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## Impact of information technology on innovation in determining firm performance

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The aim of this study is to investigate the strategic relevance of Information Technology (IT). The study used resource-based theory to test if IT was a competitive resource, by examining the role it played between the constructs of innovation capability and firm performance. A cross-sectional study was conducted amongst 292 employees at the Hillside Aluminium Smelter in Richards Bay, South Africa. The results showed that a statistically strong positive relationship exists between innovation and firm performance ( $r = 0.616$ ,  $p < 0.01$ ). The results showed a moderate and statistically significant relationship between IT Capability and Innovation Capability ( $r = 0.563$ ,  $p < 0.01$ ). A favourable result for the moderator variable ( $p < 0.01$ ) was found; however, the Innovation Capability as the independent variable showed an unfavourable result ( $p = 0.579$ ). Multiple regression analysis showed that the model proved to be statistically significant ( $p < 0.01$ ). It is therefore recommended that the drive for innovation as a key determinant of future firm competitive advantage must factor in technological capability, specifically information technology. Through the careful selection of IT resources and skills, IT capabilities displaying VRIN characteristics can be achieved, resulting in IT as a strategic resource.

**Keywords:** impact, information technology, innovation, firm performance

### Introduction

Information technology (IT) has no value beyond that offered as a common resource (Cai et al. 2016). Consider industry disruptors like Uber, AirBnb, and Alibaba that embraced IT into their business strategies resulting in significant competitive advantages within their respective markets. At the other end of the spectrum, IT outsourcing has seen significant growth over the past decade, driven by the need for organizations to focus only on their core business.

Achieving sustained competitive advantage (SCA) is the aim of any well-crafted business strategy. Resource-based theory (RBT) emerged to explain SCA. Under the definition of resource-based theory, information technology is defined as a physical resource. The growth in globalized markets is firmly establishing innovation as a key tool for the creation of business value. (Reaiche, de Zubielqui, and Boyle 2016). Innovativeness is considered a significant factor for the success of firms, a view supported by many academic fields, such as marketing, strategic and organizational management, and international business (Shin and Lee 2016). Specifically, innovation is a key enabler for firms to achieve competitive advantage (Kmieciak, Michna, and Meczynska 2012). The strategic role of information technology is studied through the relationship between innovation and firm performance.

### Problem statement

The Productivity Paradox from the 1980s referred to the increase in productivity at country and firm levels but this did not correspond with the significant growth in information technology (Daulatkar and Sangle 2015). A key point of contention is that improvements in firm performance promised by IT opportunities were not consistent with the significant investments in such IT (Daulatkar and Sangle 2015).

The correct strategic positioning of IT in an organization is crucial for its success, including its long-term competitiveness. Many CEOs and CIOs are faced with this challenge. Daulatkar and Sangle (2016) re-conceptualization of IT business value shows that if the business strategy is prospector, then IT insourcing is suggested, whereas if the business strategy is defender, then IT outsourcing is preferred. Once this decision sourcing strategy is made, it will be very costly to change. Incorrect IT strategic positioning is therefore a risk to business. Cai et al. (2016) showed ITC to be valuable but not rare and so a common resource. Ong and Chen (2013) researched the relationship between ITC and firm performance, future firm performance, and firm value. Their results showed a positive and statistically significant relationship between these constructs, albeit with varying levels of significance, and concluded ITC is a strategic resource. These studies show divergent results regarding the strategic relevance of ITC.

The relationship between innovation and firm performance has been well researched and there exists an abundance of studies confirming the positive and significant relationship between these constructs (Birkner and Mahr 2016; Leitner, Warnke, and Rhomberg 2016; Reaiche, de Zubielqui, and Boyle 2016). Extant literature on the constructs of ITC and innovation capability (INC) showed varying outcomes (Turulja and Bajgoric 2016). This research aimed to determine the impact of IT capability on innovation capability in determining firm performance.

### Literature review

#### *Information technology capability*

Resources are considered those assets of a firm that are tangible and result in profits, which may be transferred from company to company without any major loss in value. IT resources are composed of three components:

a) the tangible resources, i.e. the physical IT infrastructure parts; b) the human IT resources, i.e. the tacit IT skills of technical and management; and c) the intangible IT-enabled resources, e.g. knowledge resources (Drnevich and Croson 2013), which are common enough to ensure they retain value in a change of ownership. Information technology (IT) capability reflects a firm's ability to acquire, deploy, combine, and reconfigure IT resources in support and enhancement of business strategies and work processes (Cai et al. 2016). This ability is an important catalyst that helps achieve business value by embedding IT-enabled resources to support the processes and strategies of a firm (Cai et al. 2016).

In Cai et al. (2016), their research covers the relationship between SCC and organizational responsiveness as well as its boundary condition based on the organizational learning perspective. The same study reports that IT capability serves as a significant boundary factor that moderates the relationship between SCC and organizational responsiveness. The study shows that the moderating effects of the three IT capability types vary; both outside-in and spanning IT capability enhance the positive relationship between SCC and organizational responsiveness, whereas inside-out IT capability weakens the relationship between SCC and organizational responsiveness. The results of the study show that the three types of IT capability cannot directly influence organizational responsiveness in the context of supply chains. The results reflect an emerging insight that IT capability is valuable but not rare. IT has been standardized and homogenized meaning that most firms can afford IT artifacts and acquire such capability. As the IT barrier decreases, the strategic role of IT capability changes from a leading one to a supporting one. This supports that view that IT is a commodity can hold little strategic relevance to an organization.

Previous studies have examined the benefit that information technology brings to firms from different viewpoints. However, in studying the impact of IT capabilities, all of these studies only focus on a part of FP, future FP, and firm value (Ong and Chen 2013). Ong and Chen (2013) study is to simultaneously determine the impact of information technology capabilities on FP, future FP, and firm value. The results conclude that IT capability does have a positive influence on these three constructs, although they vary in significance. In particular, the significance level of firm value is higher than that of FP. In addition, FP represents a short-term influence and firm value represents a long-term influence. Of importance for strategic relevance, the long-term significance is important. In other words, managers should pay more attention to the long-term strategic positioning that IT provides for firms, rather than only considering the short-term improvements gained through improvements in operational effectiveness.

