Cloud Computing Business Value and Human Determinants – An Empirical Investigation

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ABSTRACT

There are high expectations that cloud computing (CC) can generate sizeable business value (BV) for firms, which includes important benefits, associated with costs reduction, agility enhancement and innovation facilitation and support. However, limited empirical research has been conducted in this direction, in order to investigate to what extent these high expectations are fulfilled, as well as the level of business value that firms realize from CC, the magnitudes of the specific benefits that firms really obtain from it, and their determinants. Our paper contributes to filling this research gap. It investigates the effects of a set of human factors, which concern firm's general human capital, ICT specific human capital, as well relevant relational capital, i.e. the relationship and co-operation between the personnel of the ICT unit and the personnel of the business units, on the BV generated by CC. our study has as theoretical foundation the 'resource-based view' of the firm theory. We have used data collected through a survey from 115 firms from technologically developed sectors of the Greek economy, from which a CC BV regression model has been estimated. It has been concluded that neither firm's general human capital (quantified by the share of firm's employees having tertiary-level formal education), nor its ICT human capital (quantified by the share of ICT employees), per se impact the BV generated by CC. On the contrary the relationship and co-operation between the ICT unit personnel and the business units' personnel have a positive effect on the BV from CC usage. Our findings indicate that it is not the mere acquisition of human resources (highly educated business and ICT employees), but their utilization for the development of a capability for productive and effective co-operation and relationship among the ICT and business personnel, that can lead to higher levels of BV from CC usage.

KEYWORDS

Cloud computing, business value, benefits, human capital, human resources, relational capital, relationship

1 INTRODUCTION

Cloud Computing (CC) has been defined by the US National Institute for Standards and Technology (NIST), as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of computing resources (e.g., networks, servers, storage, applications) that can be rapidly provisioned and released with minimal management effort or service provider interaction" [25]. In constitutes a new innovative model of sourcing the information and communication technologies (ICT) services required by firms for supporting their activities, based on external CC services providers, which is quite different from the existing 'on-premises' model, based on the internal production of these the ICT services [1, 5, 13, 23, 33].

There are high expectations that cloud computing (CC) can generate sizeable business value (BV) for firms, which includes important benefits, associated with costs reduction, agility enhancement and innovation facilitation and support [7, 9, 10, 17, 23, 26, 33, 36, 37]. However, limited empirical research has been conducted in this direction, in order to investigate the level of BV that firms realize, and the magnitudes of the benefits that firms really obtain from CC, as well as their determinants (briefly reviewed in section 2). This research is necessary because CC is a quite new innovative model of sourcing the ICT services required by firms, so our knowledge concerning the real BV and the particular benefits it generates, and also the conditions and factors that affect them positively or negatively, is quite limited. The development of knowledge in this area will be highly beneficial, both for firms using CC (in order to increase the BV and benefits they obtain from it), and also for CC services providers and consulting firms (in order to direct and support their clients towards generating more BV from CC); this knowledge can significantly contribute to reaching a higher level of maturity in CC business exploitation and BV generation from it, which is very important for our economies and societies.

Our paper contributes to filling this research gap. It is dealing with the human determinants of the BV generated by the CC. In particular, it investigates the effect of a set of human factors, which concern firm's general human capital (quantified by the share of firm's employees having tertiary-level formal education), ICT human capital (quantified by firm's ICT personnel as a percentage of its total personnel), as well relevant relational capital, i.e. the relationship and co-operation between ICT unit personnel and business unit personnel, on the BV generated by CC. The importance of firm's human capital for its innovation activity has

been extensively researched both theoretically and empirically in previous innovation literature [2, 21, 32]. Since CC is an innovation in ICT services sourcing, it is important to examine the impact that have on its business level success both firm's general human capital as well as ICT specific human capital. Furthermore, previous innovation research has revealed that the cross-functional cooperation and the combination of knowledge from different functional domains of the firm, can be highly important for innovation conception, design and implementation [16, 18, 19, 29]. In this direction, it is interesting to examine the effect of the co-operation and relationship of the ICT function with the other business functions on the CC innovation success.

Our study has been based on data collected through a survey from 115 firms from technologically developed sectors of the Greek economy, from which a CC BV regression model has been estimated. It has as theoretical foundation the 'resource-based view' of the firm theory [3, 4, 35] (briefly outlined in section 2.2).

