Does Investment in Digital Technologies Yield Digital Business Value? The Digital Investment Paradox and Knowledge Creation as Enabling Capability

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Abstract: This paper explores whether the investments in Digital Technologies relate to Business Value in organizations and the role of Knowledge Creation. To evaluate this, data collected from Japanese Small and Medium Enterprises from "Competitive IT Strategy SME Selection 100" list of 3 years was analysed by correlation, regression and general linear model analysis. The direct effect that investment in Digital Technologies had on Business Value was observed for Learning & Growth objectives. The influence that the four processes of Knowledge Creation (SECI Model) had was explored and found that Combination process was positively related with the investment in Digital Technologies for Financial and Learning & Growth objectives. Externalization had a negative relationship with the investment in Financial objectives. Although not verified statistically, a trend showed organizations with higher Knowledge Creation Capabilities gained higher benefits from investment in Digital Technologies as the investment increased and vice versa. Although the limitations of this study are related to the population characteristics and responses' reliability, it was considered that the potential insights were valuable enough to overcome such limitations. With this empirical study the concern of "Digital Investment Paradox" is raised and the debate is initiated with Knowledge Creation as an enabling capability.

1 INTRODUCTION

Over the last decade there has been a shift on the research agenda from what could be consider the classical IT and Business alignment paradigm towards an environment where business is more digitalized and the organizations aim to transform their business through Digital Technologies (Bharadwaj et al., 2017). A change in focus from the scenario where in order to achieve benefits from technology it was required that Business strategy shaped IT Strategy, towards a concern in how to effectively use the available and emerging Digital Technologies in a way organizations can enhance their value proposition (Bharadwaj et al., 2017).

The increasing availability of Digital Technologies such as SMACIT (Social, Mobile, Analytics, Cloud and Internet of Things) brings a new paradigm to organizations. Digital Technologies bring risks to organizations that have been successful in the past and at the same time provide new opportunities to combine their existing competences with capabilities from the new technologies (Ross et al., 2016b). Organizations face challenges in order to do this effectively for example choosing the right investment from the potential opportunities and, synchronizing the activities of the business units and people engaged in the delivery of the new technology-based services (Ross, Sebastian and Fonstad, 2015).

What started in the late 1980's as the IT Productivity Paradox (Brynjolfsson and Hitt, 1998) was first explored from a input-output viewpoint where the effort focused in linking IT investment with organizational performance. The inconclusive results led to look at the organizational characteristics.

This study explores the "Digital Investment Paradox" as the question: Is investment in Digital

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Technologies producing value for the organizations?.

The role of Knowledge Creation is considered as evaluating Knowledge Management performance has become an issue for the organizations in Europe, Asia and America (Chen and Chen, 2006).

The terms business value and digital business value are used in this study with the same meaning and refer to the achievement of business objectives by the use of Digital Technologies. Business objectives use the categories from the Balanced Scorecard: Financial-related objectives, Customer-related objectives, Learning & Growth (L&G) objectives (Kaplan and Norton, 1996).

The theoretical background of the research comes from the Dynamic Capabilities Theory and Knowledge-based view. Dynamic Capabilities acknowledge that the market is dynamic and that organization's resources need to change over a period of time to make them relevant to the changing market condition (Teece, Pisano and Shuen, 1997). Dynamic capabilities allow organizations to acquire, shed, integrate and recombine their resources in order to generate new value-creating strategies or new sources of competitive advantage (Eisenhardt and Martin, 2000; Grant, 1996; Pisano, 1994; Teece, Pisano and Shuen, 1997). Such capabilities also include knowledge creation routines that allow new thinking to be created in the organization (Helfat, 1997). The role of Knowledge Creation theory from Nonaka and Takeuchi's SECI Model (Nonaka and Takeuchi, 1995) was evaluated in this context as knowledge is being considered one of the key strategic assets for the organizations (Grant 1996) and both knowledge creation phase and integration also considered key assets for the organizations (Lewin and Massini, 2004; Grant, 1996). The SECI Model, an acronym for Socialization, Externalization, Combination and Internalization, is a model of organizational knowledge creation based on the actions and interactions between tacit and explicit knowledge. Knowledge Creating Capabilities (KCC) derived from it emphasize the importance of the balance between the 4 knowledge processes (Riera, Senoo and Iijima, 2009).

