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Beyond Barebones Cloud Infrastructure Services: Stumbling Competitiveness During Economic Turbulence

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ABSTRACT

The hyper competitiveness of medium-size enterprise is not only heavily dependent on its cloud computing infrastructure evolution but also on its adaptation for sustainability to global web interconnection ecosystems. While the bigger multinationals have experienced positive business values due to their economies of scale, the medium-size manufacturing plant still faces greater challenges. We update the view on two similar but evolved theoretical perspectives from Harvard University: Commodity of IT infrastructure and Disruptive Technology into a catalyst model for optimum technology maximisation. This paper proposes the establishment of a new dynamic barebones yet optimised internet infrastructure that will integrate the existing client server into the extranet to form an extended cloud environment. The study's three-stage primary data collection procedure consistently validated our findings. Our results suggest that enterprise should continue to invest in optimised IT infrastructure despite the economic turbulence for competitive gearing in the future.

Keywords: Cloud computing, economic turbulence, exostructure, framework, IaaS, ICT infrastructure, Small and Medium Size Enterprise

INTRODUCTION

The Small and Medium Enterprise (SME) is a major force that constitutes 99.2% of Malaysia's total business establishments. Organic local growth is insufficient to fend off the rise of global SMEs. East Asian countries have in the past embraced technologies and are now enjoying the fruits of early adaptation (Tsai, 2012). More significant is the contribution of the Medium Size Manufacturing Plant (MSMPs), although comprising only 3% of Malaysia's total business establishments; the MSMPs have, however, contributed around RM1 billion (equivalent to USD$330 million) to Malaysia's total Gross Domestic Product

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(GDP) in 2012. For MSMPs to continue their dominance and move up to become larger power houses, there is a need to energise them even further to create new global competitive market efficiency.

As MSMPs expand globally, so does the availability of computing services. The Internet has created a technology innovation, a new digital market place. The advent of cloud service is unavoidable and optimising the next generation cloud service seems to be the next best solution (Abareshi, 2012; Li, 2012; Luftman, 2012; Otim, 2012; Venters, 2012; Vinekar & Teng, 2012; Wang, 2012; Antonov, 2013; Chandio, 2013; Daim, 2013; Dihal, 2013; Drnevich, 2013; Gannon, 2013; Kun, 2013; Schryen, 2013;). As enterprises begin to embrace the Internet of Things (IOT) via the ability to communicate more digitally, the promise of business improvement at a reduced shared cost grows as well. MSMPs are still using outdated technology.

MSMPs face serious resource poverty with fragmented IT operation that focuses on day-to-day tactical strategies. MSMPs lack in relevant research on the utilisation of cloud computing optimisation due to perceived low commercial value when compared to larger multinationals. Past research has shown that many MSMPs have over invested in IT infrastructure, and this has increased the operation cost and inevitably hampered sustainability (Ng, 2011, 2012; Marston, 2011). But with the advancement in IT resources outsourcing, MSMPs should be able to embrace much more complex solutions. Kun (2012) has suggested that as MSMP start to grow, they should "invest in information systems, which allow the organization to process more information without overloading the communications channels". This paper highlights the evolved technology innovation that has lagged to enhance the competitiveness of MSMPs.

Uncertainty has been enterprise's greatest worry and has translated into opportunities lost. While most would assume that a volatile economy is a period of reconciliation and hibernation, the period is actually used as strategic reconsolidation of new business strategies (Linden, 2013; Ng, 2013). Economic turbulence can be actually transformed from a mere sustainability shield to a strategic weapon for competitive advantages. This period can be used to implement and stabilise the new IT infrastructure.

IT infrastructure has been at the forefront to enable various solutions in today's digital businesses. Its new innovation is available in almost every enterprise but this however turns "IT" into a commodity technology, which Carr (2003, 2005) has termed "IT Doesn't Matter" anymore. Cloud services can no longer provide the technological edge that is required for competitive advantage. As technology matures and becomes more affordable for the mass market, it will lose its competitive edge, as stated by Clayton (2006): "Disruptive Technology [provides] insignificant competitive advantage" to enterprise. Both these theories have forced enterprise to reconsider their actual IT infrastructure specification needs before jumping into unnecessary over investment.

These challenges indicate that there are insufficient frameworks or models designed specifically for MSMPs to move beyond cloud infrastructure services, and this becomes a stumbling block for their competitiveness during economic turbulence. Cloud service is undeniably still the best option for shared solutions; however, there is still room for improvement. This paper proposes a new paradigm for consensus shifting of the legacy theory evolved from the practice of multinational corporations (MNC) that can be used for MSMPs during a volatile period.

TABLE 1 : Null Hypothesis

H_N1: Disruptive technology has low influence to competitive advantage contribution.
H_N2: IT infrastructures have positive relation to commodity product classification.
H_N3: Scarce resources are associated with MSMPs' IT infrastructure performance.
H_N4: Economic turbulence has positive correlation to infrastructure investment decisions.