#### ***IT capability and knowledge management resources***

Knowledge management (KM) is an important determinant for the information infrastructure capability (IIC) and organizational competitive advantage (CA) (Sook-Ling, Ismail, and Yee-Yen 2015). Sook-Ling,

Ismail, and Yee-Yen (2015) propose an inclusive research model to overcome the single perspective issues of the previous research which were looking at either on knowledge management (KM) activity, information technology (IT) applications or information infrastructure capability (IIC) independently. The study was conducted using primarily case studies using eight companies, two international, and six national. They propose and empirically analyze an inclusive KM research framework that examines how IIC influences the sustainable KM and CA of an organization.

According to Sook-Ling, Ismail, and Yee-Yen (2015), IIC is regarded as organizational information processing capability that may result in organizational CA. These authors present a research framework that includes key IICs such as the capabilities of integration, data management, security, utility and collaboration. Such a comprehensive framework enhances the KM practices of knowledge and technology based firms so as to achieve long-term CA. Sook-Ling, Ismail, and Yee-Yen (2015) findings identified that through an understanding of the types of knowledge and services, relevant IT applications can be identified and implemented in support of KM initiatives. Knowledge management is a crucial factor in innovation. This relationship between KM and ITC demonstrates the link between innovation and information technology capability.

#### ***Disruptive technology impact on strategy management***

A disruptive technology is one that displaces an established technology and shakes up the industry or a ground-breaking product that creates a completely new industry. Harvard Business School professor Clayton M. Christensen coined the term disruptive technology. In his 1997 best-selling book, 'The Innovator's Dilemma', Christensen separates new technology into two categories: sustaining and disruptive. Sustaining technology relies on incremental improvements to an already established technology. Disruptive technology lacks refinement, often has performance problems because it is new, appeals to a limited audience and may not yet have a proven practical application.

Disruption is a theory of competitive response. It tells you: if I innovate in this way, then this is what I can expect incumbent competitors to do. If I introduce a sustaining innovation, incumbents will generally try to mount a defence and try to eliminate me. If it's disruptive innovation, they are likely to ignore me or flee rather than fight. (Denning 2016)

Information technology is a major player in the disruptive technology space, e.g. PC, email, cloud computing and social networking.

According to the strategy field, differences in an organization's form may represent a company's capability to obtain benefits through its investments in technology. Pratono's (2016) research adds to this sentiment, when, in investigating the relationship between a firm's strategic orientation (primary determinant) and firm performance (dependent variable), he claimed technology turbulence as the primary contingency factor. The purpose of his study was to offer guidance in matching strategic

orientation (SO) with varying levels of technology turbulence (TT).

According to Shin and Lee (2016), a firm's major key strategic orientations are customer orientation (CO), competitor orientation (PO), technology orientation (TO) and internal/cost orientation (IO). Their study investigates the influence of information TT on the relationship between SO and FP. Defining IT as a moderating variable offers a holistic concept of technological business value. IT contributes to firm's performance if it can properly combine with other company factors, such as SO. Information technology is defined as a moderating variable which contributes to firm performance via such a company factor, and so being considered as resource complementary.

### ***Information technology business value: strategic perspective***

In today's highly competitive economies, costs, and in particular cost/benefits, are under severe scrutiny. Daulatkar and Sangle (2015) defined IT business value (ITBV) as the organizational performance impacts of IT at both the intermediate process level and the organization-wide level, and comprising both efficiency impacts and competitive impact. The huge potential of IT in enhancing organizational performance compared to the significant investment seems to be the middle of argument (Daulatkar and Sangle 2015). IT business value (ITBV) addresses the relationship between IT investment and organizational performance (Daulatkar and Sangle 2015).

The Productivity Paradox was in reference to the disparity between productivity growth in industry (national and firm level) and the boom in information technology (Daulatkar and Sangle 2015). Widespread research was conducted to address the impact of IT and FP; however, these findings remain inconclusive. Many theoretical frameworks or models have sought to explain the impact of IT on organizational performance (Daulatkar and Sangle 2015). Extant research on ITBV has been limited up to now. According to Daulatkar and Sangle (2015), only three major themes on IT creation value for business strategy have been research.

IT business value benefits signal IT investments that enable an organization to achieve its aims of:

- economic efficiency (Utility ITBV)
- structured business partnerships (Alliance ITBV)
- innovation enabled products and services (Transformational ITBV)
- changing market (Strategic ITBV)

Mithas and Rust (2016) complement the works of Daulatkar and Sangle (2015) and Daulatkar and Sangle (2016) presented above. Mithas and Rust's (2016) study looks at the firm's emphasis on IT strategy and investment and their effect on firm performance. While firm performance is a multidimensional construct, Mithas and Rust use 'profitability' and 'market value' that connect to fundamentals and stock market evaluations respectively. Their findings indicated three strategic pathways from IT to firm performance, namely: cost reduction, increase revenues, and a dual emphasis of adopting (1) and (2) simultaneously. Mithas and Rust (2016) concluded that

strategic IT plays a significant moderating role in the relationship between IT investments and FP. Although Mithas and Rust's (2016) research provides valuable insight into the impact of IT-related strategic emphasis on FP, the findings also imply that the impacts of strategic emphasis, i.e. cost reduction, revenue growth, or a dual emphasis on FP may vary significantly and are contingent on levels of IT investments.

### ***Immersion of innovation and information technology capability***

Turulja and Bajgoric (2016) aimed to identify antecedents of firm's success in specific circumstances of the new economy. The purpose of their paper was to analyze the interaction impact of IT capability and firms' innovation on business performance. With reference to RBV, the researchers recognize the emerging importance of information technology amongst management and academia as a key resource. Turulja and Bajgoric (2016) define IT capability as the existence of three IT components, namely, infrastructure, knowledge and operations within a company. Their research utilized survey data from managers to determine the relationship amongst IT capability, firm's innovation and business performance. Turulja and Bajgoric (2016) grouped a firm's capital resources into four categories: physical, financial, human capital, and organizational.