This paper is organized as follows. Section 2 includes the background of the study, while in Section 3 our research hypotheses are formulated. Section 4 describes the data and method of this study. The results are presented and discussed in Section 5, while in the final section 6 conclusions are summarized and future research directions are proposed.

2 BACKGROUND

2.1 Cloud Computing Benefits

The high potential of CC to generate sizeable and multi-dimensional BV for firms, which includes various types of benefits, has been extensively analyzed in previous literature [1, 6, 7, 9, 10, 14, 15, 17, 23]. The most important of these potential benefits are ICT cost reduction and quality improvement, conversion of ICT capital investments to operating costs, rapid and low cost development of ICT support required for process, product and service innovations, scalability and agility, provision of flexible computing capacity for supporting firm's growth, and rapid low cost access to new technologies and high level ICT-related skills.

However, limited empirical research has been conducted in order to investigate to what extent this potential is exploited, as well as the level of business value that firms realize from CC, and the magnitudes of the specific benefits that firms really obtain from it, as well as their determinants. Malladi and Krishnan [22], using data collected through a survey from 243 USA firms, found that the use of SaaS has a positive impact on ICT-enabled innovation, which increases if there is previous ICT outsourcing experience, flexibility of firm's ICT infrastructure and process formalization and management maturity. Garrison et al. [11], based on data collected from 302 Korean firms, conclude that ICT technical, management and relational capabilities affect positively the degree of CC success, with the effect of the ICT relational capabilities, being the strongest. Schniederjans and Hales [31], using survey data collected from 247 ICT and supply chain professionals, conclude that that the use of CC has positive impact on firms' economic and environmental performance, with the impact on economic performance being partially mediated by the collaboration with supply chain partners enabled by CC.

Our study contributes to filling this research gap, by empirically investigating the effect of a set of human factors, which concern firm's general human capital, ICT specific human capital, as well the co-operation and relationship between the personnel of the ICT unit and the personnel of the business units, on the BV generated by CC, having as theoretical foundation the resource based view of the firm theory outlined in the following section.

2.2 Resources based View Theory

The 'resource-based view' (RBV) of the firm [3, 4, 35] has been extensively used for long time as theoretical foundation in empirical research on the business impacts of different types ICT resources and capabilities [8, 12, 20, 24, 28, 34]. The RBV theory argues that performance differences among firms are due to differences in their resources and capabilities: firms that are able to accumulate resources that are valuable, rare, non-substitutable, and difficult to imitate, or to use their resources in order to develop capabilities that have these characteristics, will achieve higher performance and finally competitive advantage over competitors. The main idea of the abovementioned ICT related empirical studies is that most ICT hardware, packaged software and network technological components that firms use are not rare and difficult to imitate, as they are available to all firms (e.g. competitors), so they cannot be a source of higher performance and provide competetive advantage. However, appropriate customizations and combinations can be made of such ICT technological components, as well as combinations of them with other firm's resources and capabilities (e.g. various human resources and skills, knowledge resources, procedures and processes, etc.), which can be highly valuable and at the same time rare and difficult to imitate, leading to higher firm's performance; for the development of such combinations highly important are firm's ICT human resources and capabilities.

This is the main foundation of our research hypotheses (presented in the following section 3): the CC services used by a firm are easily and rapidly available to all other firms as well, so they are not rare and inimitable; however, firm's human capital (general and ICT specific), as well the relationship and co-ordination between ICT unit personnel and business units personnel enable making:

a) rational selection of appropriate CC that satisfy firm's specific needs, and support its specific activities and processes, so that valuable combinations can be made between external CC services and internal firm's resources/capabilities;

b) valuable combinations and integrations of many different CC services (from different providers), and also with elements of firm's 'on-premises' ICT infrastructure, which are highly valu-able, and at the same time more rare and difficult to imitate, leading to differentiation from competitors and higher levels of BV from CC.