This research revealed that:

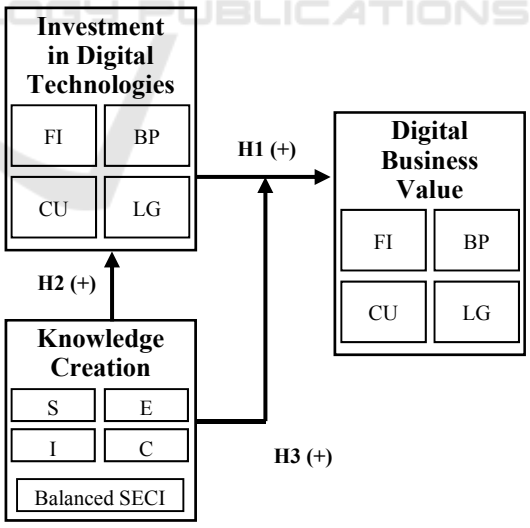
- The investment in Digital Technologies for a certain type of business objectives was positively related with the objective achievement of such objectives.
- Specific processes from the SECI Model influenced the investment in Digital Technologies. Both positive and negative relationships were found.

The main contributions are as follows.

- Provide insights suggesting that organizations with higher Knowledge Creation Capabilities gain higher benefits from investment in Digital Technologies as the investment increases and vice versa.
- Identified evidence on the importance to consider the type of business objectives when investing in Digital Technologies.
- Raised the "Digital Investment Paradox" concern in the academia. The debate is initiated by leveraging experiences from the IT Paradox and explored Knowledge Creation Capabilities as enabling capabilities.

2 FRAMEWORK AND HYPOTHESES

This study explores the challenge that organizations face on how to achieve value from Digital Technologies. Knowledge Creation is proposed as enabling capabilities for such relationship. The model is presented in Figure 1.



- FI: Financial-related business objectives
- CU: Customer-related business objectives
- BP: Business Process-related business objectives
- LG: Learning & Growth-related business objectives
- S: Socialization, E: Externalization, C: Combination, I: Internalization

Figure 1: Model and Hypotheses.

The Hypotheses are described below.

H1: The investment in Digital Technologies is positively related with the achievement of business objectives.

H2: Knowledge Creation is positively related with the investment in Digital Technologies.

H3: Knowledge Creation leverages the effect of Investment in Digital Technologies on the achievement of business objectives.

3 DATA AND MEASURES

3.1 Sample and Data Collection

The dataset was collected from Japanese Small and Medium Enterprises awarded by The Ministry of Economy, Trade and Industry "METI" in the list of "Competitive IT Strategy SME Selection 100" in 2015, 2016 and 2017 (METI, 2017). SMEs in this selection nominated themselves with concrete examples of how with the use of technology business had growth. Later on the Ministry selects and publishes the list. The characteristic of self-nomination together with the proven effective use of technology made them an appropriate target for this study and resulted in high response rate.

A questionnaire on the investment in Digital Technologies, SECI and the achieved Business Value from Digital Technologies was used.

A high response rate of 34% (34 out of 100 organizations answered the survey). The industry composition came mainly from Manufacturing (32%), Service (18%), Printing (12%), Wholesale (12%), Construction (9%), and with few participation from: Information and Communication, Transportation, Gravel sampling, Food & Beverage, Dental technology and other industries (3%).

A similar data set has been used previously (Riera, Senoo and Iijima, 2009; Riera and Iijima, 2017).