Pérez-López and Alegre (2012) proposed the importance of finding relevant organizational capacities that serve as important mediators between IT and performance. Their findings show that innovation can play a mediating role in the relationship between IT capability (ITC) and firm performance. The results confirm that ITC is necessary but not sufficient for enabling significant business performance. The researchers also noted that IT capability complemented with organizational culture does promote innovation leading to firm success.

Kmiecik, Michna, and Meczynska (2012) studied the relationship between ITC and employee empowerment (EE) on innovation as well as the effects of ITC and innovation on firm performance. Their study focused on small to medium enterprises (SMEs). Their finding was that ITC did not play a significant moderating role between innovativeness and FP. Information technology development and improvement, the integral role of IT in the economy and the empirical evidence of the impact of IT and FP has resulted in significant interest from academia. As a result, a school of thought has emerged that claims that IT cannot be more than a common resource due it not demonstrating the VRIN characteristics of competitive resources. Consequently, the RBV theory was adopted in identifying how firms use IT. As a result, causes of competitive advantage comprise various IT-related resources and skills that combine, resulting in an IT capability which demonstrates the VRIN characteristics (Kmiecik, Michna, and Meczynska 2012). Applying an IT capabilities approach to SMEs, a significant relationship was shown between using IT for internal communications and innovation activity. These results support the view that IT be leveraged off other resources, thereby strengthening the positive impact on FP Kmiecik, Michna, and

Meczynska (2012). In addition, it was found that when a suitable climate for innovation is established, the result is an improvement in innovativeness. Information technology that is applied in internal communications results in a positive effect on innovation which enhances the climate for empowerment. IT knowledge was found to be an important factor in determining the support by IT for information processes in an organization. This shows that IT skills and knowledge, and investments in these capabilities, will result in greater innovativeness.

### ***Modern interpretation of innovation***

Innovation is defined as the skill to do things in another way (Birkner and Mahr 2016), recognized as something new that can result in value (Reaiche, de Zubielqui, and Boyle 2016), and is instrumental in creating a firm's responsiveness toward a dynamic business environment (Srivastava, Sultan, and Chashti 2017). Innovation can therefore be a critical economic enabler to increase profitability and firm value.

Birkner and Mahr (2016) researched innovation amongst enterprises in Nagykanizsa, Hungary. They argued that in a knowledge-based environment, knowledge has unprecedented importance (Birkner and Mahr 2016). Consequently, knowledge and innovation combine, since innovation is the activity of applying knowledge. Creativity and knowledge are important concepts of innovation. These concepts can be attained and improved through learning (Birkner and Mahr 2016). Learning is an interactive process and has three subtypes: a) learning through searching, b) learning through research, and c) learning through production (Péter 2015). Birkner and Mahr (2016) also proposed two solutions to expanding innovation in an organization: first, by establishing new and strong network innovative enterprises within the divisions of industry and services that aspire to international quality levels; and second, by establishing strong research capacities with educational institutes around innovation. This would address the gap in innovation skills the researchers observed amongst the SMEs in their sampled population.

### ***Modern forms of innovation***

Leitner, Warnke, and Rhomberg (2016) aimed to discuss the critical aspects of new forms of innovation such as increased participation, the use of information technologies and the increased pace of innovation and their challenges for innovation policy. Based on a collection of international practice examples from industry and society, innovation visions have been generated and assessed by different experts across Europe. Contemporary innovation models, for instance, open innovation, user innovation, and crowdsourcing have raised much attention in academia, business and policy. The proponents of these models often highlight the need to adopt these strategies to increase competitiveness in the global innovation race and, albeit to a lesser extent, to address societal challenges. IT software will be integral to innovation and it is predicted that we will see further automation of innovation. The INFU project described the visions 'open source society' and 'automatized

innovation', which rest on an extensive use of information and communication technologies (ICT), and expect that we will see more use of ICT in the search for solutions and the identification of customer demands on the web and for web-based product testing, simulations, etc. With 'automatized innovation', it is assumed that a number of new techniques, such as the semantic web analysis, allows for automatizing parts of the innovation process, ranging from idea generation via design to testing. In this model, sophisticated semantic web filters track changes in consumer preferences and new ideas in real time and automatically extract innovations with an outstanding market potential. Concerning the use of ICT to run the innovation procedure, past principles offer guidance on the use of digital data innovation purposes once relevant data have been collected, which could lead to appropriate laws and standards inhibiting automation of innovation.

### ***Innovativeness and IT capability***

In modern views of economy, innovativeness is considered as one of the significant factors enabling the survival, growth and competitiveness of organizations (Kmieciak, Michna, and Meczynska 2012). In addition, it is asserted, that in the long term, innovativeness is the only effective way to be competitive (Kmieciak, Michna, and Meczynska 2012). Kmieciak, Michna, and Meczynska (2012) pursued a study to determine two business objectives. The first was how to improve and retain innovation. The second was how innovation relates to financial and non-financial firm performance. Achieving competitive advantage and improved firm performance are cited as the two primary reasons for firms to innovate. According to these researchers, empirical research is divided between the positive relation between innovation and FP. Information technology has been shown to positively influence innovation through improvements in communication, sharing of information and knowledge, inter-organizational exchange and processes of organizational learning, concepts which underlie innovation (Kmieciak, Michna, and Meczynska 2012). Through the use of IT, customer feedback can be solicited, with such data serving as input into the innovation process, thereby resulting in improved or new products or services (Kmieciak, Michna, and Meczynska 2012). Innovation does require upfront investment in tangible and intangible assets and returns on these investments may take time to be realized (Kmieciak, Michna, and Meczynska 2012). It is therefore imperative to create a climate that stimulates innovation in a sustainable way.

### ***Research methodology***

#### ***Research paradigm***

Research paradigms convey the fundamental philosophical concepts and values about the nature of reality and scientific pursuit of knowledge. Two primary schools of thought are positivism and phenomenology. Positivist research is generally quantitative and involves the use of numerical measurement and statistical analyses of measurements to examine social phenomena. Advantages of this approach are its objectivity and reliability of results.

In its application to social phenomena, however, it may not always be appropriate, as all social phenomena cannot be accurately and reliably measured, thus reducing validity of the findings. Phenomenological research argues that the world is socially constructed, and that science is driven by human interests, with the researcher being the subjective entity of the observed world. Advantages of this approach are that the findings have greater validity and less artificiality, as the process of observing phenomena in natural, real-life settings often allows researchers to develop a more accurate understanding of those phenomena. Based on the above, this research adopted a positivist approach.