3 RESEARCH HYPOTHESES

Our first research hypothesis H1 concerns the effect of firm's ICT

specific human capital (ICT personnel) on the BV generated from CC. The role and the importance of firm's human capital for its innovation activity has been extensively investigated both theoretically and empirically in previous innovation literature [2, 21, 32]. It has been concluded that the human capital of a firm is its 'engine of innovation', as it embeds firm's knowledge capital, and also can make novel combinations of different parts of it (possessed by different employees), as well as with external relevant knowledge, which are both critical for the conception, design and implementation of innovations. Since CC constitutes a radical innovation concerning the ICT support of firm's activities, we expect that firm's relevant ICT human capital will be important for its success. Firm's ICT personnel, possessing extensive knowledge on one hand about firm's existing ICT infrastructure, its strengths and weaknesses, as well as the needs for extensions and improvements of it, and on the other hand about firm's activities and business processes, can play an important role in a) collecting, filtering and assessing external knowledge about the existing CC services and providers; b) selecting the most appropriate and cost effective CC services for satisfying firm's specific needs, and supporting its specific activities and processes; c) integrating different CC services used by the firm, and also with elements of firm's internal on-premises ICT infrastructure; d) monitoring the performance of these externally provided CC services. The above can lead to higher levels of benefits from CC, such as higher quality electronic support of firm's existing activities and business processes, as well as higher agility enhancement and innovation facilitation and support, at a low cost. Therefore, if a firm has a sufficient ICT personnel (so that, beyond fulfilling their everyday duties, they have time to deal systematically with CC), this can increase the BV obtained from CC services usage. From an RBV theory perspective firm's ICT personnel a) is important for making valuable combinations of appropriate external CC services and internal resources and capabilities (through appropriate selection of CC services), and b) particularly important for making combinations and integrations of appropriate CC services, and also with firm's 'on-premises' ICT infrastructure, which are both rare and difficult to imitate, and lead to higher levels BV from CC. So, our first research hypothesis is:

H1: The ICT related human capital (ICT personnel) has a positive effect on the BV generated from CC.

Our second research hypothesis concerns the effect of firm's general human capital on the BV generated by CC. It is widely recognized that in the CC model the amount of ICT related work that has to be done inside the firm for the provision of ICT support of its activities and processes is smaller than in the 'classical', while the amount of business related work [23, 27, 30, 33, 36, 37]. In particular, the business-related tasks to be performed include the evaluation of the numerous existing relevant CC services on offer in the market from a business support functionality perspective, the selection of the most appropriate ones from this perspective, and then their optimal business exploitation, which usually includes inter-connection/integration between different CC services, and also with the on-premises ICT infrastructure. The ICT related tasks include the evaluation of the existing relevant CC services from a technological perspective (e.g. concerning the specific technologies and platforms they are based on, their security mechanisms, their reliability, as well as their integration capabilities), the selection of the most appropriate ones from this perspective, and then the implementation of the required integration of different CC services, and also with the on-premises ICT infrastructure. The first (bigger) group of the business-related tasks have to be performed by non-technical personnel of firm's business units, while the second (smaller) group of ICT related tasks have to be performed by the personnel of firm's ICT unit; for this reason the personnel of firm's business units in the CC model have a more important role than in the on-premises model [27, 30, 36, 37]. If the firm has high quality general human capital (e.g. a large share of its employees have tertiary-level formal education) then the non-technical personnel of its business units will be better positioned to play the above critical role in CC exploitation, and accomplish better these important business related tasks, leading to the generation of more BV from CC. In particular, they will be able to make a more substantial contribution towards making a better selection and exploitation of CC services in the firm, and finally achieving higher benefits from CC, concerning the reduction of the cost and improvement of the quality of the electronic support of firm's activities and business processes, as well as the enhancement of its agility and the facilitation and support of its innovation activities. These will have positive impact on the BV obtained by the firm from CC usage. From a RBV theory perspective higher quality of firm's general human capital is i) particularly important for making valuable combinations of appropriate external CC services and firm's internal resources and capabilities (since this requires detailed business related knowledge, as it is based on matching the functionality of the former with the latter), and ii) also important for identifying valuable combinations and integrations of appropriate CC services, and also with firm's 'on-premises' ICT infrastructure (since this requires detailed business related knowledge as well); these will both lead to higher levels of BV from CC. Thus, our second research hypothesis is:

H2: The general human capital has a positive effect on the BV generated from CC.

