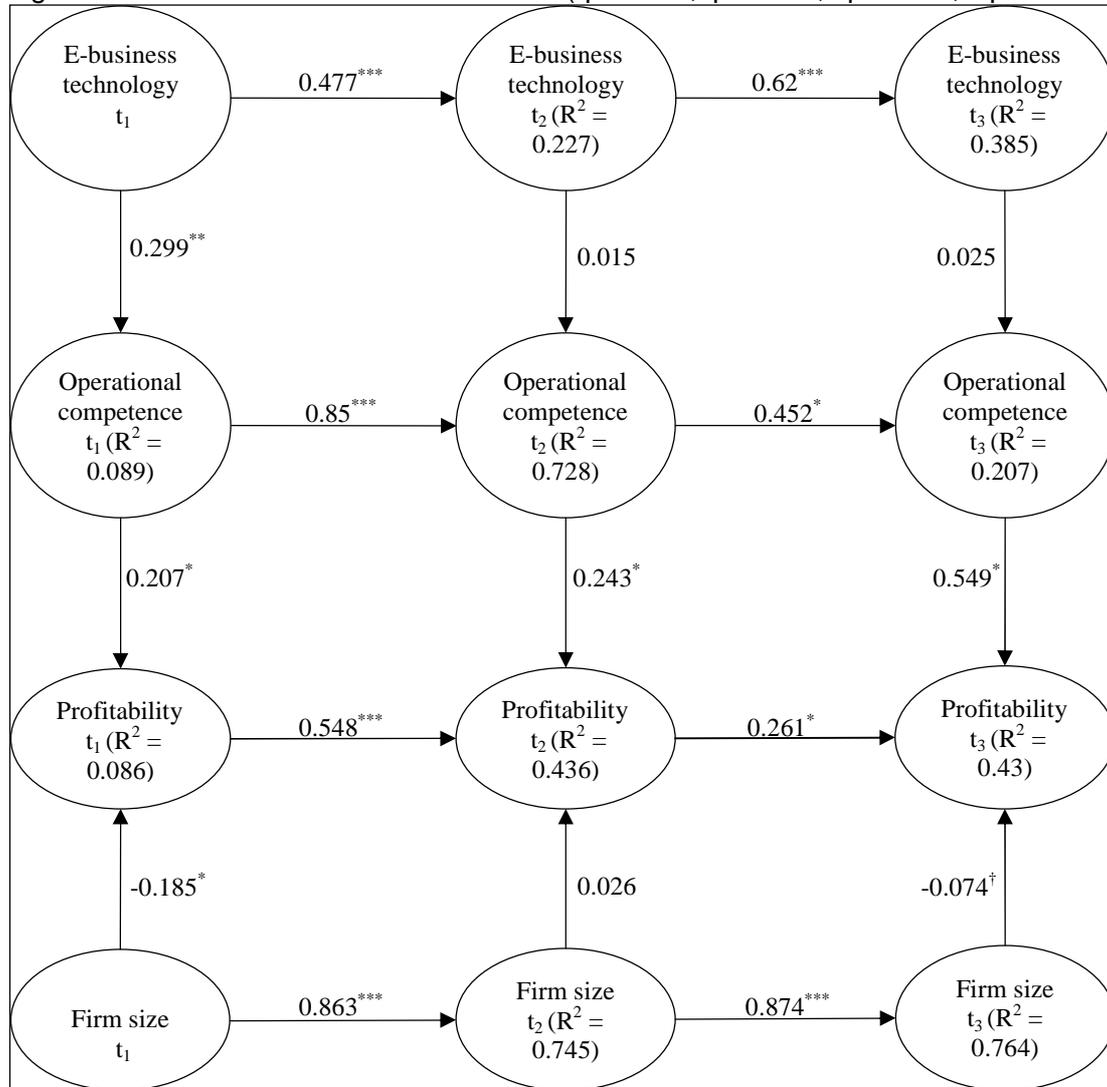
Measurement Model Evaluation

We check for weights, loadings and their level of significance for the formative first-order construct operational competence. One formative indicator should be retained when: (1) Its weight is significant, (2) its weight is not significant but its loading is, or (3) its neither weight nor loading are significant but it is advisable to keep the indicator to preserve content validity (Cenfetelli & Bassellier, 2009). The weight and/or loading of 10 of the 15 indicators of operational competence (t_1 - t_3) are significant. We decide to keep the indicator inventory turnover (t_1 and t_2), employee productivity (t_1 and t_2) and operational excellence (t_2) to preserve the content validity of constructs operational competence (t_1 and t_2). Overall, considering we use secondary data from multiple sources, this analysis suggests good properties for our formative measure (Chin, 2010).

Test of Hypotheses

The results give a relatively good support to H1 and a full support to H2. E-business technology has a positive effect on operational competence that decreases over the time even becoming non-significant. The portfolio of operational capabilities has a positive impact on profitability that becomes more significant over the time. The firm size effect on profitability is only supported in t_1 and t_3 although in the opposite of the hypothesized direction. All constructs are affected by the same construct in the prior period (significant at 0.05 level). Figure 2 shows the PLS estimation of the base model.

In a PLS estimation, the values of the path coefficients, their level of significance and the R_2 values are individual measures of the explanatory power (structural quality) of the model. Path coefficients around 0.2 are considered economically significant, and R_2 values higher than 0.2 indicate good explanatory power of the dependent variables of the model (Chin, 2010). The path coefficients of the key relationships in our model range from 0.207* to 0.85***. The R_2 values for the six dependent variables range from 0.086 to 0.728. Overall, this analysis suggests a good explanatory power (structural quality) for the proposed model.

Figure 2: PLS estimation of the base model ($\dagger p < 0.10$, $* p < 0.05$, $** p < 0.01$, $*** p < 0.001$)

Post-hoc Mediation Analysis