3.2 Measuring the Investment in Digital Technologies

The questionnaire included a section to capture the percentage of investment in Digital Technologies across four types of business objectives: Financial, Customer-related, Business Process, Learning and Growth. The organizations were first requested to divide the total investment in IT for the past 3 years into each of the four objective types using percentage. Then from such investment they were required to identify how much of the investment was put on Digital Technologies. The list of Digital Technologies included: SNS, Mobile, Analytics & Big Data, Cloud, IoT, Artificial Intelligence, 3D printing and a category as others.

The data collected was:

- Percentage of investment in IT for the 4 types of business objectives.
- From that value, the % of investment in Digital Technologies in each type of objective.

3.3 Measuring Digital Business Value

The organizations were asked to identify the achieved objective level from investments in Digital Technologies for each of the objective types. A four level Likert scale was used: Not Achieved, Partially Achieved, Highly Achieved and Fully Achieved. Examples for each of the objective types were given to provide concrete examples of each type. The input variables collected were:

- Level of business objectives achievement from the investments in Digital Technologies for: Financial, Customer, Business Process and L&G objectives.

3.4 Measuring Knowledge Creation Process (SECI Model)

The four knowledge processes from SECI Model were assessed using 24 questions in which behaviours from each knowledge conversion process were described. 6 behaviours correspondent to each knowledge process: Socialization, Externalization, Combination and Internalization. The evaluation consisted in asking the organizations to select 12 of the 24 behaviours which most represent their organization culture. The score for each knowledge conversion process was the number of items selected by the organizations for the process behaviours.

Finally, the concept of Knowledge Creation Capabilities or "Balanced SECI" (Riera, Senoo and Iijima, 2009) was calculated. This is done by taking the minimal score between the four knowledge conversion processes and focuses on the importance of the balance to avoid knowledge bottlenecks in the knowledge creation cycle or over-focus in a particular knowledge conversion process.

The input variables collected were:

- Score of Socialization, Externalization, Combination and Internalization.

KCC (Balanced SECI) score was calculated as the minimal score.

4 ANALYSIS AND FINDINGS

All the relationships were tested first by correlation analysis (parametric and non-parametric tests) and later on with regression analysis for the cases where a relationship was suggested. The analysis was done at overall and component level.

4.1 H1: Digital Investment Yields Positive Digital Business Value

The correlation analysis did not identify a relationship between the overall Digital Investment and Digital Business Value. This suggested that the achievement of business objectives with Digital Technologies is not related with the investment itself.

The exploration at the four business objectives found results linking both the investment in Digital Technologies and the objective achievement.

Correlation analysis identified a relationship (r=0.697, sig=0.003, n=15) between the investments in Digital Technologies for L&G objectives with the level of achievement of such objectives. This was confirmed by regression where a significant equation was found ($F(1,13)= 12.315$, $p<0.005$), with an R^2 of 0.486. Figure 2 shows the results.

The finding indicates that the more an organization invests in Digital Technologies for L&G objectives it would be likely that they would be able to achieve such objectives.

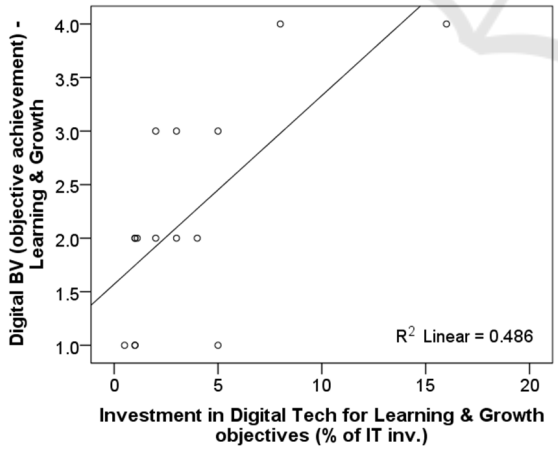


Figure 2: Digital Investment in L&G objectives and its achievement.

