

International Journal of Innovation in Management

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A Big Data Technology Foresight Study with Scenario Planning Approach

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Abstract

While the importance and value of Big Data are gradually being recognized by most enterprises worldwide, Big Data related technologies, and the priority of adopting these technologies have so far not been clearly recognized. To fill this gap, this paper focuses on the technology planning strategy of organizations that have an interest in developing or adopting Big Data related technologies.

Based on the scenario analysis approach, a technology planning strategy is proposed. In this analysis, thirty Big Data related technologies are classified into six strategic clusters, and the importance and risk factors of these clusters are then evaluated under four possible scenarios. The main research findings include the discovery that most NoSQL technologies are rated high to medium in importance and high risk in all four scenarios, and that scenario changes will have less impact on Cloud Analytics, Embedded Analytics, as well as Big Data Visualization technologies. These results provide a reference for organizations and vendors interested in incorporating emerging Big Data related technologies.

Keywords: Big Data, scenario analysis, technology foresight, strategy

1. Introduction

Big Data technology is used to store, convert, transmit and analyze large quantities of dynamic, diversified data (which may be structured or unstructured) for the purpose of commercial benefit (Borkar et al., 2012). The applications of big data technology need to be able to undertake real-time, high-complexity analysis of vast amounts of data, to help business enterprises make decisions within the shortest possible timeframe (Bryant, 2008). With the rapid pace of development in cloud computing, both public cloud and private cloud data centers are continuing to accumulate enormous volumes of data; as a result, big data technology applications are becoming ever more important (Agrawal, 2011).

Big Data is an emerging terminology used to represent the fast growing data size

encountered in organizations and societies (Bollier, 2010; Brown et al., 2011). Big Data Analytics (BDA) refers to a technology and framework for quickly storing, converting, transferring and analyzing massive amounts of constantly updated, huge, varied, structured and unstructured data for commercial gain (Russom, 2011). BDA has now evolved from large database storage systems to cloud technology in order to analyze and process data in a way that is more economical, more effective and easier for the customer to manipulate (Baer, 2011). The leading global vendors today include EMC, IBM, Oracle, SAS, SAP and Teradata. Solutions currently offered by these BDA vendors include data warehousing, data mining, analytics, data organization, data management, decision support, automation interface, to name only a few. Innovative technologies and solu-

tions in this field are currently under rapid development (Mukherjee, 2012).

Presently, major IT firms worldwide are exploring possible business opportunities in the Big Data generated market. However, what is the scope of Big Data technologies? And what are the possible outlooks in terms of the importance as well as the risks of these technologies? These key questions need to be answered before one can have confidence in the accuracy of technology strategy planning. To assist IT vendors moving forward in the emerging Big Data market, this research aims to explore possible planning strategies for adopting or developing Big Data related technologies. To achieve this objective, a systematic approach of scenario analysis followed by technology strategy planning is conducted.

2. Literature Review

2.1 Evolution of Big Data Technology

Chen et al. (2012) describe the evolution of Big Data technology. These researchers use business intelligence and analytics (BI & A) as a unified term, and treat big data analytics as a related field. They argue that the evolution of Big Data technology is characterized by BI & A 1.0, BI & A 2.0 and BI & A 3.0. Data management and warehousing is considered the foundation of BI & A 1.0. BI & A 2.0 systems require the integration of scalable techniques in text mining, web mining, social network analysis, and spatial-temporal analysis with those existing DBMS-based BI & A 1.0 systems. BI & A 3.0 integrate Big Data technology with mobile applications, such as mobile BI, mobile and sensor-based content, location-aware analysis, person-centered analysis, context-relevant analysis and mobile visualization and HCI.

In an article by Waller and Fawcett (2013), data science, predictive analytics and big data are collectively referred to as DPB. They argue that data science is the application of quantitative and qualitative methods to solve relevant problems and

predict outcomes. Data scientists need deep domain knowledge and a broad set of analytical skills. Predictive analytics is a subset of data science. Although predictive analytics is related to many long-standing quantitative approaches, it stands as distinct from each. Predictive analytics attempts to quickly and inexpensively approximate relationships between variables while using deductive mathematical methods to draw conclusions. Chiang et al. (2012) argue that the current state of the analytics software industry makes it difficult and cumbersome to conduct analyses without a deep perspective of the underlying systems and technologies. They advocate that BI & A should be an interdisciplinary area that integrates data management, database systems, data warehousing, data mining, natural language processing, text mining, network analysis, social networking, optimization, and statistical analysis.

2.2 Features of Big Data Technology

Big Data has three features: volume, velocity and variety (McAfee and Brynjolfsson, 2012). Most discussion in the past has focused on how to store the volume of data. However, velocity and variety are crucial in competitive differentiation. Variety refers to the variety of data formats. Data can be structured data that can be sorted or non-structured data such as pictures, music, videos, essays and discussions. Compared to structured data, non-structured data provides a better reflection of reality for making important decisions. The New York City government for example integrated its previously separate criminal record, surveillance and traffic control systems into a single crime fighting system (Garicano, 2009). Big data analysis technology was used to identify patterns of criminal behavior and optimize police assignments, effectively reducing the local crime rate. The other feature is velocity. In a business environment where every second counts, businesses must collect and analyze data in a timely manner so as to make crucial decisions faster than their competitors. Examples include re-

al-time patient bio-monitoring in the medical industry, process improvement information in electronics manufacturing, and web view/click-through data in advertising and marketing. By processing huge volumes of constantly changing information that must be processed immediately, businesses can convert a mass of seemingly useless data into a product with economic value.