### **Research design and methods**

A research design is a blueprint for the collection, measurement, and analysis of data, based on the research questions of the study (Sekaran and Bougie 2013). Common forms of research design include causal-comparative research, correlational research, explanatory research, descriptive research, and exploratory research. Based on the aim of this study, correlational research design was selected. Correlational research refers to studies in which the purpose is to discover relationship between variables through the use of correlational statistics, e.g. correlational coefficient. However, a correlational study must guard against arguing for a cause and effect relationship between the variables merely because of a strong correlation between them. A major advantage of correlational research is that the researcher can explore a wide variety of different relationships in the same study. Therefore, the use of this approach in this study enabled us to test the effect of IT capability as a moderator variable.

### **Study setting, population and sample of the study**

South32 is an international mining and resources company. Commodities in its portfolio include coal, manganese, and aluminium. Hillside Aluminium is a wholly owned subsidiary of South32 and is based in the town of Richards Bay, South Africa. Hillside Aluminium produces approximately 700 Mt of primary aluminium annually. The price of aluminium is set by the London Metal Exchange (LME). Of the many input costs, one of the largest, and most critical, is electricity. As the price of aluminium is determined by the LME, the only factor the company can control to influence profitability is cost ( $\text{Profit} = \text{Revenue} - \text{Cost}$ ).

The population refers to the entire group of people, events, or things of interest that the researcher wishes to investigate (Sekaran and Bougie 2013). Hillside Aluminium (HA) has two categories of employees, expertise and management team (EMT) and expertise and action team (EAT). The EMT category of employees are seen as the management layer of the organization and therefore are more involved in strategic and tactical level decision-making. Shanteau et al. (2002) have listed eight primary tactics to expert selection. These researchers base their selection on a single criterion, the level of management in the IT domain for the industry personnel. This approach is followed in selecting the EMT category of employees as

the population for this research. Based on the payroll as of May 2017, two hundred and ninety-two (292) elements (or samples) make up the population. This also serves as the sampling frame. No sampling was done as the total population was part of the study.

### **Construction of the instrument**

Drawing on the findings from the literature review, questions relevant to each of the constructs researched were adapted in compiling the questionnaire. Questions were drawn from Tippins and Sohi (2003), Turulja and Bajgoric (2016), Karadal and Saygin (2011), and Tseng (2014). The questionnaire was constructed along the following: Demographic – four (4) questions, seventeen (17) questions relating to IT Capability, seven (7) questions relating to Firm Performance, and thirty-three (33) questions relating to Innovation Capability. The demographic questions employed the use of nominal and ordinal scales. This allowed the categorization of respondents into the various characteristics. The questions relating to the three constructs all used a five-point Likert scale. The scale item should be at least five and preferably seven categories (Brown 2011).

### **Data collection**

Questionnaires can be administered personally, via email to respondents, or electronically distributed. For the purposes of this survey, a cloud-based software-as-a-service (SaaS) was used ([www.surveymonkey.com](http://www.surveymonkey.com)). As part of this service, the utility provides a hyperlink to the online survey. Using the relevant Hillside Aluminium email distribution lists, this hyperlink was sent to the targeted sampling frame. The survey remained open for the period 5th May 2017 to 6th June 2017. In total, 136 responses were received.

Prior to data collection, the questionnaire was sent to two industry experts in IT and project management to check. The following feedback was received, and changes affected:

1. Use of the FP and business performance was originally used and this could lead to confusion. Firm performance was chosen as the way to describe the construct and changes to the questionnaire were made.
2. Original list of questions included a total of eighty-two (82). If it was felt to be too long and introduced risk of respondents not completing the survey. After re-examining the questions, this was reduced to fifty-seven (57).

### **Data analysis**

All the raw data were exported from surveymonkey into a Microsoft Excel<sup>®</sup> format file. The data was searched for missing entries and these were removed. The cleansed file was then used to determine the composite values for the primary constructs of the study. This data were then used as input into the statistical software called Minitab<sup>®</sup>, a widely used software tool for statistical analysis popularized for use in Six Sigma programmes. Initially, descriptive analysis such as frequency distribution was conducted. In order to interpret the data to address the research objectives, Pearson correlation coefficient and

regression analysis were used. *P*-values less than 0.05 were considered statistically significant.

### **Ethical considerations**

This study obtained an ethical clearance certificate from the ethics committee of the University of KwaZulu-Natal. Participation in this survey was completely voluntary and this was communicated in the email note. In addition, the letter of informed consent was incorporated into the online survey with the choice for the participants to participate in the survey.

### **Results**

#### **IT capability distribution**

The frequency distribution for each of the questions for the IT Capability construct is presented in Table 1. Majority of the results point towards a high level of IT Capability. The use of decision-support systems for managing customer information showed a result of 50.83%. The question asking if there is a climate that encourages risk taking and experimentation with IT showed a 22.5% positive result. Regarding whether IT outsourcing improves firm performance, 43.33% of the participants responded positively.

#### **Innovation distribution**

Table 2 shows the frequency distribution for each of the Innovation Capability questions. Less than half of the participants responded positively toward customers' preferences changes in product quality. Similarly, answers regarding culture of innovation (Questions 29, 31, 32, and 34) indicated a low disposition. It was found that an aggregate result of 31.67% indicated the company is a follower of innovation, albeit a quick follower. Questions 37 and 38, with aggregate values of 21.67% and 35% respectively, support this view that the company is often first-to-market as well as introduces more innovative processes

and services. Questions 48 and 49, with aggregate values of 42.50% and 40.83% respectively, are consistent with the fact that the organization currently only intends on producing a single market product.

#### **Firm performance distribution**

The majority of the results were consistent with the overall performance of the company over the past three years. Question 53 (82.50%) and question 54 (81.67%) complement each other and show consistency. Question 55 indicates there is 40% potential for improvement for this important company performance indicator. Question 65 was 65% and indicates a good result for the impact of innovation on growth and profitability; however, this too indicates opportunity for further firm gains. Similarly, question 57 with a result of 54.17% indicate that just below 50% of departments achieved all their KPIs, thus indicating further opportunities for improvements to the overall firm performance (Table 3).