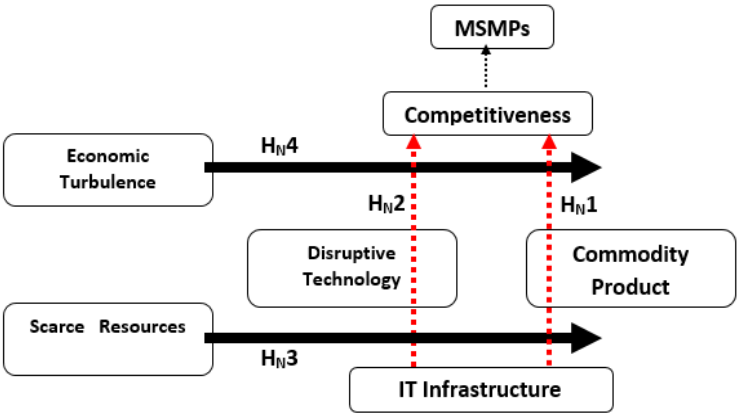

Fig.1: Initial null hypothesis relationship.

We draw a new paradigm shift that may be important in overcoming economic turbulence, uncertainty and dynamism in an evolving competitive landscape. This qualitative research initially started with the traditional Null Hypothesis shown in Table 1 with the relationship shown in Fig.1 and was then concluded with a revised Directional Correlation Hypothesis based on new findings from three data collection instruments (mass survey, personalised interview and expert group discussion). For this paper, the term "barebones" is defined as the minimum infrastructure specification needed to maintain and operate the ICT requirement for an enterprise. The new framework proposed for MSMPs cloud optimisation can also be extended to MNCs as a benchmark barebones model.

The conceptual explanatory results were deployed in sequential mixed mode process of quantitative generalisation to justify further qualitative reasoning. The quantitative results derived from previous research were used in this paper to reaffirm the current qualitative findings to conclude the analysis. This paper, however, will provide contradictive views to the above and propose the following research objectives:-

1. To explore the relationship between technology uniqueness at the point of time of disruptive technology.
2. To identify the period of product commoditisation during the product's life cycle.
3. To explore the criteria that attract enterprise to adopt the utility model.
4. To access the impact of economic turbulence towards IT infrastructure investment.

Medium-Size Manufacturing Plant Infrastructure Investment Outlook Literature

Economic turbulence has significantly impacted many enterprises. Kappelman (2014) in his survey across 484 enterprises found that IT spending represented an average of 5% of the total spending, equivalent to USD215 million annually. Marston (2011) also reported that "2/3 of the average corporate IT staffing budget goes towards standard support and maintenance" and this has increased their operation cost significantly. This has forced many enterprises to wait for the next positive outlook cycle. However, when bullish opportunities appear, the crowded market space and slow technology could not stand out to ice the cream.

Malaysia's poor economic performance continues to raise doubts globally as the country's economic outlook has been downgraded from "Stable" to "Negative" and its competitive ranking has dropped to 25th spot. MSMPs today need to re-energise for a positive bounce back or risk future survival impact (Reuters, 2013; Bloomberg, 2013; Starbiz, 2013; Sunbiz, 2013). Outside the country, the rise of global MSMPs has also put pressure on local MSMPs.

Malaysia's Medium Size Manufacturing Plant is experiencing booming growth as information technology becomes part of the day-to-day operation cycle. New advancement in industrial robotics, namely computer-aided manufacturing and enterprise resources planning, have helped not only to automate traditional manual processes but also improved production efficiency. These highly sensitive technologies require sophisticated local control to interact with embedded tools while integrating multi-source information systems that are geographically diverse in location. Understandably, as production sales are demand driven with challenging cycles, the need for on-demand shared services is unavoidable.

We substantiated Nicholas Carr's (2003, 2005) theory of commodity of technology and Christensen Clayton's (2006) theory on disruptive technology to understand how technology adoption was being applied. Many enterprises have over time come to believe that having the best and latest technology delivers superior results. These enterprises failed to understand that their competitors also had the same idea and, therefore, also invested in similar technology to neutralise competition (Bannister & Remenyi, 2005). Furthermore, technology catch-up is a never-ending race with exponential improvement over time that will disrupt the supply chain environment of the manufacturing plant. The whole exercise of business process reengineering will require more resources, which MSMPs lack. The integration of both theories here brings in the synergistic value of fencing off technology glories that could impact enterprise relearning.

Nicholas Carr's (2003, 2005) theory of commodity of technology argued that the normalisation of available IT infrastructure superiority reduces the competitiveness of the enterprise. This is the reverse of what happened during the golden era when technology opened up new opportunities for servicing client needs and the market place. However his research was only confined to larger Multinational Corporations (his example focused on the railway, telegraph and electrical supply system enterprise), which is not entirely applicable to the MSMP environment. Bannister and Remenyi (2005) in their paper, however, contemplated Carr's statement that "IT is not of strategic importance anymore" while Bhatt and Grover (2005) disagreed on the "delineating of infrastructure capabilities". These larger enterprises focused on larger capital expenditure using their huge almost bottomless operating expenses while patiently waiting for longer strategic returns. This luxury, however, could not be enjoyed by the MSMPs that required technological advantages to open up greater digital market place

or to streamline traditional manual processes as they grew bigger. Carr also stated that IT infrastructure is now considered a commodity product and, therefore, enterprise should no longer lead in technology advancement to gain competitiveness. This is clearly shown by the exponential increase in George's (2004) paper on 'Outsourcing and Globalization: The View from the United States'. We recommend that MSMPs adopt existing available technology from MNCs and not venture into reinventing technology.