2.3 Progress of Big Data Technology

Big Data technology can be divided into two broad categories: Advanced SQL technology, which is oriented towards the use of relational databases, and NoSQL technology, the emphasis of which is on non-relational databases (Baer et al., 2011). Advanced SQL is specifically designed to provide real-time analysis results with large quantities of structured data. However, as the scale of data collection grows ever larger, and as the different categories of data that need to be processed become ever more complex, non-structured data is presenting business enterprises with new challenges, especially in terms of data storage and analysis (Borkar et al., 2012).

NoSQL non-relational database systems (Adrian, 2012) offer enhanced performance and extensibility, making them ideally suited to processing large amounts of non-structured, highly variable data. There are four main types of NoSQL database: key-value databases, in-memory databases, graphics databases, and document databases. The Advanced SQL database platform segment is currently going through a period of market consolidation, indicating that this segment is entering the mature phase of its evolution, characterized by slow but steady growth. By contrast, the NoSQL market is still very much in the growth stage, but is expected to play an increasingly important role in the big data technology of the future.

Hadoop is a form of big data technology that is attracting growing interest from various enterprises; more specifically, it is a form of key-value database technology (Baer, 2011). Leading U.S. retailer

Wal-Mart is using Hadoop to analyze sales data and identify new business opportunities. As well, online auction site eBay has been using Hadoop to process unstructured data and reduce the burden of database storage requirements.

MapReduce is a parallel computing method that permits the processing of very large volumes of data within a clustered computer framework. MapReduce breaks down tasks into two stages – Map and Reduce – in order to achieve a distributed computing effect.

3. Research Method

3.1 Scenario Analysis

Scenario Analysis (SRI, 1996) has been used in various domains for analyzing and forecasting trends in the development of technology. Many versions and variations of the SRI scenario analysis methods have been proposed (Mietzner and Reger, 2005). The technology portfolio planning process (Yu, 2006) is a systematic procedure used to assist in the strategic decision necessary to find the cluster set of resource allocations among available technologies that best fits the goal of an organization. Scenario planning is a key technique used by futurists to develop future models in order to facilitate this process and to develop strategic action plans and policies, as well as create a vision for the future (Erdogan et al., 2009).

The major steps of the technology strategy planning process are as follows (Bishop et al., 2007).

- (1) Identify decision criteria, which are the motivational forces for the resource allocation decision.
- (2) Propose possible future scenarios by exploring combinations of significant impact variables.
- (3) Compose a set of technology alternatives and classify them into clusters.
- (4) Generate a set of technology assessment indicators from mutually exclusive dimensions.

- (5) Find the best plan for a technology portfolio.

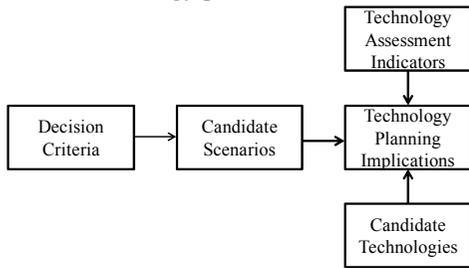


Figure 1: Research Framework of a Technology Foresight study

3.2 Expert Panel

To conduct the technology foresight study, an expert panel was formed with eleven domain experts selected from both the IT industry and the academic world. This expert panel consisted of the following members:

- (1) Three consultant managers of publicly listed IT services firms.
- (2) Four CEO and VP level executives from independent software vendors.
- (3) Two CIOs of publicly listed IT device manufacturers.
- (4) One professor of Management Information Systems.
- (5) One professor of Industrial Engineering and Management.

A facilitator led the expert panel discussion sessions by following the steps in Figure 1 above. Activities in these sessions included open discussions, anonymous voting, as well as the administration of surveys.

4. Results

4.1 Decision Criteria

To identify decision making criteria, expert panel discussions were conducted concerning decision making factors from the social, political, economic and technological perspectives. Possible decision factors were discussed, such as the market outlook for a technology, as well as the competence of the industry to acquire this technology. The final set of indicators is summarized in Table 1.

Table 1: Major Decision Factors

Decision factors	Issues
Social factors	1. Availability of Big Data for quality of life improvement for people
Technological factors	1. Entrance barrier level of Big Data technology 2. R&D strength of the industry
Economic factors	1. Strategic benefit of the enterprises 2. New business opportunity for the industry
Political factors	1. Strength of Big Data industry promoting policies of government

4.2 Candidate Scenarios

There are many different scenario alternatives which organizations may select for big data technology trends. Impact variables which are most likely to affect the scenario development were identified by the expert panel. Through evaluations from different combinations of these variables, final choices of scenarios were then determined. After the Expert Panel discussions, the scenarios were labeled and elaborated upon. The results are illustrated in Table 2.