Pearson correlation test was conducted to determine the relationship between variables (Table 4). Results found a significant positive relationship between Innovation Capability and Firm Performance ( $r=0.62$ ,  $p<0.01$ ). Similarly, a significant positive relationship was found between IT Capability and Firm Performance ( $r=0.58$ ,  $p<0.01$ ).

#### **Innovation and firm performance**

Simple regression analysis was used in a situation where one independent variable was hypothesized to affect one dependent variable. The first regression test was conducted for the Firm Performance (independent variable) and Innovation Capability (dependent variable). The results showed an  $R^2$  value of 37.94%. This means that approximately 38% of the variation of the Firm Performance can be explained by Innovation Capability. The *p*-value was  $<0.01$  showing a statistically significant

**Table 1:** IT Frequency Distribution of statements regarding IT capabilities.

| Question | IT capability questions                                                                                                                 | SD   | D     | U     | A     | SA    |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------|------|-------|-------|-------|-------|
| 1        | Overall, our technical support staff is knowledgeable when it comes to computer-based systems                                           | 1.67 | 8.33  | 4.17  | 60.00 | 25.83 |
| 2        | Our firm possesses a high degree of computer-based technical expertise                                                                  | 1.67 | 5.83  | 8.33  | 63.33 | 20.83 |
| 3        | We are very knowledgeable about new computer-based innovations                                                                          | 0.83 | 11.67 | 28.33 | 50.83 | 8.33  |
| 4        | We have the knowledge to develop and maintain computer-based communication links with our external and internal suppliers and customers | 0.00 | 5.00  | 13.33 | 68.33 | 13.33 |
| 5        | We routinely utilize computer-based systems to access market information from outside databases                                         | 0.00 | 8.33  | 36.67 | 46.67 | 8.33  |
| 6        | We have set procedures for collecting customer information from online sources                                                          | 1.67 | 10.00 | 29.17 | 53.33 | 5.83  |
| 7        | We utilize decision-support systems frequently when it comes to managing customer information                                           | 0.00 | 10.83 | 38.33 | 48.33 | 2.50  |
| 8        | We rely on computer-based systems to acquire, store, and process information about our customers                                        | 0.00 | 7.50  | 17.50 | 54.17 | 20.83 |
| 9        | Our company has a formal IT department                                                                                                  | 0.83 | 0.00  | 0.83  | 50.00 | 48.33 |
| 10       | Our firm employs a manager whose main duties include the management of our information technology                                       | 0.00 | 4.17  | 5.00  | 55.83 | 35.00 |
| 11       | Our firm creates customized software applications when the need arises                                                                  | 3.33 | 11.67 | 12.50 | 50.83 | 21.67 |
| 12       | Our firm's members are linked by a computer network                                                                                     | 0.00 | 0.00  | 2.50  | 49.17 | 48.33 |
| 13       | Implemented IT solutions fulfil our business objectives                                                                                 | 0.83 | 7.50  | 3.33  | 56.67 | 31.67 |
| 14       | There is a climate that encourages risk taking and experimentation with IT                                                              | 5.83 | 34.17 | 37.50 | 20.00 | 2.50  |
| 15       | There is clarity of vision regarding how IT contributes to firm value or strategy                                                       | 0.00 | 21.67 | 21.67 | 47.50 | 9.17  |
| 16       | There is integration of business strategic planning and IT planning                                                                     | 0.83 | 11.67 | 21.67 | 55.83 | 10.00 |
| 17       | IT outsourcing improves firm performance                                                                                                | 5.83 | 26.67 | 24.17 | 38.33 | 5.00  |