Another Harvard University scholar, Christensen Clayton (2006) shared his theory on disruptive technology, which put greater emphasis on the dynamic nature of the IT infrastructure product life cycle that causes distortion to a product's contribution to the current ecosystem. He warned about the insignificant competitive advantages that are originally perceived by using the best of new technology. Stratechery (2013), Tellis (2006) and Danneels (2004) have, however, questioned Clayton's definition of "disruptive" and "technology", asking at what point these should be considered. While Clayton's theory focused on mainstream market saturation, so-called disruptive technologies still provide a golden opportunity for tapping into the MSMP, as discussed by Lucan and Goh (2009) in 'Disruptive technology: How Kodak missed the digital photography revolution'.

Both these two fundamental theories have put a hold on MSMPs' traditional infrastructure investment outlook. As cloud services can no longer provide the expected uniqueness, economic turbulence adds a further complication to the low-cost replacement of outsource services by service providers. However, after considering the time IT infrastructure requires for making significant contributions to the results and given the current disruptive economic happenings, cloud computing investment needs a fresh outlook assessment, as explained in the latter part of this paper. Past research shows that MSMPs have over invested in IT infrastructure after being pressured by their peers' competitive advantage, resulting in significant impact on their financial returns (Marston, 2011; Joseph, 2013, 2014). When a competitor makes an IT infrastructure investment based on a new technological innovation and finds it incompatible, they seldom make public their failure. Other enterprises unaware of the real issues hear of the adoption news, join the bandwagon and, thus, create an industry-wide tsunami. His finding further affirms that the reason IT infrastructure was classified as a commodity was not due to the saturation of technological advantages but because of discrepancies in investment decisions. At a time when almost all enterprises have been digitised, the option of not digitising is unthinkable but just when to digitise is a critical question. MSMPs, however, have glorified their technology chasing, yet are unable to maximise their utilisation efficiency. There are others who have ignored the infrastructure investment due to its non-direct revenue contribution and its high initial capital expenditure.

In this research, the focus is on Table 2 where cell M3, 3 indicates slightly high turbulence with reasonable competitive pressure to sustain operations. This is a group that can still invest in IT infrastructure to make an edge for competitive change without having much difficulty in sustainability. The current turbulence experienced in Malaysia is at T3 as defined by Fong YS and Tan CK as the country is experiencing spillover effects of the European crisis and the USA's fiscal cliff while undergoing moderate competitive business competition locally. This was also reaffirmed during the Top Management Interview conducted by Ng (2013). The current business competition is positioned at midpoint at C3 as there is sufficient business opportunity for aggressive enterprises, although this requires hard work.

TABLE 2 : ICT Infrastructure Turbulence Sustainability and Competitive 3-Dimensional Matrix

			Competitive Level				
			High Competitive Requirement				Low Competitve Requirement
			5	4	3	2	1
Turbulence Level	High Turbulence	5	M5,5				M5,1
		4					
		3			M3,3		
	Low Turbulence	2					
		1	M1,5				M1,1

Sustainability Level

Cloud Computing Utility Model Characteristic Literature

Lee (2013) highlighted that "the success of a firm depends on its ability to take advantage of the technology shifts to innovate in their business models and eventually to compete differently". The globalisation of MSMPs requires an IT infrastructure solution that is available geographically 24/7. Given their constraints on resources and the complexity of technology management, cloud computing is undeniably a must-have infrastructure for MSMPs (Venters, 2012; Chandio, 2013; Gupta, 2013; Lee, 2013; Sultan, 2013; Kleis, 2013). The inclusion of cloud computing as the 5th utility variable component besides electricity, water, gas and the telephone, the expectation of the pay-per-use economic factor seems to have motivated many MSMPs to jump on the bandwagon. This allows MSMPs to pay for only the additional service utilised while having greater flexibility with market environment dynamics. When compared to the traditional investments, some IT infrastructure may not be fully utilised due to low requirement and may become obsolete by the time they are actually used. However, considering that 73% of the 484 respondents in Kappelman's (2014) survey still used their internal cloud shows there is still room for improvement.

The utility cloud is the best fit model that allows MSMPs to focus on their core business activity in relation to smaller capacity requirements. This has provided a cost reduction of between 20 and 30% in IT operations (Venters, 2012). However, Clayton advocated that the pitfalls of innovative value contributor in new market contributor. Furthermore, Carr highlighted that most enterprises that require digital communication have already embraced the cloud model and, therefore, provided insignificant technology uniqueness and some may even experience decreasing values. Although consensus is for the adoption of this model in general, an argument can also be produced for the MSMPs that consider cloud utility to be new innovations as it expands from the traditional local market to the international market, citing an example of the use of a payment gateway for electronic commerce.

Although Infrastructure as a Service (IaaS) may seem to have reached its saturation period for most enterprises, there is, however, still room for optimisation of its use by medium-size enterprises. In this research, the emphasis was on the extension of IaaS as enterprises today operate a variety of solutions that require specific infrastructure specifications to host localised web application systems. Nevertheless, these specific infrastructures are now readily available

on shared services provided by cloud services solution providers. MSMPs are more receptive to a cheaper but good enough solution in what is called a Low End Disruptive Technology to make reasonable competitive advantages in the New Market Disruption innovative value contributor.

RESEARCH METHODOLOGY

This research extracted views and opinions to explain the phenomena sequence that leads to technology adoption (Czamecki & Spiliopoulou, 2012; Paliokaite, 2012; Venkatesh, 2013). The hypothesis proposed earlier aimed to test the conceptual framework in an economically turbulent environment to extract its correlation. The research methodology is summarised in Table 3.