Additionally, a negative relationship was identified between the digital investments for customer objectives and the achievement of financial objectives (r=-0.680, sig<0.001, n=20). This was verified by regression ($F(1,18)= 15.517$, $p<0.005$), with an R^2 of 0.463. Figure 3 show the results.

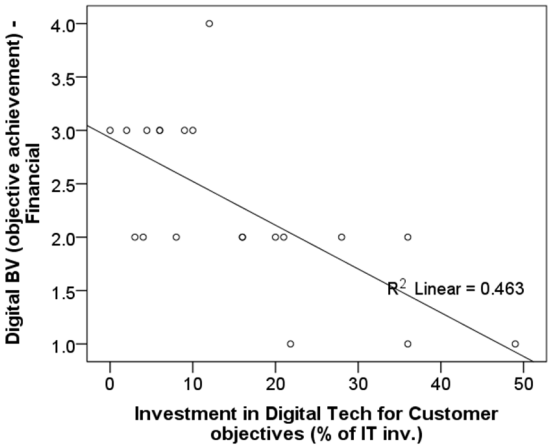


Figure 3: Digital Investment in Customer business objectives and Financial objective achievement.

Such negative relationship suggests that the more SMEs invest onto Digital Technologies in order to achieve Customer business objectives; the organization will see a decrease in the achievement of Financial objectives and few or no impact on the achievement of Customer objectives.

4.2 H2: Knowledge Creation Is Positively Related with the Investment in Digital Technologies

On an overall level the tests did not find a relationship between KCC and Investment in Digital Technologies.

Analysis of variance between the organizations with Low, Medium and High KCC and the investment in Digital Technologies did not produce significant results. This implied that the score of KCC was not related to the level of overall investment in Digital Technologies.

The analysis by Knowledge Creation Processes (S, E, C, I) against all of the four business objectives types yielded the following results.

First of all, the correlation analysis identified a negative relationship (r=-0.462, sig=0.017, n=26) between SECI's Externalization process and the investments in Digital Technologies for Financial objectives. This was found by Pearson's correlation analysis but not under Spearman's tests. Regression analysis found a significant regression equation ($F(1,24)=6.526$, $p=0.017$), with an R^2 of 0.214. The results can be seen in Figure 4.

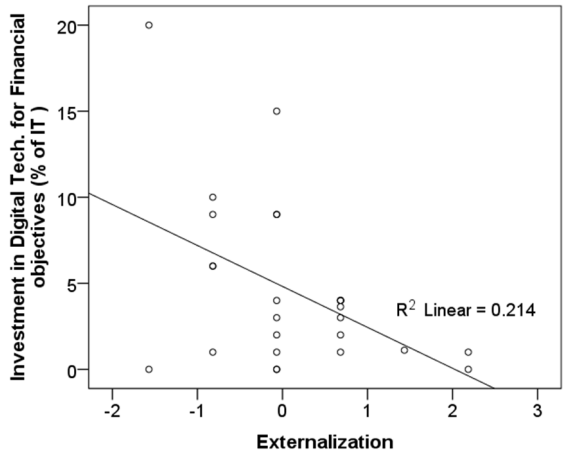


Figure 4: SECI's Externalization and Digital Investment in Financial business objectives.

This suggests that the more an SME focuses on the conversion of tacit onto explicit knowledge (SECI's Externalization); the more likely it will route its Digital investments to financial objectives.
Secondly, positive relationships were found between SECI's Combination and the level of investments in Digital technologies for Financial (r=0.398, sig=0.044, n=26) and L&G (r=0.545, sig=0.005, n=24) objectives. Regression confirmed such relationship ($F(1,24)=4.514$, $p=0.044$) with an R^2 of 0.158 for investment in Financial objectives while a regression ($F(1,22)=9.319$, $p=0.006$), with an R^2 of 0.298 for investments in L&G objectives (Figure 5).