Our third research hypothesis concerns the effect of the relationship and cooperation between the personnel of firm's ICT unit with the personnel of its business units on the BV generated by CC. Previous research in the area of innovation has revealed that the cross-functional cooperation, and the combination of knowledge from different functional domains of the firm, is highly important for its innovation activities [16, 18, 19, 29]. Furthermore, previous research in the area of information systems (IS) has revealed the importance of the 'internal ICT relationship' between the personnel of firm's ICT unit and the personnel of its business units (who use ICT for supporting their activities) for the effective exploitation of ICT in the firm, and the generation of high levels of BV from it, in the 'classical' on-premises model [12, 20, 28]. We expect that this

will hold to an even larger extent for new CC model, since, as mentioned in the previous research hypothesis, it requires a quite different set of highly interdependent tasks to be performed inside the firm, in which the weight of the business-related tasks is increased, while the weight of the ICT related tasks is reduced, in comparison with the on-premises paradigm. In particular, close co-ordination and co-operation, including extensive exchange of knowledge, is required between firm's ICT unit (responsible for performing the ICT related tasks mentioned in the previous research hypothesis) and its business units (responsible for performing the business-related tasks) for a successful exploitation of CC by the firm, and the realization of high levels of BV from it. The existence of a good internal ICT relationship, between the ICT unit of the firm and its business units, creates high levels of mutual understanding, trust and inter-dependence between them, and in general a tradition of good co-operation, while it also establishes practical mechanisms and procedures (formal or informal) for this; these are expected to lead to and facilitate a close and effective cooperation between them for the effective exploitation of CC in the firm as well; this is expected to result in higher levels of BV generation from CC, concerning improvements of efficiency as well as agility, and facilitation and support of innovation. From a RBV theory perspective this ICT internal relationship, due to the combination of ICT and business skills and knowledge it enables, can be a very good source of ideas for valuable, rare and difficult to imitate: a) combinations of appropriate external CC services and firm's internal resources and capabilities; and b) combinations and integrations of many different CC services (possibly from different providers), and also with elements of the internal on-premises IS; these can both lead to the generation of more BV from CC. So our third research hypothesis is:

H3: The internal ICT relationship (between the ICT unit and the business units) has a positive effect on the BV generated from CC.

4 DATA AND METHOD

For this study, we have used data collected from 115 Greek firms through a survey, which has been conducted in cooperation with ICAP S.A. (www.icap.gr), one of the largest business information and consulting companies in Greece. As our starting point we used the original large sample of Greek firms of ICAP including 6429 firms. From it we constructed an intermediate smaller sample, with about 50% of the firms of the initial sample, which included 3308 firms, with the same composition by industry and size with the original sample, to which we sent a questionnaire developed by the authors. It included a large number of questions concerning background information of the firm, ICT resources and capabilities, cloud usage and benefits, and innovation activity. For this study we used part of these questions, which are shown in the Appendix. Finally, we received completed questionnaires from 363 firms (188 small, 131 medium and 41 large ones), having a response rate of about 11%. For this study we used data from 115 of these firms which are using cloud computing (59 small, 41 medium and, 15 large). It should be noted that both the sample of ICAP and the one of our study focus on the most technologically developed part of the Greek economy, with a high representation of manufacturing (26.9%) and modern service industries (such as computer, communication, business and transport services) (43.1%).

In order to test out research hypotheses H1 to H3 presented in the previous section 3, a linear regression models was estimated using the aforementioned data, having the following specification:

$$CC\_BVi = bo + b1*HCi + b2*ICT\_HCi + b3*INT\_RELi + b4*D\_SIZEi + b5*D\_SECTi + ei \quad (for\ firm\ i) \quad (1)$$

In this model, dependent variable is the BV obtained from CC (CC_BV). As it is quite multidimensional it has been measured though a six items scale developed based on previous literature on the benefits offered by CC [23, 26, 33]; they assess to what extent the use of CC services by the firm has provided six main potential CC benefits mentioned by the above relevant literature (using a 5-levels Likert-type scale 1-5, where: 5 = to a very large extent, 4 = to a large extent, 3 = to a moderate extent, 2 = to a small extent, 1 = not at all or to a very small extent): reduction of cost of firm's electronic support, improvement of its quality, use and exploitation of new technologies, electronic support and facilitation of products/ services innovations, electronic support and facilitation of methods/ processes innovations, improvement of firm's agility/adaptability. A Principal Component Analysis was performed for these six variables, which gave one factor that was used as our dependent variable.