This research identified and compared various empirical literature to review the historic dynamics that lead to the need to start the research. The analysis highlighted the imbalance of IaaS technology adoption in the MSMPs that led to an environment of unjustified differentiation in investment returns. Previous research from Ng (2011; 2012a, 2012b) highlighted the availability of sufficient resources to drive computing infrastructure investment as compared to the earlier mindset of ill resources held by MSMPs. This improved condition is supported by the advancement of shared service through the utilisation of cloud computing and service outsourcing.

The novelty of these phenomena in this research is unique as there is limited discussion on economic turbulence in the case of a small enterprise. The use of Mix Mode methods can help to provide greater insight into many phenomena of interest that are difficult to explain using either the qualitative or quantitative method alone (Venkatesh, 2013). In this method, the initial mass survey was first carried out to test the quantitative volume needed to plan the research project's resources. Numerical justification was used to generalise the issues faced by MSMPs and also to relate the magnitude of impact from the issues. It was then backed by qualitative reasoning to define the hypothesis. As IaaS is a long-term strategic investment decision, it also requires the input of top management. This requires qualitative interpretation from the research instrument. This narrative statement was then customised to narrow down the area of improvement for competitiveness.

The (1) Focus Group interactive Delphi method used in current research to gather primary data was an extension of the previous (2) mass survey with operational team and (3) personalised interview with top management. Table 3 shows the profile of the respondents selected for this research. In this current Focus Group data gathering, 10 experts, who were experienced IT personnel, were gathered in an email group to discuss various questions pertaining to this study. Three different instruments were used, as shown in Table 4. The Concurrent Validity method aimed to affirm the consistent views and opinions of all executive ranks within the enterprise.

As for Construct Validation as shown in Table 4, the instruments were tested in both the university and at industry level. The views and opinions of the lecturers helped to test the research theoretical framework to ensure all possible theories were revisited. The industry respondents were required to test the practical implication of the framework in a non-controlled environment with multi-factored constraints. Validation was gathered from the executive interview with top management on the MSMP's strategic direction of computing infrastructure

TABLE 3 : Research Methodology Summary

Activity / Phase	Phase 1 Quantitative Generalisation	Phase 2 Qualitative Reasoning	Phase 3 Testing	Phase 4 Validation
Research Dimension	Phenomena Explanatory Sequential Dimension			
Research Design	Random Survey	Personal Interview	Focus Group Discussion – Technical Level	Focus Group Discussion – Strategic Level
Data Collection	• End users – Managerial level • Across Peninsular Malaysia • January to February, 2012 • 228 respondents	• End users – Top management level • Central Malaysia • January to March 2013 • 10 respondents	• Consultants, vendors & end-users • Central Malaysia • October 2013 • 10 respondents	• Malaysian Manufacturing Federation • Central Malaysia • Targeted October 2014 • 10 respondents
Research Methods	• Convenient sampling using available organisation hosting final-year industrial-training students • Distributed by undergraduate students to the site supervisor during their industrial internship	• Convenient sampling of who was willing to participate and share information • Interviewed by first author	• Convenient sampling of who was willing to participate and share information • Facilitated by first author	• Convenient sampling who are willing to participate and share information • Facilitated by first author
Data Analysis	Spearman Correlation Quantitative Exploration	Qualitative Reasoning Explanation	Delphi Inductive Conclusion	Qualitative Reasoning Explanation
Contribution	Conceptual framework	Draft framework	Preliminary framework	Pilot framework

TABLE 4 : Research Validation

1.	Content validity -Domain distribution -Language, Depth
2.	Concurrent Validity -Mass Survey -Personalised interview -Focus group
3.	Construct Validity -Lecturer -Industry experts

(Joseph, 2013). As the infrastructure investment was higher, the deliverable was mapped to the long-term strategic direction of the enterprise, which was set by top management. Further validation was obtained from the focus group discussion via email with the technology subject matter experts. This was conducted between March and May 2013 (Joseph, 2014). The Delphi method was used to share views and comments from the experts, and their feedback was analysed.

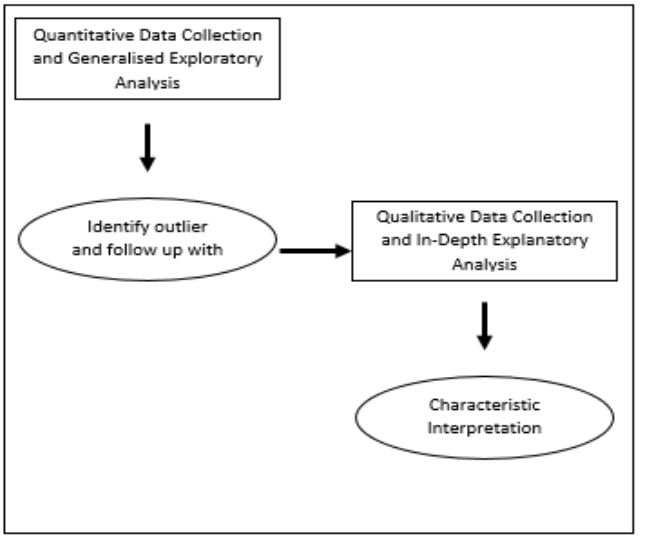

Fig.2: Sequential design.