Table 2: Candidate Scenarios

Scenario Code	Global IT Spending Outlook	Big Data Technology Breakthrough	Final Scenario Choice and Naming
00	High	High	Big Demand
10	Low	High	Cautiously Optimistic
01	High	Low	Slow Progress
11	Low	Low	Pessimistic

A detailed description of the scenarios is as follows.

4.2.1 Scenario 00: Big Demand

In the Big Demand scenario, the foreseen global economic situation is strong, and the worldwide IT spending outlook is in good shape. At the same time, with the progress of continuous research in both industry and academia, the development of Big Data technology is experiencing a major breakthrough.

4.2.2 Scenario 10: Cautiously Optimistic

In the Cautiously Optimistic scenario, the global economic outcome is in a downturn, possibly due to slow recovery from previous global financial turmoil, or encounters with new financial crises. However, the advancement of Big Data technology is not likely to stagnate, since leading vendors have invested significantly in R&D, and the volume and growing velocity of global data continue to progress.

4.2.3 Scenario 01: Slow Progress

In the Slow Progress scenario, the foreseen global economical situation is

strong, and the worldwide IT spending outlook is in good shape. However, the progress of academic and industrial Big Data technology research and development is slow. As a result, potential users may relocate their resources to other areas with more promising technologies.

4.3 Candidate Technologies

To assess the possible Big Data Analytics technologies for the proposed scenarios, another technology expert panel of ten members was formed. This panel differed from the previous panel. The purpose of a different expert panel was to assure independence between technology planning activities. Big Data technology data were collected by interviewing these panel members, as well as from secondary data which included vendor propositions and research literature. The final list of the most promising Big Data Analytics technologies is exhibited in the following table.

Table 3: Candidate Big Data Analytics Technology

Cluster	Technology
Data Warehouse (DW)	DW1: Central enterprise data warehouse DW2: Data warehouse appliance DW3: Data marts for analytics DW4: Analytics processed within the EDW DW5: Extract, Transform, Load (ETL)
NoSQL BDA (NS)	NS1: MapReduce NS2: Hadoop NS3: NoSQL or non-indexed DBM NS4: Column oriented storage engine NS5: Text mining
Advanced SQL BDA (AS)	AS1: Complex SQL AS2: Distributed SQL AS3: OLAP AS4: Advanced SQL Appliance AS5: SQL Accelerator
Cloud Analytics (CA)	CA1: Public cloud analytics CA2: Private cloud analytics CA3: Social analytics CA4: Software as a service (SaaS) CA5: Internet of Things (IoT)
Embedded Analytics (EA)	EA1: Predictive analytics EA2: Complex event processing (CEP)

Cluster	Technology
	EA3: In-memory database EA4: In-database analytics EA5: In-line analytics
Big Data Visualization (DV)	DV1: Advanced data visualization DV2: Real-time reports DV3: Dashboards DV4: Visual discovery DV5: Infographics
Total items	30

4.4 Technology Assessment Indicators

The expert panel on technology then applied the scenario analysis approach to assess the candidate Big Data technologies of the six major clusters in two dimensions: importance and risk. These two dimensions are quantified by selected indicators summarized in Table 4.

For the surveying process of the risk dimension, a three point scale was used in the beginning. However, this yielded a result with many ratings squeezed together. A

nine point scale was then surveyed by the same expert panel and produced a dispersed and readable result. Therefore, although the final result is presented in a three level scale of Low, Medium and High, the survey adopted a nine point scale. These scores were then converted to three level indicators with Low Level for 1~3 points, Medium Level for 4~6 points, and High Level for 7~9 points. The final set of Technology Assessment Indicators is shown in Table 4.

Table 4: Technology Assessment Indicators

Dimensions	Indicators	Low Level	Medium Level	High Level
Importance	Global market size	< US\$1B	US\$1B~US\$10B	> US\$10B
	Enterprise adoption ratio	< 10%	10%~60%	> 60%
Risk	Entrance barrier	1~3 points	4~6 points	7~9 points
	Strength of industry	1~3 points	4~6 points	7~9 points

4.5 Technology Planning Implications

Based on the important indicators and risk indicators in Table 4, the expert panel assessed the Big Data technologies compiled in Table 3 with respect to the four scenarios. The assessment results are exhibited in figures 2-5 and discussed as follows.

4.5.1 Technology Planning Implications for Scenario 00: Big Demand

For the Big Demand scenario, the assessment outcome is depicted in Figure 2. In this scenario, the Advanced SQL tech-

nologies would be of high importance and low or medium risk in general. This is mainly because the Advanced SQL technologies, based on the development of Relational DBMS, are relatively mature and have a large base of users worldwide. Also note the NoSQL technologies are positioned in both high importance and high risk. Though NoSQL technologies are viewed as the next big opportunity for the IT industry, these technologies are new to most enterprises and the adoption of them is considered highly risky.