**Table 2:** Frequency distribution of statements regarding innovation capability.

| Question | Innovation Capability Statements                                                                                                          | %    |       |       |       |       |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------|------|-------|-------|-------|-------|
|          |                                                                                                                                           | SA   | D     | U     | A     | SA    |
| 18       | In our kind of business customers' product and quality preferences change quite a bit over time                                           | 2.50 | 37.50 | 12.50 | 40.00 | 7.50  |
| 19       | Our customers tend to look for new product quality all the time                                                                           | 5.00 | 33.33 | 14.17 | 40.00 | 7.50  |
| 20       | Technological changes provide big opportunities in our industry                                                                           | 0.00 | 7.50  | 8.33  | 65.00 | 19.17 |
| 21       | A large number of new product ideas have been made possible through technological breakthroughs in our industry                           | 1.67 | 18.33 | 21.67 | 47.50 | 10.83 |
| 22       | The technology in our industry is changing rapidly                                                                                        | 0.83 | 20.83 | 10.00 | 52.50 | 15.83 |
| 23       | Competition in our industry is cutthroat                                                                                                  | 1.67 | 16.67 | 14.17 | 51.67 | 15.83 |
| 24       | Price/Cost competition is a hallmark of our industry                                                                                      | 0.83 | 4.17  | 11.67 | 51.67 | 31.67 |
| 25       | Anything that one competitor can offer, others can match readily                                                                          | 0.00 | 10.00 | 21.67 | 51.67 | 16.67 |
| 26       | We encourage people to think and behave in original and novel ways                                                                        | 0.83 | 15.00 | 8.33  | 70.00 | 0.83  |
| 27       | We are willing to try new ways of doing things and seek unusual, novel solutions                                                          | 0.83 | 21.67 | 15.00 | 56.67 | 5.83  |
| 28       | Our company can be described as flexible and continually adapting to change                                                               | 0.83 | 15.00 | 8.33  | 65.00 | 10.83 |
| 29       | In our company, we tolerate individuals who do things in a different way                                                                  | 1.67 | 30.83 | 21.67 | 40.83 | 5.00  |
| 30       | Employees get a lot of support from managers if they want to try new ways of doing things                                                 | 1.67 | 26.67 | 14.17 | 50.00 | 7.50  |
| 31       | The reward system encourages innovation in our company                                                                                    | 4.17 | 40.00 | 20.83 | 31.67 | 3.33  |
| 32       | Our company gives employees free time to pursue creative ideas during the workday                                                         | 5.83 | 43.33 | 18.33 | 31.67 | 0.83  |
| 33       | When we see new ways of doing things, we are last at adopting them                                                                        | 1.67 | 41.67 | 25.00 | 29.17 | 2.50  |
| 34       | In our firm we are willing to take risks and explore 'chancy' growth opportunities                                                        | 2.50 | 48.33 | 26.67 | 21.67 | 0.83  |
| 35       | Our investments in new machinery and equipment are significant compared with our annual turnover                                          | 3.33 | 34.17 | 20.83 | 35.83 | 5.83  |
| 36       | Our investments in new methods of production are significant compared with our annual turnover                                            | 4.17 | 37.50 | 25.83 | 30.00 | 2.50  |
| 37       | In new process and service introductions, our company is often first-to-market                                                            | 6.67 | 40.00 | 31.67 | 20.00 | 1.67  |
| 38       | In comparison with our competitors, our company has introduced more innovative processes and services during the past three years         | 1.67 | 25.00 | 38.33 | 31.67 | 3.33  |
| 39       | Our new processes and services are often perceived as very novel by customers                                                             | 1.67 | 19.17 | 38.33 | 38.33 | 2.50  |
| 40       | In comparison with our competitors, our company has introduced more innovative production or delivery methods during the past three years | 2.50 | 30.00 | 33.33 | 30.00 | 4.17  |
| 41       | New processes and services in our company often take us up against new competitors                                                        | 1.67 | 24.17 | 30.83 | 40.00 | 3.33  |
| 42       | Our firm will introduce new processes or services within a year                                                                           | 3.33 | 20.00 | 25.83 | 47.50 | 3.33  |
| 43       | In new process and service introductions, our company is often at the cutting edge of technology                                          | 2.50 | 31.67 | 22.50 | 40.00 | 3.33  |
| 44       | During the past three years, our company has developed many new management approaches                                                     | 0.00 | 6.67  | 8.33  | 72.50 | 12.50 |
| 45       | We are constantly improving our business processes                                                                                        | 0.00 | 8.33  | 8.33  | 66.67 | 16.67 |
| 46       | IT has an effect on the new production ideas                                                                                              | 1.67 | 13.33 | 8.33  | 62.50 | 14.17 |
| 47       | IT has an effect on the innovation of production works                                                                                    | 0.83 | 11.67 | 9.17  | 65.00 | 13.33 |
| 48       | IT has an effect on the decrease of development process of the new products                                                               | 1.67 | 22.50 | 33.33 | 39.17 | 3.33  |
| 49       | IT has an effect on the decrease of the changes in product designs                                                                        | 1.67 | 28.33 | 29.17 | 38.33 | 2.50  |
| 50       | IT has an effect on the convenience of the new product for the customers                                                                  | 0.83 | 18.33 | 21.67 | 52.50 | 6.67  |

**Table 3:** Distribution of statements regarding firm performance (%).

| Question | Firm Performance Questions                                                                                    | SD   | D     | U     | A     | SA    |
|----------|---------------------------------------------------------------------------------------------------------------|------|-------|-------|-------|-------|
| 51       | The quality of our processes and services in your department has improved over the past three years           | 3.33 | 22.50 | 8.33  | 53.33 | 12.50 |
| 52       | Your consumer satisfaction is greater than it was last year                                                   | 4.17 | 23.33 | 20.00 | 45.00 | 23.33 |
| 53       | The firm's profitability is higher than it was last year                                                      | 0.00 | 2.50  | 15.00 | 63.33 | 19.17 |
| 54       | The firm's cost-base has improved since last year                                                             | 0.00 | 7.50  | 10.83 | 63.33 | 18.33 |
| 55       | Labour productivity has improved since last year                                                              | 1.67 | 20.83 | 17.50 | 53.33 | 6.67  |
| 56       | Innovations introduced in the last three years have contributed to income growth or profitability in our firm | 0.83 | 14.17 | 20.00 | 52.50 | 12.50 |
| 57       | Your department achieved all set key performance indicators in the past three years                           | 2.50 | 34.17 | 9.17  | 49.17 | 5.00  |

**Table 4:** Pearson correlation analysis output.

| Analyses              | Constructs Relationship | r-value | p-value |
|-----------------------|-------------------------|---------|---------|
| Innovation Capability | ↔ Firm Performance      | 0.616   | <0.01   |
| IT Capability         | ↔ Firm Performance      | 0.577   | <0.01   |
| IT Capability         | ↔ Innovation Capability | 0.563   | <0.01   |

relationship. Also, from the research analysis, the model fitted very well ( $p$ -value  $< 0.01$ ) (Table 5).

#### **IT capability and innovation capability**

It was found that there was a statistically significant relationship exists between the constructs ( $p < 0.01$ ). The results indicated that 32% of variation in Innovation Capability is determined by IT Capability (Table 6).

#### **Testing moderation of IT capability**

The conceptual model presented in this study was employed to determine the strategic relevance of IT in today's business world. Based on resource-based theory, IT Capability was tested for its moderating effect on the relationship between innovation and firm performance, a relationship proven to be positive and significant in the research analysis. A regression analysis was conducted using the three constructs of the conceptual model. The analysis of the results showed a  $p$ -value of  $< 0.01$  for the moderator variable, thus indicating a statistically significant relationship exists. However, a

$p$ -value of 0.579 was found for Innovation Capability. As a  $p$ -value  $> 0.05$  indicates a statistically insignificant relationship, the conceptual model does not fit well. The  $R^2$ -value was found to be 0.45, a favourable value. The results indicate that 45% variation in the dependent variable can be determined by the independent variable. This is an interesting finding, as it shows that the relationship between Innovation Capability and Firm Performance is improved through the inclusion of the IT Capability construct. This indicates that IT Capability does have a positive impact on the relation between the underlying constructs. It was therefore decided to re-run the tests but using multiple regression analysis (Table 7).

Multiple regression analysis was run in view of the unfavourable outcome based on using IT Capability as a moderating variable. This prompted a retesting of the model using the model applied by Turulja and Bajgoric (2016), in which they showed IT Capability and Innovation Capability as antecedents of Firm Performance.