The sequential design shown in Fig.2 explained the factors that led to a series of actions taken by MSMPs when deciding to adopt cloud computing IaaS for the environment. The preliminary descriptive explained the metamorphosis transition that MSMPs endured in adopting the new IaaS while the inductive reasoning explained the cause of the results in each transition. All this led to the explanatory findings that were used to understand the phenomenon progression. The mass survey aimed to gather quantitative operational reasoning;

the personalised interview aimed to extract deeper strategic direction while the focus group interview provided opportunity for expert debates. The expert groups were given the feedback gathered from the top management interview to evaluate. The use of multiple methods of data collection in the study enhanced the reliability of the data collected, yielding consistent results when the characteristic being measured was not significantly changed. This helped to "address why a particular sample was chosen" (Zhang, 2012). The instruments used in the study (questions) were distributed to different experts in the field for pre-testing of language, depth, technical and knowledge jargon. This also ensured that an appropriate question proportion was distributed to reflect various parts of the research domain.

FINDINGS AND DISCUSSION

The medium-size enterprise is a mature group that can project economical maturity to up-class itself by staying in line with IaaS to fend off economic turbulence. ICT is now a common tool that not only helps to automate business process but will also distinguish each competitor in the future (Brown, 2012; Santos, 2012; Bharadwaj, 2013; Gu, 2013; Rong, 2013; Sen, 2013; Tambe, 2013). Based on the original theory of commodity by Carr (2003, 2005), it can be argued that although each technological edge is swiftly available to almost all the enterprises within the same horizontal industry or across the industry, there has not been much discussion on MSMPs that are sitting just below the fence. They do not have the privilege of exploring IaaS technology superiority just because these commodity IT infrastructure is considered too fanciful for them to enjoy. Indeed, a new technology may not necessarily help an enterprise to leap-frog ahead of competition as mentioned by Clayton's (2006) theory of disruptive technology. Lee (2013) has pointed out that "the sustainability of any specific business model has become unclear as technology changes from outside an organization can be highly disruptive". However, when economic turbulence becomes the real disruptive force, new technologies become the equaliser to form equilibrium to balance between sustainability and competitiveness. There have also been insufficient research studies to develop a shield technology that can defend the medium enterprise from any sustainability issues during the volatile period of economic turbulence. This is where this new novel theory of barebones IaaS for competitiveness during economic turbulence comes from. Table 5 summarises the findings.

TABLE 5 : Research Findings Summary

Managerial Survey Findings Summary	Top Management Interview Findings Summary	Expert Focus Group Findings Summary
A1. Continuous IT infrastructure investment currently	B1.Currently economic turbulence has limited impact on IT investment decision due to it medium- and long-term deliverables.	C1. Current economic turbulence is a seasonal factor that may be beyond the work scope of the budgeting process.

TABLE 5 : (Continued)

A2. IT infrastructure investment is based on pressure from having what competitors have.	B2. Sufficient technology to fulfil operation requirements	C2. IT infrastructure is a medium- and long-term planning requirement where contribution may be experienced during or after the economic turbulence
A3. Technology focuses on day-to-day electronic business.	B3. IT infrastructure investments to provide the platform to differentiate the market player	C3. Technological-edge service is a major differentiation in technological product competition.
A4. Felt that their organisation has over invested in ICT	B4. Slow migration to IaaS due to security and capacity concerns on shared services	C4. IaaS high baseline charges forcing impractical utility model for lower range users
A5. A technological edge is highly dynamic and evolving.	B5. IT infrastructures are nowadays considered a utility tool for day-to-day operation support.	C5. Current market saturation is forcing a competitive pricing war to attract customers.
A6. Lacking in internal IT expertise to implement technology solution	B6. Focus mainly on core operations like client service and manufacturing flow	C6. Technology resources are now available from outsourcing

Based on the findings, the following revised Directional Correlation hypothesis was developed and is discussed together with the earlier NULL hypothesis.

H_N1: Disruptive technology has low influence to competitive advantage contribution.

H_R1: Technology differentiation has high influence on disruptive technology at the point of time.

Competitive advantage can be derived from having a technological edge that is superior to what a current competitor has. Granted the fact that a mature technology can no longer provide an advantage in the mainstream market, this technology, however, can still provide golden opportunities to the emerging market where this technology is still under development. This can be concluded from the findings obtained from the top management interview shown in Table 4 under Section A5, B4 and B5. One man's shield is another man's weapon.

In the case of IaaS, it is already a stable and readily adopted product by larger enterprises in day-to-day operation. These premium products are considered luxury 'wants' by most MSMPs; however, as MSMPs cross over the fence to compete with more advanced enterprises, a want becomes a critical 'need'. According to Bannister and Remenyi (2005), "IT has revolutionized the way business is conducted as well as how businesses communicate with different entities". Furthermore, at this point of time, MSMPs need to focus on delivering their core competencies and not be distracted by complex IT infrastructure management.

H_N2: IT infrastructures have positive relation to commodity product classification.

H_R2: Commodity product classification has positive relation to IT infrastructure life cycle.

Each enterprise requires a product or services that give it a form of competitive advantage to differentiate itself from the market. When the product or service can no longer provide that edge during its product life cycle, then it becomes a disruptive technology. This is where the product becomes so saturated that almost all enterprises use it as part of their standard operating product and, therefore, it is categorised as a commodity product. Section A2 and A4 in Table 5 show this while C5 shows the product normalisation stage where the product has lost it technology superiority edge.