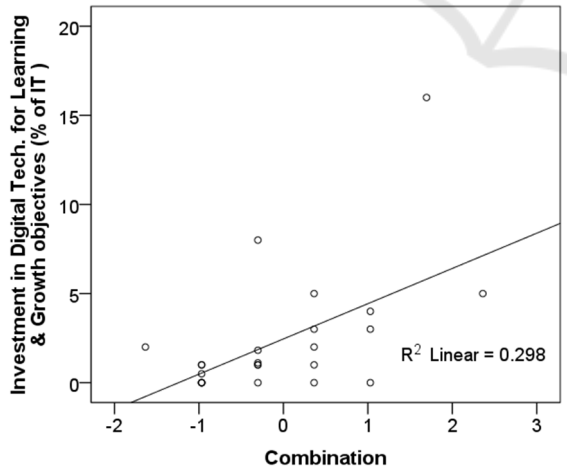


Figure 5: SECI's Combination and Digital Investment in Learning & Growth business objectives.

Although weak, they indicate that the more an SME is focused on integration or combination of explicit knowledge in order to create new knowledge (SECI's Combination); the more likely it will route investments in Digital Technologies to achieve Financial or L&G objectives.

4.3 H3: Knowledge Creation Leverages the Effect of Investment in Digital Technologies on the Achievement of Business Objectives

First of all an analysis on the overall effect that Knowledge Creation Capabilities had on Digital Business Value was tested with General Linear Model. Although there were not significant results, a positive trend can be seen in Figure 6.

Digital Business Value (Y-axis) scale is represented by: 1 - Not achieved, 2 - Partially achieved, 3 - Highly achieved and 4 - Fully achieved.

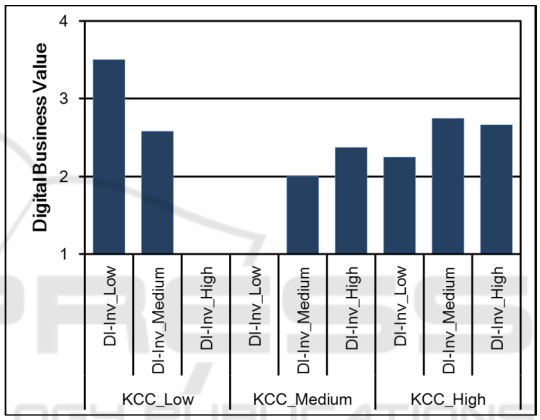


Figure 6: Influence of KCC (Balanced SECI) on Digital Investment and Digital Business Value.

The figure show that when SME have low KCC the benefits they get from Digital investment actually decrease when investment increases. On the other hand, when organizations have higher KCC the benefits from investment in Digital Technologies increase when the investment increases.

The analysis at component level was done based on results from H1 and H2 and aimed to identify the combined effects of KCC and Digital Investment on L&G business objectives.
Digital BV on L&G objectives was the dependent variable for the models. As the independent variables first the level of investment in Digital Technologies to achieve L&G objectives is used (1). Then, the score of the Combination process from the SECI Model becomes the independent variable in the next model (2). Afterwards the independent variables are combined in the last model (3). The following equations specify the models. Table 1 summarizes the results.

$$DI\_BV\_LG = \alpha + \beta \times DI\_Inv\_LG \quad (1)$$

$$DI\_BV\_LG = \alpha + \beta \times Combination \quad (2)$$

$$DI\_BV\_LG = \alpha + \beta \times Combination + \gamma \times DI\_Inv\_LG + \delta \times (Combination \times DI\_Inv\_LG) \quad (3)$$

The values for Adj. R^2 in (3) show no improvement from the combined effects. This indicates that although Combination score of an organization was found to be related with the level of Investment in Digital Technologies for various types of objectives as identified by H2; it certainly does not have major effect with the achievement of the objectives or Digital BV. Multicollinearity tests confirmed no collinearity (VIF=1.440) between the dependent variables.

Table 1: Results of Hypothesis 3.