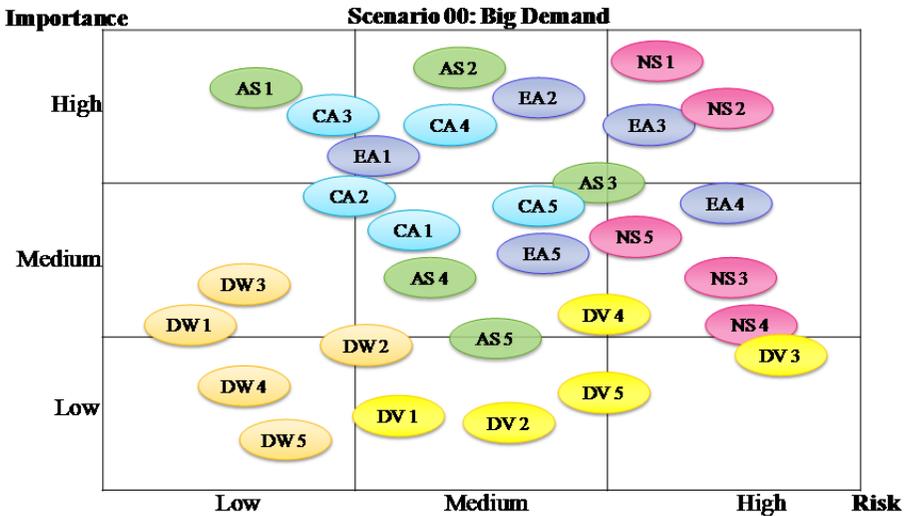


Figure 2: Technology Assessment for Scenario 00: Big Demand

4.5.2 Technology Planning Implications for Scenario 10: Cautiously Optimistic

For the Cautiously Optimistic scenario, the assessment outcome is depicted in Figure 3. In this scenario, the economic outlook is not as good as in the Big Demand scenario. Compared with the results of Scenario 00 in figure 2, most Big Data

technologies have lower importance ratings except the NoSQL (NS) technologies. This implies that when the global IT spending outlook is weak, the progress of many Big Data technologies will be affected. However, vendors will continue the development of NoSQL technologies and await possible new opportunities.

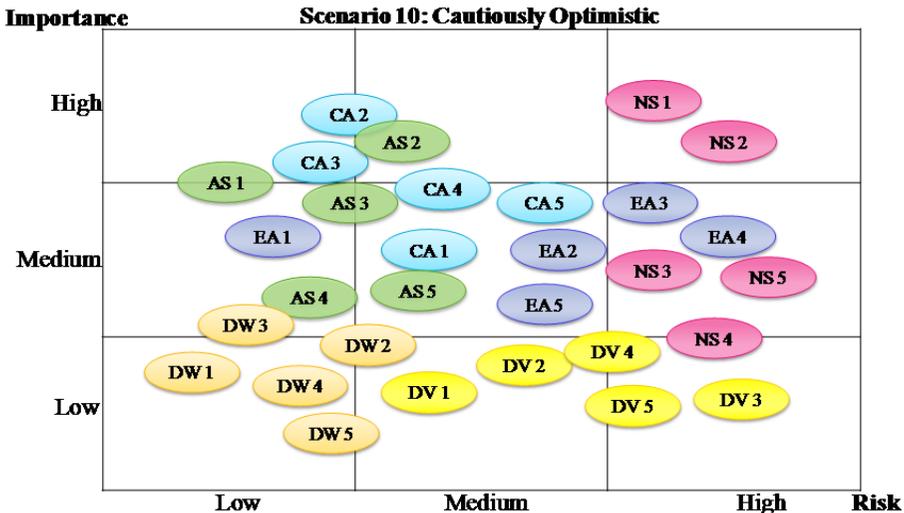


Figure 3: Technology Assessment for Scenario 10: Cautiously Optimistic

4.5.3 Technology Planning Implications for Scenario 01: Slow Progress

For the Slow Progress scenario, the assessment outcome is depicted in Figure 4. In this scenario, the risk of Advanced SQL (AS) and Cloud Analytics (CA) technologies would increase compared with the

previous two scenarios. The Advanced SQL technologies, based on the development of Relational DBMS, would have decreased importance. In general, the Cloud Analytics would also have lower importance, due to the slow advancement of technology development.

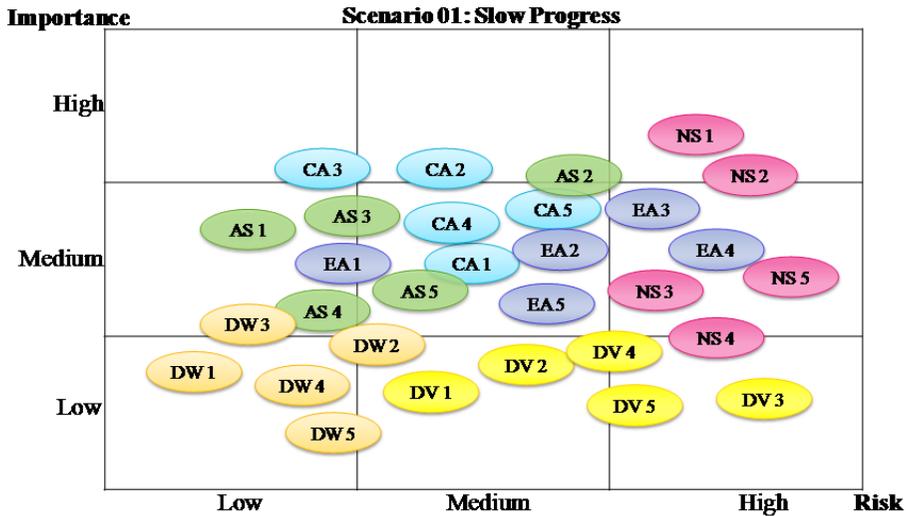


Figure 4: Technology Assessment for Scenario 01: Slow Progress

4.5.4 Technology Planning Implications for Scenario 11: Pessimistic

For the Pessimistic scenario, the assessment outcome is depicted in Figure 5. In this scenario, the global IT spending outlook is not good. The advancement of Big Data related technologies is also slow-

ing down. The risk rating of most Big Data related technologies would rise and their importance rating would drop. An important observation is that the NoSQL (NS) technologies are the most robust against scenario changes.