While the product goes through its life cycle, the same product has a different life cycle in a different environment. IaaS may have reached its peak contribution in the large enterprise, but it is growing for the MSMPs. In the example of Kodak, they "experienced a nearly 80% decline in its workforces, loss of market share, a tumbling stock price and significant internal turmoil as a result of its failure to take advantage of new technology" (Lucas & Goh, 2009). Using the utility model, MSMPs can be seen as enjoying the cream of the technological edge provided by the cloud service provider without worrying about when the product will become obsolete and be classified as a commodity product as seen in feedback by top management in Table 4 B5.

H_N3: Scare resources are associated with Medium-Size Enterprise performance.

H_R3: Utility model has high association to scarce resource.

Medium-size enterprises are constrained by resources and seek solutions with minimum capital outlay and are not usually amazed by technology skimming. Additionally, with the high uncertainty during an economic turbulence, enterprises are not confident of the direction technology might take. They seek technologies that are mature and easily available without much commitment in capital expenditure. Complex solutions require highly skilled expertise and tools to configure and maintain where MSMPs are currently lacking as shown in Table 4 Section A6 and B6. Even managing an expert is a complex process of recruitment, reskilling and retention. Therefore medium-size enterprises are enticed by all-in-one solutions that can be implemented by general users. This is where cloud service has helped to minimise the problem as suggested in Table 4 Section C6. While smaller enterprises are facing difficulties in fulfilling the minimum baseline requirement of typical cloud service as highlighted in Section C4, medium-size enterprises, on the other hand, have found the fit.

IaaS provides "IT efficiency, whereby the power of modern computers is utilized more efficiently through highly scalable hardware and software resources" (Marston, 2011) and is a product that is charged based on actual utilisation without much initial investment required. Furthermore, it also requires minimum expertise to configure and it is an advantage to enterprises that lack in-house skilled and knowledge manpower.

H_N4: Economic turbulence has positive correlation to infrastructure investment decisions.

H_R4: IT Infrastructure investment decision has low correlation with economic turbulence.

While economic turbulence can be experienced in a short period of less than a year, most IT infrastructure requires a longer period of two to three years to demonstrate positive results. This can be seen from all three respondent groups in Table 4 Section A1, B1, C1 and C2. Therefore, enterprise todays should continue to invest in IT infrastructure during this current uncertainty to prepare for future opportunities. However, prudent decisions on barebones specification for hibernation is also a strategic survival consideration.

The impact of economic turbulence is "perceived to be a secondary temporary IT importance in strategic alignment from the perspective of top management" (Leelien, 2012). Despite the economic uncertainty, businesses today are globally connected in a digital environment that still requires the same solutions irrespective of whether services are hosted internally or externally.

The interrelated findings in Table 4 showed consistent concurrent validity as seen from the feedback obtained through all three data collection instruments (survey, interview and focus group) to validate the research results. In summarising the four revised hypotheses above, it can be noted that technology life cycle is an important component in mapping technology adoption where crafting product specification is a management art for future decision makers. IT infrastructure is a medium- and long- term investment and returns can only be experienced later. While economic turbulence has created a storm for many enterprises, the cloud utility model has provided much sunshine for emerging enterprises.

Exostructure as a Service (EaaS)

In this paper, we introduce a new cycle of cloud computing service that provides the technology difference that is required by the MSMPs for sustainability during a period of economic turbulence yet competitive enough to penetrate into the larger and more lucrative multinational market places. The solution is the provision of a new service that must be resilient to the potential disruptive technology dumped by the MNC to the MSMPs. While understanding that each technology will somehow move into the commoditisation stage during their life cycle, it must have the capability to revitalise itself from the best of LAN and WAN technology. As the cloud services are embedded within the concept of a utility model, this new service should have the components of flexible costing. Assuming that the economic turbulence is a seasonal occurrence, new technology introduction should incorporate a dynamic upgrade as shown in Fig.3.

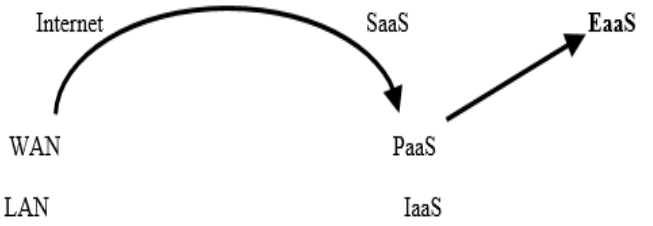

Fig.3: Infrastructure quantum leap.

Recalling Ng (2014) and Marston's (2011) findings that most MSMPs have over invested in their current IT infrastructure, EaaS will optimise the existing Local Area Network (LAN) infrastructure before expanding it into the shared services Wide Area Network (WAN). Exostructure is an extension of local IT infrastructure to a cloud computing environment. The cloud service is an integrated IaaS deployed in a Client Server environment compared to traditional SaaS and PaaS. This allows the benefits of the LAN to be integrated with the benefits of the WAN. This ensures local infrastructure is optimised while maximising the utility model for the excess resources.

EaaS will provide the technological edge for the enterprise to differentiate itself from other medium-size enterprises to penetrate the new market place when they move into the global market share of larger enterprises. In the example of an enterprise moving towards electronic businesses, many new servers or solutions are required, namely electronic payment servers or store front web servers. While servers that are costly require complex configurations, they are easily available to MSMPs via shared cloud services. Therefore MSMPs can now compete more equally in the international market instead of depending only on the local market.