**Table 5:** Regression Analysis for Firm Performance and Innovation Capability.

| i. Analysis of Variance                                 |        |                      |         |         |         |
|---------------------------------------------------------|--------|----------------------|---------|---------|---------|
| Source                                                  | DF     | Adj SS               | Adj MS  | F-Value | P-Value |
| Regression                                              | 1      | 898.3                | 898.32  | 72.15   | <0.01   |
| Innovation Capability                                   | 1      | 898.3                | 898.32  | 72.15   | <0.01   |
| Error                                                   | 118    | 1469.1               | 12.45   |         |         |
| Lack-of-Fit                                             | 50     | 502.1                | 10.04   | 0.71    | 0.901   |
| Pure Error                                              | 68     | 967.1                | 14.22   |         |         |
| Total                                                   | 119    | 2367.5               |         |         |         |
| ii. Model Summary                                       |        |                      |         |         |         |
| S                                                       | R-sq   | R-sq(adj) R-sq(pred) |         |         |         |
| 3.5285                                                  | 0.38   | 0.37 0.36            |         |         |         |
| iii. Coefficients                                       |        |                      |         |         |         |
| Term                                                    | Coef   | SE Coef              | T-Value | P-Value | VIF     |
| Constant                                                | 4.58   | 2.42                 | 1.90    | 0.060   |         |
| Innovation Capability                                   | 0.1849 | 0.0218               | 8.49    | <0.01   | 1       |
| Regression Equation:                                    |        |                      |         |         |         |
| Firm Performance = 4.58 + 0.1849 Innovation Capability. |        |                      |         |         |         |

**Table 6:** Regression Analysis for Innovation Capability and IT Capability.

| i. Analysis of Variance                                                      |       |                      |         |         |         |
|------------------------------------------------------------------------------|-------|----------------------|---------|---------|---------|
| Source                                                                       | DF    | Adj SS               | Adj MS  | F-Value | P-Value |
| Regression                                                                   | 1     | 8319                 | 8319.1  | 54.67   | <0.01   |
| IT Capability                                                                | 1     | 8319                 | 8319.1  | 54.67   | <0.01   |
| Error                                                                        | 118   | 17957                | 152.2   |         |         |
| Lack-of-Fit                                                                  | 33    | 6117                 | 185.4   | 1.33    | 0.148   |
| Pure Error                                                                   | 85    | 11839                | 139.3   |         |         |
| Total                                                                        | 119   | 26276                |         |         |         |
| ii. Model Summary                                                            |       |                      |         |         |         |
| S                                                                            | R-sq  | R-sq(adj) R-sq(pred) |         |         |         |
| 12.3359                                                                      | 0.32  | 0.31 0.29            |         |         |         |
| iii. Coefficients                                                            |       |                      |         |         |         |
| Term                                                                         | Coef  | SE Coef              | T-Value | P-Value | VIF     |
| Constant                                                                     | 45.39 | 8.82                 | 5.15    | <0.01   |         |
| IT Capability                                                                | 1.015 | 0.137                | 7.39    | <0.01   | 1       |
| Regression Equation:<br>Innovation Capability = 45.39 + 1.015 IT Capability. |       |                      |         |         |         |

**Table 7:** Regression Analysis with IT Capability as the Moderating Variable.

| i. Analysis of Variance |          |                      |         |         |         |
|-------------------------|----------|----------------------|---------|---------|---------|
| Source                  | DF       | Adj SS               | Adj MS  | F-Value | P-Value |
| Regression              | 2        | 1075.38              | 537.692 | 48.69   | <0.01   |
| Moderator               | 1        | 177.06               | 177.062 | 16.03   | <0.01   |
| Innovation Capability   | 1        | 3.42                 | 3.422   | 0.31    | 0.579   |
| Error                   | 117      | 1292.08              | 11.043  |         |         |
| Lack-of-Fit             | 113      | 1282.08              | 11.346  | 4.54    | 0.073   |
| Pure Error              | 4        | 10                   | 2.5     |         |         |
| Total                   | 119      | 2367.47              |         |         |         |
| ii. Model Summary       |          |                      |         |         |         |
| S                       | R-sq     | R-sq(adj) R-sq(pred) |         |         |         |
| 3.3232                  | 0.45     | 0.44                 | 0.42    |         |         |
| iii. Coefficients       |          |                      |         |         |         |
| Term                    | Coef     | SE Coef              | T-Value | P-Value | VIF     |
| Constant                | 10.65    | 2.73                 | 3.890   | <0.01   |         |
| Moderator               | 0.001629 | 0.000407             | 4       | <0.01   | 4.79    |
| Innovation Capability   | 0.025    | 0.0449               | 0.56    | 0.579   | 4.79    |

Regression equation:

Firm Performance = 10.65 + 0.001629 Moderator + 0.0250 Innovation Capability.

The  $p$ -values for IT Capability and Innovation Capability were <0.01. This indicates a statistically significant relationship between these independent variables and Firm Performance. Furthermore, the  $R^2$ -value of 0.4573 was produced, an improvement on the model showing IT Capability as a moderator. Hence, 45.73% variation in Firm Performance could be explained by IT Capability and Innovation Capability. From the research analysis, this model fitted very well ( $p < 0.01$ ) (Table 8).

### Discussion

The aim of this study was to investigate whether IT Capability plays a moderating role on the relationship between Innovation and Firm Performance. The present study found that the company has a climate that encourages risk taking and experimentation with IT and IT outsourcing improves firm performance. Kmiecik, Michna, and

Meczynska (2012) found that IT enables innovation through empowerment. Leitner, Warnke, and Rhomberg (2016) found that innovation is a critical enabler for firm performance going forward. The result for this factor in the current study showed an IT environment that does not support innovativeness. In view of the broader results, the consensus is there is a favourable level of IT Capability in the organization. Within the context of IT being regarded a common resource, this result seems consistent. On this basis, there appears to be a gap in the organization in addressing the innovative capability required to drive firm performance.