Our independent variables include a measure of firm's general human capital (HC), which is the share of firm's employees having tertiary-level formal education (degrees from Universities or Technological Education Institutes (TEI)), as well as a measure of firm's ICT specific human capital (ICT_HC), which is equal to the number of firm's ICT employees as a percentage of its total number of employees. Also, our model includes an independent variable that assesses the internal ICT relationship (between the personnel of the ICT unit and the personnel of the business units) (INT_REL). Finally, we have two dummy independent variables: one size dummy (D_SIZE), in order to capture the effects of firm size on CC benefits, which was based on firm's number of employees, taking value 1 for small-sized firms with less than 50 employees, 2 for medium-sized firms with 50 to 249 employees and 3 for large-sized firms with 250 or more employees; and another sector dummy (D_SECT), in order to capture the effects of firm sector on CC benefits, taking value 0 for service sectors firms and 1 for manufacturing or construction sectors firms.

5 RESULTS AND DISCUSSION

In Table 1 are shown for the above six CC benefits' variables we have used for creating our dependent variable CC_BV (corresponding to the most important potential benefits of CC according to the relevant literature) the relative frequencies of their five possible values (shown below the Table). We can see that for all six CC benefits variables the sum of the relative frequencies of the two highest values (4 = to a large extent and 5 = to a very large

extent) exceed 50%, having its highest values for the quality improvement of the electronic support of firm's activities and processes (48.3% + 18.6% = 66.9%), and the exploitation of new technologies without need for additional investments (37.6% + 23.1% = 60.7%), and its lowest value for the improvement of firm's agility (34.7%+16.1% = 50.8%). At the same time the sum of the relative frequencies of the two lowest values (2 = to a small extent and 1 = not at all or to a very small extent) are between 10% and 20% for five of these variables, having its highest values for the quality improvement of the electronic support of firm's activities and processes (4.2% + 5.9% = 10.1%), and the exploitation of new technologies without need for additional investments (1.7% + 8.5% = 10.2%), and its lowest value for the improvement of firm's agility (7.6%+15.3% = 22.9%).

Table 1. Relative frequencies for CC benefits' variables.

BENEFITS	1	2	3	4	5
Electronic support cost reduction	10.2	10.2	23.7	44.1	11.9
Electronic support quality improvement	4.2	5.9	22.9	48.3	18.6
Exploitation of new technologies	1.7	8.5	29.1	37.6	23.1
Support of products – services innovation	5.1	12.8	29.1	36.8	16.2
Support of methods processes innovation	4.3	15.5	24.1	40.5	15.5
Improvement of agility	7.6	15.3	26.3	34.7	16.1

(5 = to a very large extent, 4 = to a large extent, 3 = to a moderate extent, 2 = to a small extent, 1 = not at all or to a very small extent)

These results indicate that firms of the technologically developed sectors of the Greek economy obtain significant benefits from the usage of CC services, and seem to exploit to a good extent the BV potential of CC. They also indicate that despite the ongoing economic crisis in Greek since 2010 the most important CC benefit is not the reduction of the cost of the electronic support of firm's activities and business processes, but the improvement of its quality, as well as its enhancement by exploiting new technologies without making additional investments (which is difficult due to the reduction of liquidity as well as the difficulty of borrowing capital from banks because of the economic crisis). Furthermore the results of Table 1 indicate that the above firms are obtaining significant innovation support related benefits from CC use (53% obtain to a large or very large extent benefits concerning electronic support and facilitation of the rapid and lower cost introduction of products/services innovations, while this percentage is at the even higher level of 56% for methods/processes innovations), so they seem to exploit to a good extent this advanced dimension of the BV potential of CC.

In Table 2 we can see the estimated CC BV regression model according to the specification described in the previous section 4 (equation 1); for each independent variable the standardized regression coefficients are shown (statistically significant coefficients at the test levels of 5% are shown in bold). We can see that the internal ICT relationship between the ICT unit and the business units has a positive effect on the BV generated from CC, so research hypothesis H3 is supported. On the contrary, the effects of both the ICT related human capital (quantified by firm's ICT personnel as a percentage of its total personnel) and the general human capital (quantified by the share of firm's employees having tertiary-level formal education, i.e. degrees from Universities or Technological Education Institutes (TEI)) are not statistically significant; so research hypotheses H1 and H2 are not supported.

Table 2. Cloud computing business value regression model.