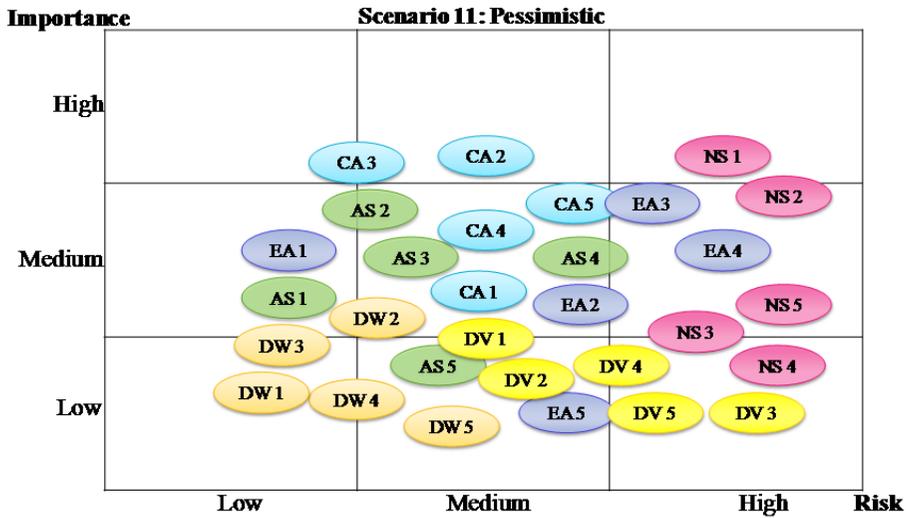


Figure 5: Technology Assessment for Scenario 11: Pessimistic

5. Conclusions

5.1 Research Findings

In this study, a systematic approach geared towards deriving foresight towards possible Big Data technology developments over the next five years was conducted. Highlights of the research findings are summarized in Table 5. Based on these

results, the strategic thinking of an organization toward developing or adopting Big Data technologies for competitive advantages can be initiated. For example, these findings suggest that NoSQL technologies should have a higher priority for organizations in the pursuit of new market opportunities.

Table 5: Results and Implications

Big Data Technology Cluster	Result	Implication
Data Warehouse (DW)	Data Warehouse (DW) technologies remain in low importance and low risk corner in general in all scenario analyses.	These technologies are mature technologies classified in the BI & A 1.0 technology category. Data Warehouse (DW) software has been implemented in the production IT systems of many enterprises. Adoption is safe but opportunity is also limited.
NoSQL BDA (NS)	Most NoSQL (NS) technologies are rated high to medium importance and high risk in all four scenarios.	This implies the emerging NoSQL technologies are still in the early stage of development, and both the market potential and risk need to be carefully balanced for most enterprises.
Advanced SQL BDA (AS)	If the market demand for Big Data technologies is not strong, Advanced SQL (AS) technologies will have lower importance.	This reflects the fact that Advanced SQL is extended from Relational DBMS which is competed by other emerging Big Data technologies. When the global IT spending outlook is low, most enterprises will be more conservative on investing

Big Data Technology Cluster	Result	Implication
		further in this type of technologies.
Cloud Analytics (CA)	Cloud Analytics (CA) technologies are rated of similar importance but lower risk than NoSQL (NS) technologies in all scenarios.	This implies Cloud Analytics (CA) technologies may serve as safer candidates for organizations which are seeking new opportunities with Big Data technologies but are vulnerable to risk.
Embedded Analytics (EA)	In general, Embedded Analytics (EA) technologies are rated of similar importance but higher risk than Advanced SQL (AS) technologies.	This implies Advanced SQL (AS) technologies may serve as a safer choices than the Embedded Analytics (EA) technologies for organizations which plan to extend SQL based technologies in the future.
Big Data Visualization (DV)	Scenario changes will have less impact on the Big Data Visualization technologies (DV), which remain in the higher risk and lower importance corner.	Big Data Visualization technologies (DV) are technologies with high risk for now and in the near future. Their potential for development requires further observation and investigation.

On the other hand, vendors interested in exploring the market opportunities of Big Data technologies can use the analysis framework and outcome of this research as a reference for their strategic planning, thereby avoiding many unnecessary trial and error marketing efforts. In particular, with a clear picture of the Big Data technologies scenario analysis, vendors can better position themselves for the most suitable market sector in terms of importance and risk.

5.2 Future Research Suggestions

Further studies on Big Data technology planning could be conducted more thoroughly through various scenario investigations. In particular, the following questions are worthy of attention.