According to Johansson and Bergkvist (2012), information systems (interchangeably used with information technology) that require deep business knowledge must be kept inhouse or onshore. Innovation in the context of an organization requires a deep level of understanding to

**Table 8:** Regression Analysis for Firm Performance with Innovation Capability and IT Capability as the Independent Variables.

| i. Analysis of Variance |        |                      |         |         |         |
|-------------------------|--------|----------------------|---------|---------|---------|
| Source                  | DF     | Adj SS               | Adj MS  | F-Value | P-Value |
| Regression              | 2      | 1082.65              | 541.324 | 49.29   | <0.01   |
| IT Capability           | 1      | 184.33               | 184.326 | 16.79   | <0.01   |
| Innovation Capability   | 1      | 293.7                | 293.704 | 26.75   | <0.01   |
| Error                   | 117    | 1284.82              | 10.981  |         |         |
| Lack-of-Fit             | 113    | 1274.82              | 11.282  | 4.51    | 0.074   |
| Pure Error              | 4      | 10                   | 2.5     |         |         |
| Total                   | 119    | 2367.47              |         |         |         |
| ii. Model Summary       |        |                      |         |         |         |
| S                       | R-sq   | R-sq(adj) R-sq(pred) |         |         |         |
| 3.31381                 | 45.73% | 44.80%               | 42.79%  |         |         |
| iii. Coefficients       |        |                      |         |         |         |
| Term                    | Coef   | SE Coef              | T-Value | P-Value | VIF     |
| Constant                | -0.78  | 2.62                 | -0.300  | 0.765   |         |
| IT Capability           | 0.1827 | 0.0446               | 4.1     | <0.01   | 1.46    |
| Innovation Capability   | 0.1279 | 0.0247               | 5.17    | <0.01   | 1.46    |

Regression equation:

Firm Performance = -0.78 + 0.1827 IT Capability + 0.1279 Innovation Capability.

be effective. Consequently, value-adding activities can be identified and implemented resulting in improvements to firm performance. This result is consistent with the literature in recognizing that IT for the use of improving firm performance must leverage off innovation and, hence, insourced IT is best suited.

### ***Innovation capability***

Shin and Lee (2016) investigated the relationship between Innovation and Firm Performance by narrowing on innovation from a culture perspective. Their results proved that innovation culture has a significant statistical relationship with firm performance. The present study showed a 67% unfavourable result for a culture of innovation. The results of this research were inconsistent with the findings of Shin and Lee (2016). A plausible explanation for this is that their study focused only on the culture dimension of innovation, whereas this study focused on innovation as an input and an output, as well as on the culture of innovation. Reaiche, de Zubielqui, and Boyle (2016) studied the role of country culture in defining innovation, proving that culture does impact on the interpretation and application of innovation. The low culture of innovation presented by the results in the current study brings into question the perception towards IT in driving innovation in and by the organization.

### ***Firm performance***

The factors used by the organization support the multidimensionality perspective of firm performance as defined by Santos and Brito (2012). The results show a strong awareness amongst the respondents for the profitability factors. This indicates a bias towards the financial perspective of firm performance. The stakeholder perspective for firm performance was found through the inclusion of customer satisfaction. The result of 68.33% shows a strong awareness of the measure by the respondents, implying that there is a good interpretation of the measure from a stakeholder perspective.

### ***Relationship among the constructs***

The results found there to be a statistically significant relationship between Innovation Capability (IC) and Firm Performance (FP). These results are consistent with the findings of Kmiecik, Michna, and Meczynska (2012) and Brem, Maier, and Wimschneider (2016). A positive and significant relationship was shown to exist between IT Capability (ITC) and Innovation Capability (IC). These results are consistent with the findings of Turulja and Bajgoric (2016), Kmiecik et. al. (2012), Leitner, Warnke, and Rhomberg (2016).

The results showed a positive and significant statistical relationship existed for this conceptual model. However, the regression analysis showed an unfavourable  $p$ -value  $>0.05$ . Hence it was inconclusive in showing ITC as a moderating variable. A similar result was found by Kmiecik, Michna, and Meczynska (2012). Kmiecik et. al. suggested that IT capabilities demonstrating the characteristics of VRIN resources were necessary for consideration of IT as a competitive resource. In view of the low innovation culture finding, it is plausible that IT is not being

viewed within the context of innovation potential. Rather, IT is being viewed from the perspective of a common resource, i.e. a resource that helps the organization achieve competitive parity at best. This is consistent with the  $r$ -value of 0.563 and  $p$ -value  $<0.01$ , showing a positive and strong relationship between ITC and FP. Pérez-López and Alegre (2012) showed that innovation can have a mediating affect between IT and FP. Ong and Chen (2013) however showed a direct relationship between IT and FP. In particular, they showed that IT plays a more significant role in firm value than FP.

### ***Conclusions***

IT capability did not have a positive impact on innovation capability in determining firm performance. In this way, the research showed that, applied correctly, IT can have a strategic role in an organization and is not limited to being a common resource. Therefore, IT resources, such as skills, infrastructure, and management must be combined into capabilities displaying VRIN characteristics to be considered a strategic resource. It is equally important and critical that the organization complements this with dynamic capabilities to ensure that sustainable competitive advantage can be achieved, a goal to which all modern organizations aspire.

### ***Limitations of the research***

The following limitations were experienced in the course of this study:

- The study was limited to only the EMT population of the Hillside Aluminium Smelter and therefore cannot be generalized to all smelter operations, nor to the industry.
- The response rate was 41%, which fell below the target of 58% as recommended for the size of sampling population. It is therefore recommended that generalization of the results be done with caution.

### ***Recommendations***

For future practical considerations:

- Firm performance should be broadened to include sustainability dimension. Considering the impact of IT on these sustainability factors could strengthen the case of IT as a strategic resource.
- IT capabilities include different IT-related resources and skills. IT management must interpret these resources in the context of competitive advantage. In so doing, the correct investment decisions are made in developing those IT attributes that contribute to FP and ultimately business strategy.
- To achieve sustainable competitive advantage, the dynamic capabilities of an organization, specifically in relation to IT capability, must be understood and managed. The pace of change in the business and technological environments will shorten the life-span of IT resources offering strategic benefits requiring the identification of an updated portfolio of strategic resources. This will have to be a continuous process.

### ***Disclosure statement***

No potential conflict of interest was reported by the authors.

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