Independent Variable	Standardized b Coefficient
HC	0.144
ICT_HC	-0.005
INT_REL	**0.249**
D_SIZE	-0.142
D_SECT	-0.080

The above results indicate that neither firm's general human capital (i.e. share of employees with tertiary-level formal education), nor its ICT specific human capital (ICT employees), per se impact the BV generated by CC. On the contrary, the relationship and co-operation between the ICT personnel and the business units' personnel have a positive effect on the BV from CC usage. Therefore, it is not the mere acquisition of human resources (highly educated business and ICT employees), but their utilization for the development of a strong capability for productive and effective co-operation and relationship among the ICT and business personnel, that can lead to higher levels of BV from CC usage. Each of these two groups possesses a different set of knowledge and skills, which are both highly important for the effective exploitation of CC in the firm, and the generation of high levels of BV from it; so, it is necessary these two knowledge and skills sets to be effectively combined and synthesized towards this objective. The development of a good relationship between the personnel of firm's ICT units and the personnel of its business units, by creating high levels of mutual understanding, trust and interdependence between them, as well as practical co-operation mechanisms and procedures (formal or informal), facilitates their co-operation for CC exploitation as well, their interaction and exchange of knowledge, leading to the generation of more BV from CC.

This is in agreement, with the conclusions of previous innovation research concerning the importance of the cross-functional cooperation, and the combination of knowledge from different functional domains of the firm, for its innovation activities [16, 18,

19, 29]. Furthermore, it is in agreement with previous research in the area of IS concerning the importance of the ICT internal relationship for the effective exploitation of ICT in the firm, and the generation of high levels of BV from it, in the on-premises model [12, 20, 28]. Finally, from a RBV theory perspective [3, 4, 35] the above finding reveals that this ICT internal relationship is a much stronger source, in comparison with the other two examined sources (employment of highly educated personnel as well as specialized ICT personnel), of ideas for valuable, rare and difficult to imitate a) combinations of appropriate external CC services and firm's internal resources and capabilities, and b) combinations and integrations of many different CC services (possibly from different providers), and also with elements of the internal on-premises IS, which can both lead to the generation of more BV from CC.

6 CONCLUSIONS

There are high expectations among both researchers and practitioners in the areas of management and ICT that CC can generate high levels of BV for firms, which includes important benefits, associated with costs reduction, agility enhancement and innovation facilitation and support. However, limited empirical research has been conducted in this direction, in order to investigate to what extent these high expectations are fulfilled, and the level of business value that firms realize from CC, the magnitudes of the specific benefits that firms really obtain from it, as well as their determinants.

Our paper contributes to filling this research gap. It is dealing with the human determinants of the BV from CC usage; in particular, it investigates empirically the effect of a set of human factors, which concern firm's general human capital, ICT specific human capital, as well relevant relational capital, i.e. the relationship and co-operation between the personnel of the ICT unit and the personnel of the business units (internal ICT relationship), on the BV generated by CC. For this study we have used data collected through a survey from 115 firms from technologically developed sectors of the Greek economy.

It has been concluded that the above firms obtain significant benefits from the usage of CC services, and seem to exploit to a good extent the BV potential of CC. The most important of these benefits concern the improvement of the quality of ICT support of firm's activities' and processes', as well the exploitation of new technologies without making additional investments. Also, it has been concluded that neither firm's general human capital (quantified by the share of firm's employees having tertiary-level formal education) nor its ICT human capital (quantified by the share of ICT employees), per se impact the BV generated by CC. However, the relationship and co-operation between the ICT unit personnel and the business units' personnel impact positively the BV from CC usage.

Our study has interesting implications for research and practice. With respect to the former it extends the research that has been conducted concerning the effects of various types of firm's ICT resources and capabilities on different aspects of its performance, which concerns the classical on-premises model, to the CC model, using a sound theoretical foundation: the RBV theory. With respect to practice the findings of our research can be useful to firms' business and ICT management, as well as relevant consultants, in order to maximize the BV generated from CC. They indicate that in order to increase the BV obtained from CC it is important to promote the co-operation and knowledge/views exchange between the ICT unit and the business units for the effective exploitation of CC in the firm.

This study has two main limitations. First, it has been based on data collected from one country (Greece), from its technologically developed sectors; so, it is necessary such research to be conducted in other national and sectoral contexts as well. Second, it examines the effects of a limited number of firm's resources and capabilities on the BV generated from CC; it would be interesting to investigate the effects of other types of firm's both general and ICT resources and capabilities as well.

REFERENCES

[1] M. Armbrust, A. Fox, R. Griffith, A. Joseph, R. Katz, A. Konwinski, G. Lee, D. Patterson, A. Rabkin, I. Stoica, and M. Zaharia. 2010. A view of Cloud Computing. *Communications of the ACM* 53, 4, pp. 50- 58.