- (1) How are Big Data technology development trends influenced by the adoption of trends in other innovative technology areas, such as cloud computing (Agrawal, 2011) and mobile apps?
- (2) How are Big Data technology adoption trends related to IT industry competitiveness as well as the level of IT readiness of different countries (EIU, 2007)?

In addition, more decision making factors that affect the enterprise adoption of Big Data technology could be integrated and more insights could be obtained by incorporating decision techniques such as AHP (Saaty and Vargas, 2001) into the analytical framework and process of this research.

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Innovation and IPRs Management for Perceived Low-Tech Industries: A Case for the Implementation of Certification Marks in the Fishing and Fish Processing Industry of Newfoundland and Labrador

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Abstract

Historically, the fishing and fish processing industry has been portrayed as less dynamic than other resource-dependent research and development (R&D) intensive industries, such as the offshore oil industry. However, some “low-tech” industries have become capital and technology intensive. Despite this transformation, technological innovations are still incremental and are sporadic for this industry. For the fishing and fish processing industry, the use of Intellectual Property Rights (IPRs) to create value and foster innovation has been almost neglected. This paper aims to present, in a qualitative way, the implications and effects of IPRs and product innovation for the so-called “low-tech” industries. In addition to this, the paper reviews the current usage and legal framework of the IPRs in use in the Canadian province of Newfoundland and Labrador. This paper concludes with a proposition to enhance and increase the use of certification marks.

Keywords: Low-tech industries, innovation management, technology management, IPRs, certification marks

1. Introduction

A multitude of studies on Intellectual Property Rights (IPRs) and innovation management, emphasizing the preeminence of high-tech industries in the knowledge economy, have been the common denominators in the debate between the management of IPRs and innovation. In this regard, Christensen et al. (2011) have acknowledged the fact that the innovation dynamics of industries in the primary sector have received limited attention from scholars, practitioners and policy makers. Nonetheless, primary sector activities are still the driving source for economic progress for

both developed and developing nations alike.

The fishing and fish processing industry has been portrayed as less dynamic than other resource-dependent R&D intensive industries, such as the offshore oil industry. For that reason, the fishing and fish processing industry can be labeled as “low-tech”. However, some “low-tech” industries have become capital and technology intensive. Despite this transformation, technological innovations are still incremental and are sporadic for this industry. A clear motivation for this research is the fact that, in the fishing and fish processing industry, the use of IPRs to create

value and foster innovation has been almost neglected.

To the best of our knowledge, there is a clear void between the innovation management literature and the legal studies literature, which has not addressed of innovation and value creation approaches for SME and low-tech industries through the practical use of IPRs. For this reason, this study aims to help document the dynamics between IPRs and innovation in the fishing and fish processing (F&FP) industry of the Canadian province of Newfoundland and Labrador (NL). This paper could be used to enable the improvement of managerial practices by local producers. In addition, it could assist in the documentation of the policy changes needed to ignite sustainable economic growth for this industry in the province of NL.

1.1. The North Atlantic Fisheries and Fish Processing Industry

The fishing and fish processing (F&FP) industry in the North Atlantic has been a source of wealth and labour for centuries. According to Agnarsson (2003), the North Atlantic countries that are heavily dependent on the fish processing industry are the Faroe Islands, Iceland, Greenland (Denmark), Newfoundland (Canada) and, to a lesser degree, Norway.

Danielsson (1997), as cited in Agnarsson (2003), emphasized that, in terms of labour productivity, the Icelandic fish processing industry is slightly more productive than their Norwegian or Danish counterparts. Olafsson (2001), as cited in Agnarsson (2003), claims that in terms of processing efficiency, Iceland and Norway represent the clear benchmark for the North Atlantic region. In Olafsson's study, the average efficiency of fish processing firms in Iceland and Norway are the highest in the North Atlantic region. Newfoundland was not considered in Agnarsson's study due to the lack of detailed and available data.

1.2. Status of Canada's and Newfoundland and Labrador's Fishing and Fish Processing Industry

According to Fisheries and Ocean Canada (2011), shellfish (lobster, crab, shrimp, scallop, clam, mussels and oysters) was the most profitable seafood accounting for \$1.26 billion CAD in landing value (fished shellfish) for 2009. In Canada, ground fish (codfish, haddock, halibut, Greenland turbot, flatfish, pollock, and others) landings accounted for \$237 million CAD in 2009.

The Canadian province of NL is located in the North Atlantic corner of the North American subcontinent. The province has an estimated population of circa 511,000 inhabitants (Newfoundland and Labrador Statistics Agency, 2011). Historically, the fishing industry in this province has been the backbone of the provincial economy. It is also a very important component of the social tissue for Newfoundlanders and Labradorians. For more than 200 years of provincial economic history, the fishing industry in NL has been dedicated and focused mostly on the fishing, processing and commercialization of ground fish (i.e. codfish). For instance, in Canada, the fishing industry alone contributes approximately two billion Canadian dollars to the national GDP. In 2008, the Canadian F&FP industry provided employment for nearly 80,000 people in the whole country (Fisheries and Oceans Canada, 2011).