Model	(1)	(2)	(3)
Constant	1.666***	2.111***	1.476***
DI_Inv_LG	0.190**		0.245**
Combination		0.450*	0.249
DI_Inv_LG * Combination			-0.067
R^2	0.486	0.218	0.539
Adj. R^2	0.447	0.169	0.414
*, **, *** indicates sig. at the 90%, 95%, and 99% level			

4.4 Updated Model

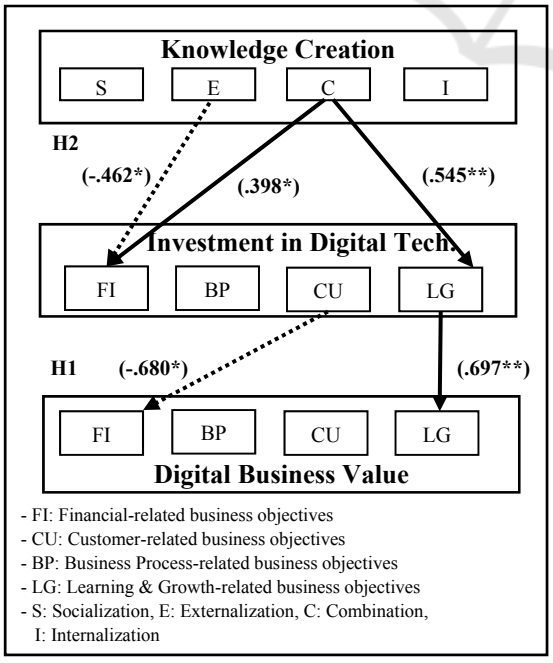


Figure 7: Updated Model.

5 DISCUSSION

5.1 Position of the Article

This study is built on the Dynamic Capabilities theory and Knowledge-based view. This research focused on Knowledge Creation process (Nonaka and Takeuchi, 1995) since within this view knowledge creation and integration are considered perhaps the most important strategic organization assets (Lewin and Massini, 2004).

With the main research question focused on the challenge that organizations face from the risks and opportunities that Digital Technologies bring (Ross, Sebastian and Fonstad, 2015; Ross et al., 2016a; Ross et al., 2016), this research first explored if level of investment in Digital Technologies was related with the benefits from them. This reflects a phenomenon that has been explored largely as part of the IT Productivity Paradox in which the returns from IT investments were challenged (Brynjolfsson and Hitt, 1998; Weill, 1992; Weill and Aral, 2007). This study uses the term "Digital Investment Paradox" to refer to the same challenge experienced before for IT Paradox but this time focusing on the investment of Digital Technologies.

5.2 Interpretation of the Results

H1 initially did not identify a relationship between Digital Investment and the level or achievement of objectives using such technologies (Digital BV). These results are aligned with literature of IT Paradox (Weill, 1992). This was nevertheless the case when the analysis was done at the objective type level. For the L&G objective type this relationship was positive, suggesting that the more investment in Digital Technologies would results in a higher level of achievement of such objectives.

This could be explained by considering that in one hand objectives in the L&G area are highly dependent on people such as education, development capability, retention and; in the other that some of the most widely used Digital Technologies like social and mobile rely on and connect people facilitating their interaction. By this particular people centred characteristic, the investment in Digital Technologies on such objectives may directly lead to the achievements. It could be easy to acknowledge for example that if an organization invests in social networking to increase collaboration and knowledge sharing, the delivery itself of such platform may result in such collaboration increase.

It would be harder to justify similar direct relationship between investment in Digital Technologies and achievement of objectives for the other three types of business objectives (Financial, Customer and Business Process-related) as the objectives may have several dimensions for example if the objective is improving customer loyalty; it may be not be achieved by the only deployment of a digital technology but it may require a set of additional factors that influence the customer behaviour. This was confirmed by the empirical data as no direct relationship was identified between the investments on Digital Technologies on Financial, Customer and Business Process-related objectives and their achievement.