We perform a post-hoc analysis to examine the more significant mediation effects involved in the proposed model. Specifically, we add to the base model (i.e., model of Figure 1 and 2) a link between: (1) E-business technology t₁ and profitability t₁, (2) E-business technology t₁ and operational competence t₂, and (3) E-business technology t₁ and operational competence t₃. Any of these three links is significant (0.108[†], 0.026 and -0.038 respectively) while the path coefficients and their level of significance of other relationships are kept, which reinforces the results obtained in the test of hypotheses and suggests full mediation for the mediation effects examined (Baron & Kenny, 1986).

DISCUSSION AND CONCLUSIONS

Although IT capability investments can develop and improve the firm's process capabilities and competitiveness, not all IT capability investments generate the expected results. This study focuses on e-business technology and examines the evolution of the impact of e-business technology on operational competence and profitability. We uncover that: (1) E-business technology has a positive effect on operational competence that decreases over the time even becoming non-significant, and (2) the firm's proficiency in exploiting a portfolio of operational capabilities has a positive impact on profitability that becomes more significant over the time.

We find that the firm's proficiency in leveraging its web-based technologies has a positive effect on the firm's proficiency in exploiting a portfolio of operational capabilities (i.e., inventory turnover, gross margin, employee productivity, operational talent management and operational excellence). The weight analysis suggests that the most significant contributors to operational competence over the time are gross margin, operational talent management and operational excellence. Web-based technology enables the firm to real-time interchange accurate and timely information on product cost and demand with upstream suppliers and downstream customers to improve gross margin management. E-business technology also enables to: (1) Acquire/provide information from/to the market to recruit and get on board outstanding operational talent, (2) implement scheduling and workplace flexibility activities to retain operational talent, and (3) provide reliable information on goals completion, performance appraisal and career planning to develop and retain operational talent. Finally, e-business technology also facilitates to better execute the operational routines and manufacturing/supplying products more agilely to the markets.