Particularly for the province of NL, the fishing (hunting and trapping included) and fish product industry contributes 0.7% and 0.8%, respectively, to the provincial GDP (Department of Finance, 2010). According to Fisheries and Oceans Canada (2011), in the province of NL the most commonly captured species for their commercial value are crustaceans (snow crab, lobster and shrimp) and ground fish (codfish and turbot). With reference to the status of the F&FP industry, a senior provin-

cial official¹ with insight into the technological and economic realities of this industry in the province, commented on the following:

“The industry in NL has not been particularly innovative in developing or adopting technology. Even technologies in common use elsewhere are slow to be adopted. The basic problem is poor return on capital investment because the operating season is short. When ROI (Return-on-Investment) is already poor, it is difficult to invest even more capital and the short seasons make it difficult to get the returns needed to justify the investment.”

2. IPRs and Innovation Management in “Low-Tech” Industries: A Review of the Literature and Related Legal Concepts

Buxton (2005) argues that innovation is far more about prospecting, mining, refining and adding value than it is about pure invention. In this regard, innovation in “low-tech”² industries is more about creating value through incremental and constant innovation (i.e. the opening of new markets, improvements in the manufacturing process, etc.) rather than technological breakthroughs. Silverberg and Verspagen (2005) define innovation as the constant process of refining and redefining value creation practices in the form of products, processes, services and other working artifacts. Teece (1986) argues that complementary assets, such as marketing expertise, after-sale service, etc., are critical know-how that can generate profits. For the purpose of this research, the authors identify product and process innovation in

the F&FP as value creation and value-capturing practices used by firms.

In this regard, Pavitt (1998) argues that coordinating and organizing correctly are likely to be enablers toward the success of an innovation. Thus, the authors of this paper consider that the only merit of Certification Marks (CMs) as vehicles of innovation is the fact that they enable coordination and organization for producers who would otherwise never be able to successfully compete in the market.

CMs, in contrast to other marketing devices, such as marketing slogans, create for the consumer an inherently distinctive mental association of the CM with the quality and characteristics of the product or service. Conversely, marketing slogans can be trademarked but they have to meet the requirements of the country of origin’s trademark office. Reviewing the requirements for the granting of trademark protection is beyond the scope of this paper.

Specifically, this study considers that the effective management of IPRs falls within the scope of management innovation (MI), as defined by Birkinshaw et al. (2008 p. 825). They argue that management innovation refers “to the invention and implementation of a management practice process, structure or technique that is new to the state of the art and is intended to further organizational goals”.

From Miller and Floricel (2007, p. 15), it can be assumed that industries that rely on patent rights as their main method of innovation, are industries which are characterized by having high to average levels of knowledge production dynamism and high to average structuring potential that enable value capture (dixit).

For these reasons, patent rights, which require absolute novelty, a high degree of inventiveness and industrial applicability, are not commonly used by “low-tech” industries as rights to protect innovations. Among the relevant approaches for the utilization of patents, Franzoni (2008) argues that patents are not only the statutory rights to protect innovations but can also

¹ The interviewed official plays a major role in the technology adoption policy for the fishing and fish processing industry of the province of NL. The interviewee is the current managing director of a provincial government backed institution based in St. John’s, Newfoundland. For privacy considerations, his name has been withheld.

² According to the OECD (1994), the definition of low-tech corresponds to those industries that devote, on average, less than 0.9% of their expenditures to R&D.

function as signaling devices for measuring a firm's intangible assets.

According to WIPO (2008), utility models (UMs), or petty patents, are statutory rights that are similar to patents, but with far less stringent patentability requirements. In addition to this, their duration is shorter than patents. UMs are very appealing to "low-tech" industries since they are mostly designed to protect incremental innovations. However, not all jurisdictions have approved the use of UMs in their legislation. For instance, Canada and the US do not offer such an option for incremental innovation. However, many jurisdictions in South East Asia (i.e. Indonesia and Vietnam) and Latin America (i.e. Chile and Mexico) should use this right to protect innovations in the food processing industry.

Authors such as Mansfield (1986) and Lopez (2011) have suggested that only a handful of industries truly depend on patents as an effective mechanism for value creation. It is suggested that for certain "low-tech" industries, such as food or textiles, the natural product lead time and secrecy are more effective mechanisms for protecting innovations. This is explained by the fact that process innovations (such as those needed in the textile and food industries) are easier to keep secret than product innovations (Lopez, 2011). Key drivers of the innovation process in food firms include R&D, market orientation and the role of entrepreneurs (Avermaete et al., 2004).

According to Merges et al. (2011) trademark protection is awarded on the basis of novelty of use in commerce. Merges et al. also claim that trademarks are more relevant to the protection of consumers and unfair competition rather than to encourage innovation and the spread of knowledge (in contrast to patents and copyrights).

Historically, "low-tech" industries have relied on trademarks (Goebel, 2003). However, the food and food processing industry, in particular, has historically used

trademarks (TM), appellations of origin (AO), geographical indications (GIs) and certification marks (CMs) as ways to prevent imitation and create value by selective differentiation (Cortes-Martin, 2004). According to the Lisbon Agreement³ for the protection of AOs from 1958, an appellation of origin is the,

"Geographical name of a country, region, or locality which serves to designate a product originating therein, the quality and characteristics of which are due exclusively or essentially to the geographical environment, including natural and human factors."