Local servers will communicate with local devices like industrial robotics, input-output controllers and local applications that are sensitive to acute response time with high data transmission load. Speed and localised infrastructures are required due to specific local application that is indispensable and non-substitutable factors in the core processes. This could be a typical Network Access Solution (NAS), Manufacturing Resource Planning (MRP) or Enterprise Resource Planning (ERP). However, Ng's (2013) research highlighted the alarming over-investment by most MSMPs. With EaaS, local infrastructure investment is kept to the minimum barebones level, thus saving cost especially during economic turbulence when cost does matter for sustainability reasons. However, other additional processing and storage requirements can be offloaded into a remote infrastructure for batch processing. As the infrastructure requirement grows beyond local capabilities, this excess requirement is then extended to shared cloud services like Infrastructure as a Service (IaaS). This is done via configuration of network (router and switches) parameters to make the IaaS transparent to local client servers. Depending on the economic sales cycle, these requirements can have a volatile high and low. Deploying the utility model of paying for what you use, this method balances with the enterprise's real business requirement as shown in Fig.4.

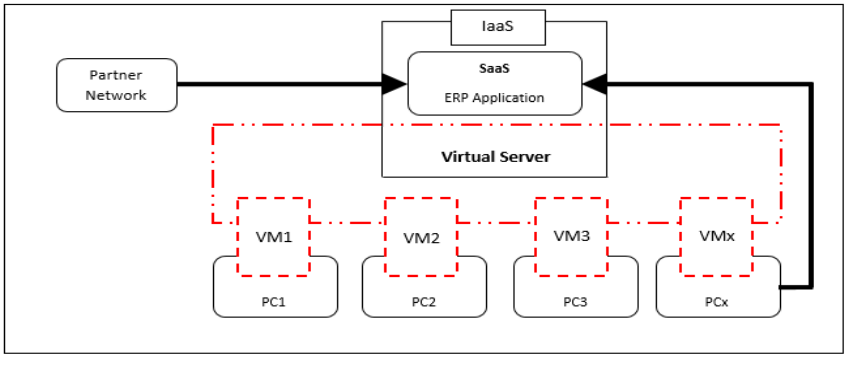

Fig. 4: EaaS logical architecture.

The local server, however, is a virtual server that emerges from the virtualisation of many local desktops that are traditionally underutilised. Here, each desktop will be installed with a tool to enable virtual machine partition to form a grid computing network that connects to a virtual server that will host the application software (like SAP financial application) in a Software as a Service (SaaS) platform. The desktop will then be reconnected to the virtual server to access the application software as if it were a normal server. As the number of desktop clients increase, the demand for processing capabilities of the virtual servers would also increase, and this is provided by the same increase in desktop. Thus, this parallel increment provides a balanced demand versus supply of resources without idle or redundant infrastructures.

Management Implications

Gartner's (2013) IT Market Clock is a powerful analysis tool to classify and describe the characteristic of a particular product or service in a simple quadratic life cycle for easier visual presentation. Fig.5 shows a revised version of the clock incorporating EaaS as the main actor in moving the arm of technology life cycle.

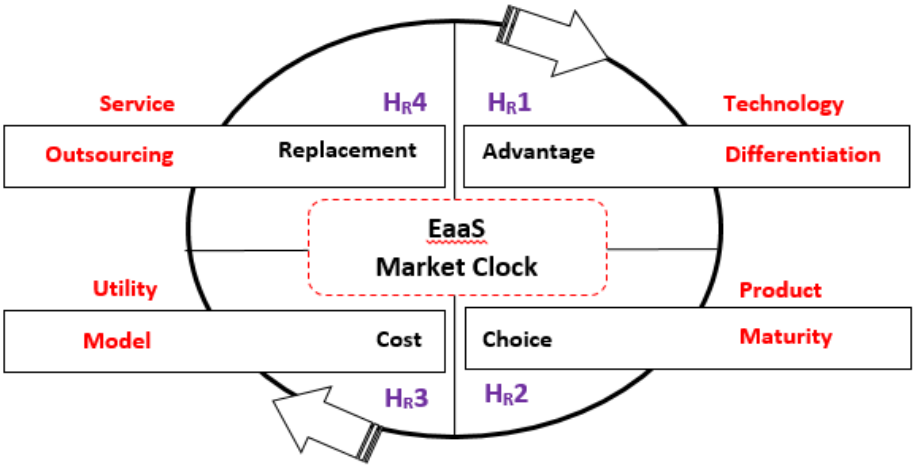

Fig.5: EaaS market clock.

As the market place becomes more saturated and turbulent, aggressive MSMPs need to acquire a new technological edge to gain the competitive advantages and differentiate themselves among the players. MSMPs today are global multi-site enterprises with networks of factory, sales office and distribution centres integrating with customers and suppliers who also have multi-site locations where speed of deployment for new products and services does matter. All these require electronic commercial solutions like payment gateways and a centralised solution for a multi-branch network that requires high capital expenses (CAPEX) that are traditional unaffordable for the MSMPs, but are now easily deployed via cloud services. This readily available solution allows for a rapid response to changing technological needs via fast deployment with minimum startup delay. Furthermore, these cloud services are more tolerant of innovation with extensive third-party connectivity to merchant banks and major

regulatory services. Enterprise sales are a seasonable contribution where holding excessive infrastructure can be wastage yet on the other hand, they are unable to support growth opportunity when it arises, which is indeed a loss. With the dynamics of economic turbulence, EaaS can allow MSMPs to mitigate negative business turnover with options to terminate or scale down services. This operating expenses (OPEX) model will avoid any potential pitfall of underutilised investment as highlighted earlier.