The negative relationship identified between the investments in Digital Technologies for Customer-related objectives with the level of achievement of Financial objectives using Digital Technologies could indicate an opposition between customer centred-approach vs financial-centred approach that organizations may take while deciding on investments in Digital Technologies.

H2 explored if the Knowledge Creation Processes from the SECI Model were able to influence the digital investments decisions. The results positioned the SECI Processes as influencer on the Digital Technology investment results. At an overall level the Balanced SECI was found to be related with the level of investments on L&G business objectives. This suggests that the higher balance an organization has on its knowledge creation process it is more likely that the level of investments on Digital Technologies for L&G objectives increase. This is a relationship worth to note since it was already identified by H1 that the investment in Digital Technologies in such objectives type was actually related to its achievement. Thus organizations may consider increasing their knowledge creation process in order to increase the achievement of L&G objectives using Digital Technologies.

From the analysis of each Knowledge Creation process, there were 2 processes from SECI Model which had an impact on the digital investments.

Externalization and had a negative impact on the investments in Digital Technologies for Financial-related objectives. Such relationship indicates an opposite focus in organizations between the aim to make tacit knowledge available thru the conversion to explicit in a way that can be shared within the organization and the pursuit of Financial objectives.

Combination showed a positive relationship with the investment in Digital Technologies to achieve Financial and L&G objectives. From the nature of the Combination process in which the knowledge gathered both from outside and inside the organization is processed to form new knowledge, it could be expected that it relates to investment in Digital Technologies of all objective types. Since the empirical evidence found that relationship only with two of the four objective types; it suggests that the organizations with high score of Combination invest more on Financial and L&G objectives.

H3 showed the effects that KCC had on the relationship of Digital Investment and Digital BV. A trend showed that when organizations with low KCC invest in Digital Technologies, the benefits decreased as the level of investment increased. Similarly, the benefits increased as the level of investment increased when organizations had high KCC. Although this was not confirmed statistically, it provides insights on the role of KCC.

On individual SECI processes, the combined effects of SECI Model Combination and Digital Investment on the achievement of L&G business objectives were explored. The results instead suggested that the combined effect did not differ much from the scenario of sole effect.

The interpretation of all hypotheses is then that KCC are related to the level of investment in Digital Technologies in some types of business objectives. And at the same time it was verified that the level of investment in Digital Technologies for L&G objectives and its achievement are related.

5.3 Further Work and Limitations

Additional organizational capabilities like Effective Decision Making, Delivery Excellence, etc. may enhance the understanding of the Digital Paradox.

The limitations of this study can be grouped into two categories. The first relates to the target population. All organizations belong to a selected population embed in a country, culture and business practices which could affect the answers. In addition, the number of observations could be considered small for a quantitative study. This was acknowledged but it was considered that the benefits of selecting such group would actually enrich the study findings.

The second resides on the accuracy of the data collected as the data is as much as reliable as the reliability of the participants. This study is vulnerable to errors as the accuracy of the responders could only be ensured as the participants were in most cases the CEO or owners of the organizations. Finally, qualitative exploration may refine the findings.

6 CONCLUSION

The empirical evidence unveiled the relationship between investment in Digital Technologies and the Business Value under categories of objectives.

The exploration started in H1 by considering if the investment itself can provide such value. The results provided a positive answer but only for a particular type of business objective: L&G.

Then H2 considered if Knowledge Creation Process influenced the level of investments in Digital Technologies. The answer was positive for two types of business objectives: Financial and L&G.

H3 analysed the combined effects of Knowledge Creation Process and Investment onto the Business Value. The response this time was a negative answer.

The findings indicate the importance of considering the type of business objectives Digital Technologies support. Another contribution is considering the Digital Investments not as technology assets by themselves but actually linking such investments with business goals.

The concern of "Digital Investment Paradox" is raised and opens doors for new research. This debate is initiated with Knowledge Creation as an enabling capability and it deserves attention in order to understand how to achieve business value from Digital Technologies.

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