[2] S. Arvanitis, E. Loukis, and V. Diamantopoulou. 2016. Are ICT, workplace organization and human capital relevant for innovation? A comparative Swiss/Greek study. *International Journal of the Economics of Business 23*, 3, pp. 319-349.

[3] J.B. Barney. 1991. Firm resources and sustained competitive advantage. *Journal of Management 17*, 1, pp. 99-120.

[4] J.B. Barney and D.N. Clark. 2007. *Resource-based theory: Creating and sustaining competitive advantage*. Oxford University Press, New York.

[5] M. Bayramustaa, and V.A. Nasirb. 2016. A fad or future of IT?: A comprehensive literature review on the cloud computing research. *International Journal of Information Management 36*, 4, pp. 635–644.

[6] A. Benlian, and T. Hess. 2011. Opportunities and Risks of Software-as-a-Service: Findings from a Survey of IT Executives. *Decision Support Systems 52*, 1, pp. 232-246.

[7] S. Berman, L. Kesterson-Townes, A. Marshall, and R. Srivathsa. 2012. The power of cloud - Driving business model innovation. IBM Institute for Business Value, New York, USA

[8] A. Bharadwaj. 2000. A resource based perspective on information technology capability and firm performance: An empirical investigation. *MIS Quarterly 24*, 1, pp. 169-196.

[9] E. Brynjolfsson, P. Hofmann, and J. Jordan. 2010. Economic and Business Dimensions - Cloud Computing and Electricity: Beyond the utility model. *Communications of the ACM, 53*:5, pp. 32–34.

[10] F. Etro. 2009. The Economic Impact of Cloud Computing on Business Creation, Employment and Output in Europe. *Review of Business and Economics 54*, 2, pp. 179-208

[11] G. Garrison, R.L. Wakefield, and S. Kim. 2015. The effects of IT capabilities and delivery model on cloud computing success and firm performance for cloud supported processes and operations. *International Journal of Information Managemen, 35*, 4, pp. 377-393

[12] J.W. Gu, and H. W. Jung. 2013. The effects of IS resources, capabilities, and qualities on organizational performance: An integrated approach. *Information & Management 50*, 2-3, pp. 87-97.

[13] P. Hoberg, J. Wollersheim, and H. Krcmar. 2012. The business perspective on cloud computing - A literature review of research on cloud computing. *Proceedings of the American Conference on Information Systems (AMCIS) 2012.*

[14] B. Iyer, and J. C. Henderson. 2010. Preparing for the Future: Understanding the Seven Capabilities of Cloud Computing. *MIS Quarterly Executive 9*, 2, pp. 117-131.

[15] B. Iyer, and J. C. Henderson. 2012. Business Value from Clouds: Learning from Users. *MIS Quarterly Executive, 11*, 1, pp. 51-60.

[16] G. C. Kane, D. Palmer, A. N. Phillips, D. Kiron, and N. Buckley. 2017. Achieving Digital Maturity. MIT Sloan Management Review and Deloitte University Press, July

[17] B. Karpovich, L. Kesterson-Townes, and S. Rishi. 2017. Beyond agility - How cloud is driving enterprise innovation. IBM Institute for Business Value, New York, USA