Cloud services have now matured as a standard operating platform of choice for enterprise as the product is already a mature technology. This allows for the creation of a standard operating procedure in the enterprise and also with partner enterprises as they share the same cloud platform. This allows the MSMPs to securely add capacity on demand. A variety of multiple vendors allows for wider comparison and competitive solution costs, making it more affordable. The standardisation of the cloud services comes with more open architectural interoperability of products and providers, thus eliminating proprietary legacy technology dependencies and customer locking. This flexibility allows MSMPs greater choice when deciding the value differentiations, thus avoiding commoditisation of product or services.

Economic turbulence is a major factor that causes enterprises to hold or take a wait-and-see attitude on their next investment decision. This is where the utility model is highly elastic as the enterprise only pays for the service acquired and thus avoids unproductive asset idling especially for enterprises that have flat or declining IT budgets. The utility model also allows greater values from superior technology returns at lower investment with internal savings for internal support services to operate IT operations and these may include electricity to power up their data centre. Non-IT services can also include human-resource services to hire IT personnel and stationery. This helps MSMPs to concentrate on their core operation and avoid distractions from IT operations. The utility model also allows the MSMPs to obtain the required level of support assurance in line with the service level agreement, thus providing measurable management implications. Threats to one enterprise may be an opportunity for another enterprise, and this is the period where MSMPs can seize the opportunity to negotiate further discounts on charges from their cloud service providers. EaaS also enhances MSMPs' corporate social responsibility activities by being more environmental-friendly as it replaces their internal data centre with a centralised cloud provider and, thus, reduces carbon footprint and physical space usage.

MSMPs currently face challenges in up-scaling experts, skills and knowledge especially in high-end systems such as complex human capital management to accommodate flexible growth. With the outsourcing of backend infrastructure to cloud service providers, already scarce MSMPs may focus on their core competencies to maintain sustainability during economic turbulence. Outsourcing also helps to reduce training cost associated with continuous development of in-house expertise or even retiring redundant IT personnel. The implementation of EaaS also allows enterprises be up-to-date on competitive emerging technologies and to seek strategic advantages. With the outsourcing of IT infrastructure, huge office floor space can be reused to house MSMPs' core support services including more space for sales and marketing personnel to bring in more revenue.

IT infrastructure requires higher capital expenditure upfront while results can only be experienced years later with a market clock constraint. These products have a dynamic shelf

life and, therefore, requires future upgrade or replacements to avoid becoming just an expensive tool. By implementing EaaS as a pay-per-service utility model, this burden is transferred to the cloud service provider while relieving the MSMPs of complex IT strategic and divestment decision.

CONCLUSION

As the current economic environment is still very vulnerable, MSMPs need to have a strategic IT infrastructure strategy not only for sustainability but also to gain competitive advantage. Economic turbulence is no longer a period for lazy hibernation but a golden opportunity for reenergising. Enterprises need to spend less, follow the emerging trend, adopt less risky investment while understanding their own vulnerabilities. EaaS makes eminent sense to a new framework for MSMPs, which for the time being, have been suppressed by unavailable new ideas for a competitive advantage leap. MSMPs should not fear economic turbulence but rather embrace it in order to differentiate between sustainability and competitiveness.

Despite the poor resources of MSMPs, IT infrastructure has revolutionised the way MSMPs must compete to contribute to national productivity. While volatile economies can be largely attributed to many uncontrollable factors, strategic IT infrastructure investment decisions can still be optimised internally. EaaS enables MSMPs to shift from traditional slow organic growth hierarchies to a more aggressive one capable of penetrating into a larger enterprise marketplace while other less aggressive ones remain indecisive during a volatile economy.

In this paper, we have highlighted the evolved meaning of commodity IT infrastructure and revised it by redefining the 'disruptive environment' to mean moire than purely 'disruptive technology'. The findings appear to contradict Carr and Clayton's theory that IT infrastructure still has potential growth opportunity before it reaches the commodity level for emerging medium-size enterprises. This paper highlights new consequences of basing long-term IT infrastructure solely on their evolved theories. Furthermore, the argument that technology has saturated and no longer provides a competitive edge is no longer valid as it can explore new, untapped new enterprises. While IaaS is focused on pooling of Internet shared resources and client servers are focused on local interaction with backend processing, EaaS is an integrated barebones of a LAN and WAN infrastructure environment. EaaS is a solution that will provide the flexibility to grow while MSMPs transition themselves during critical periods of economic turbulence.

Localised cloud services are far from complete, and this allows deeper research into the EaaS specification development. This paper has focused on the qualitative framework development and opportunities for future quantitative research are still wide. This paper further serves as a reference for future implementation during a volatile economy that may recur and, therefore, MSMPs must be prepared, as reminded by Pong (2013), "US recession: it's closer than we think". MSMPs must strategise themselves beyond barebones cloud infrastructure services that may be the stumbling block to competitiveness during economic turbulence or risk becoming irrelevant.

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