However, the positive effect of e-business technology on operational competence decreases over the time even becoming non-significant. According to our best judge, this result seems to suggest that firms learn to invest and develop e-business technology across the time, which convert e-business technology into a non-unique capability to enable/improve operational competence. This implies that early investors/developers of e-business technology are the firms that mainly achieve the e-business technology-based operational development. While prior research has focused on the IT impact on the supply chain management activities through a cross-sectional design (e.g., Sanders, 2007), we examine the dynamic effect of e-business technology on a portfolio of operational capabilities. The first key contribution of this paper is to explain theoretically and test empirically the evolution of the effect of e-business technology on operational competence.

We find that operational competence has positive impact on profitability that becomes more significant over the time. Through a better management/estimation of product margins, an appropriate recruitment, the development and retention of operational talent, and a higher product manufacturing/supply chain flexibility, the firm can increase benefits and profitability. Since the firm's operational competence is the core of the business model and can be refined through experience, the operational competence impact on profitability increases over the time. Do early e-business technology capability investments imply any difference on the operational competence impact on firm's profitability over the time? Yes. Early developers of operational capabilities through early investments in e-business technology can achieve a greater profitability based on a higher time and experience to develop their operational capabilities. The second key contribution of this study is to examine the impact of a portfolio of operational capabilities on profitability on a dynamic base and the differentiator role of early e-business

technology investments in the development of operational capabilities over the time. We believe this is a valuable contribution to the operational capabilities-based theory.

This research has one key limitation and presents one room for improving our understanding. The results of this study can be only generalized to large manufacturing and service firms in the economic downturns in Spain. Future research can explore whether these results are kept under other environmental conditions, in other countries and/or discriminating by industries. Moreover, to the extent the effect of e-business technology on operational competence decreases over a three-year panel data, even becoming non-significant, to explore whether this result is kept over a longer panel data (e.g., 10 years) is an excellent research opportunity to improve our understanding on the role of IT in the operations management system development.

Our research also provides lessons learned for managers. First, this study shows how managers can develop e-business technology and operational competence to increase profitability. Second, our study suggests to managers leading their e-business technology investments and control these investments over the time. Early e-business technology investments provide a higher time and experience to refine the firm's portfolio of operational capabilities, thus improving the operations management system and increasing their profitability in the long run.

ACKNOWLEDGMENTS

This research was sponsored by the Spanish Government and the European Union (Research Project ECO2010-15885), and the Campus of International Excellence BioTic of the University of Granada (Research Project CEI2014-MPTIC1). This manuscript has benefited from the comments of Andes J. Navarro-Paule.

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APPENDIX

Table 1: List of E-business Technologies
Website
Online catalogue
Online e-ordering (i.e., e-commerce)
Banner or links to other sites
Online order tracker
Site map
Search engine
Subscription to electronic bulletin system
Email
Open discussion forum
Online calendar/agenda
Repository of documents
Tools to provide recommendations to customers
Billing/invoice systems (i.e., if a customer can ask for an invoice through the website)
Customer service management solutions
Shopping cart solutions
Payment and verification systems
Website advertising
Intranet for employees
Supplier management solutions
Shareholders solutions (e.g., a specific section/page for shareholders)
Use of social media (e.g., Facebook, Twitter, LinkedIn)
Frequently asked questions
Counter on online visitors
Customer loyalty solutions

INDICATOR	WEIGHT	LOADING
Inventory turnover t ₁	0.02	0.093
Gross margin t ₁	0.444 [*]	0.456 [*]
Employee productivity t ₁	0.099	0.184
Operational talent management t ₁	0.877 ^{***}	0.886 ^{***}
Operational excellence t ₁	0.007	0.075
Inventory turnover t ₂	-0.048	-0.115
Gross margin t ₂	0.522 [*]	0.607 ^{**}
Employee productivity t ₂	0.081	0.131
Operational talent management t ₂	0.798 ^{**}	0.834 ^{***}
Operational excellence t ₂	0.056 [†]	0.013
Inventory turnover t ₃	-0.096 [†]	-0.161 [*]
Gross margin t ₃	0.829 ^{**}	0.842 ^{***}
Employee productivity t ₃	0.023	0.255 [†]
Operational talent management t ₃	0.496 [*]	0.508 [*]
Operational excellence t ₃	0.138 [*]	0.207 [*]