[18] J. H. Love, and S. Roper. 2009. Organizing innovation: complementarities between cross-functional teams. *Techno-vation 29*, 3, pp. 192-203.
[19] A. Nerkar, and S. Paruchuri. 2005. Evolution of R&D Capabilities: The Role of Knowledge Networks Within a Firm". *Management Science 51*, 5, pp. 771-785.
[20] T. P. Liang, J. J. You, and C.C. Liu. 2010. A resource-based perspective on information technology and firm performance: a meta analysis, *Industrial Management & Data Systems, 110*, 8, pp. 1138–1158.
[21] P. Lopez-Garcia, and J. Montero. 2012. Spillovers and Absorptive Capacity in the Decision to Innovate of Spanish Firms: The Role of Human Capital. *Economics of Innovation and New Technology 21*:7, pp. 589-612.
[22] S. Malladi, and M. Krishnan. 2012. Does Software-as-a-Service (SaaS) has a role in IT-enabled Innovation?–An Empirical Analysis. *Proceedings of American Conference on Information Systems (AMCIS) 2012*.
[23] S. Marston, Z. Li, S. Brandyopadyay, J. Zhang, and A. Ghalsasi. 2011. Cloud Computing – The Business Perspective. *Decision Support Systems 51*, 1, pp. 176-189.
[24] F. J. Mata, W. L. Fuerst, and J. B. Barney. 1995. Information Technology and Sustained Competitive Advantage: A Resource-Based Analysis. *MIS Quarterly 19*, 4, pp. 487-505.
[25] P. Mell, and T. Grance. 2011. The NIST definition of cloud computing. National Institute of Standards and Technology (NIST), pp. 1-3.
[26] S. D. Müller, S. R. Holm, and J. Søndergaard. 2015. Benefits of cloud computing: literature review in a maturity model perspective. *Communications of the Association for Information Systems, 37*, pp. 851 – 878.
[27] A. Ragowsky, P. Licker, J. Miller, D. Gefen, and M. Stern. 2014. Do Not Call Me Chief Information Officer, But Chief Integration Officer: A summary of the 2011 Detroit CIO roundtable. *Communications of the Association for Information Systems 34*, 1, pp. 1333–1346.
[28] T. Ravichandran, and C. Lertwongsatien. 2005. Effect of Information System Resources and Capabilities on Firm Performance: A Resource-Based Perspective. *Journal of Management Information Systems Vol. 21*, No 4, pp. 237-276.
[29] E. Rogers. 2003. *Diffusion of Innovations*. Free Press, New York, USA.
[30] S. Schneider, and A. Sunyaev, (2016). Determinant factors of cloud-sourcing decisions: reflecting on the IT outsourcing literature in the era of cloud computing. *Journal of Information Technology 31*, 1, pp. 1-31.
[31] D. G. Schniederjans, and D. N. Hales. 2016. Cloud computing and its impact on economic and environmental performance: A transaction cost economics perspective". *Decision Support Systems 86*, pp. 73-82.
[32] J. Vandenbussche, P. Aghion, and C. Meghir. 2006. Growth, Distance to Frontier and Composition of Human
[33] Venters, W. & Whitley, E. (2012). A Critical Review of Cloud Computing: Researching Desires and Reality, Journal of Information Technology, 27:3, pp. 179-197.
[34] Wade, M., & Hulland, J. (2004). Review: The resource-based view and information systems research: Review, extension, and suggestions for future research. MIS Quarterly, 28(1), 107–142.
[35] Wernerfelt, B. (1984). A resource-based view of the firm, Strategic Management Journal, 5:2, pp. 171-80.
[36] Willcocks, L., Venters, W. & Whitley, E. A. (2013). Cloud sourcing and innovation: slow train coming?, Strategic Outsourcing: An International Journal, 6:2, pp. 184 – 202.
[37] Willcocks L., Venters W. & Whitley E. A. (2014). Moving to the Cloud Corporation. Palgrave Millan: UK.

Appendix: Questions Used

To what extent the use of CC services by your firm has provided the following benefits? (answer in a scale of 1 to 5, where: 5 = to a very large extent, 4 = to a large extent, 3 = to a moderate extent, 2 = to a small extent, 1 = not at all or to a very small extent)

CC_BV	Reduction of the cost of the electronic support of your activities and business processes	1 2 3 4 5
	Improvement of the quality of the electronic support of your activities and business processes (e.g. by providing more capabilities/functionalities, higher availability)	1 2 3 4 5
	Use and exploitation of new technologies without need for additional investments	1 2 3 4 5
	Electronic support and facilitation of the rapid and lower cost introduction of products/services innovations (= new products/services or significantly improved ones)	1 2 3 4 5
	Electronic support and facilitation of the rapid and lower cost introduction of methods/processes innovations (= new methods/processes or significantly improved ones)	1 2 3 4 5
	An overall improvement of the 'organizational agility' of your firm, defined as its ability to respond to various changes/challenges in its external environment (e.g. introduction of new products, services and pricing policies by competitors, changes in market demand for your products and service, changes in customers' needs/preferences, need for satisfying special requirements of specific customers, need for changing the products/services mix you offer, opportunities for expansion in new markets)	1 2 3 4 5

To what extent does your firm have the following? (similar scale)

INT_REL	*Good relationship, cooperation, mutual understanding and trust between the ICT personnel of your company and the personnel of its business units who use ICT*	*1 2 3 4 5*

Number of firm's employees _____

ICT_Personnel: Number of firm's ICT personnel (employees) _____

Share of firm's employees having degrees from Universities/Technological Education Institutes (TEI) _____