Thus, an AO can be considered and be indicative of a source or origin when geographical and human factors determine the quality of the product. Article 22.1 of the TRIPs agreement⁴ describes GIs as,

"Indications which identify a good as originating in the territory of a Member, or a region or locality in that territory, where a given quality reputation or other characteristic of the good is essentially attributable to its geographical origin."

Based on the above, it can be said that GIs are technically and legally IPRs, which confers to its holder(s) an economic monopoly similar to a patent or copyright, but with a *de facto* infinite duration. GIs are controversial rights since they are perceived by many jurisdictions to be a hindrance to commerce and trade.

For instance, in Canada, there is much reluctance to enforce GIs other than for wine and spirits (Viju et al., 2011). This can be understood since many of the global GIs for foodstuffs are not from Canada or the North American Free Trade Agreement (NAFTA) region. Thus, enforcing foreign

³ Lisbon Agreement for the Protection of Appellations of Origin and their International Registration, Oct. 31, 1958. Revised at Stockholm on Jul. 14, 1967. Amended on Sept. 28, 1976.

⁴ Agreement on Trade-Related Aspects of Intellectual Property Rights, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, Legal Instruments-Result of the Uruguay Round, 33 I.L.M. 1125, 1197 [hereinafter TRIPs agreement].

GIs would force Canadian and NAFTA producers out of the local Canadian market.

Taking the example of “Feta” cheese, this cheese is locally produced in Canada and the NAFTA region at large by Canadian and NAFTA manufacturers. However, according to European Union (EU) Council Regulation 1107/96 and its latter modification, the name “Feta” has been declared a GI. This implies that only “Feta” cheese can be produced, and processed in Greece⁵.

Certification marks (CMs) are used *“for the purpose of distinguishing or so as to distinguish wares or services that are of a defined standard”*⁶ (McKeown, 2010). CMs can encompass the compliance of quality standards by the bearing of a certification mark and or the fact that the good is produced in a certain geographical region (Stack, 2000). According to section 25 of the Trade-marks Act⁷, a geographical CM may be registered by an administrative authority or commercial association to describe the place of origin of wares or services. Thus, CMs, contrary to GIs, are IP rights designed to protect the association of producers/manufacturers/service providers, not their specific products or services.

Normally, innovation literature is full of studies that have used patent filings as a measure of innovation or of a firm’s innovativeness. The problem with using this metric to measure innovation is that patents can have multiple uses and not all of them attain the ultimate goal of innovation, which should be value creation. For instance, patents can be used to protect value creation innovations (inventions in products or processes depending on the jurisdiction). However, they can also be used as tools to restrict market access, to restrict the rate of dissemination of an innovation or to delineate the freedom to operate in a certain market. Ultimately, it is document-

ed that only a handful of patents truly create value for their holders.

In terms of literature available, there is not much in terms of studies that document organizational innovations regarding CMs. For example, the creation of self-motivated and self-governed organizations with the sole aim of creating value for all the members with a specific certification mark is clearly an innovation, since the members of such a CM collaborate with each other to ultimately compete in a higher and better priced market segment. This is similar to Brandenburger and Nalebuff’s (1996) concept of co-opetition.

2.1. Research Methodology

The authors of this research project have been studying innovation management approaches for “low-tech” industries for several years. This paper is an attempt to build and expand on the authors’ previous research on innovation management for “low-tech” industries.

Methodologically, this research was conducted to provide an insight into the status of the F&FP industry of NL. Hence, the methodology selected for this study is qualitative in nature and includes the use of a case interview with a subject matter expert on the issues affecting the F&FP industry in Newfoundland and Labrador. Additionally, two well-known existing CMs in the F&FP industry were reviewed, using documents available in the public domain, and then contrasted with an analysis of the case of the F&FP industry in Newfoundland and Labrador. According to Yin (2003), qualitative studies are best suited to providing an accurate description and prognosis of a situation. For this specific research, it was selected to conduct a literature review of the managerial and legal factors affecting “low-tech” industries, especially the F&FP industry. Specifically, this research project ran over a period of six (6) months. The objectives covered by this research include:

- (1) Identifying the extent of CMs suitability for small, local producers in the F&FP industry.

⁵ The name “Feta” was permanently accepted as a GI. This is according to the proposal for a Council Regulation amending the Annex to Commission Regulation (EC) No. 1107/96 with regards to the name “Feta”, 2002, O.J (C 262E) 7ff.

⁶ Canada Trade-marks Act R.S.C. 1985, c. T-10 s. 2

⁷ Canada Trade-marks Act R.S.C. 1985, c. T-10 s. 25.

- (2) Documenting successful experiences following the implementation of CMs as value creation innovations.
- (3) Providing general guidelines on the adoption of CMs by small, local producers in developed and developing countries.

The research question, which this research attempts to answer, is shown below:

Can “low-tech” and labour intensive industries (such as the fishing and fish processing industry) benefit from IPRs to boost innovation? If so, what are the best-suited rights for these industries?

3. Intellectual Property Rights and Innovation in the Fishing and Fish Processing Industry of Newfoundland and Labrador

The F&FP industry of NL is characterized for being a “low-tech” industry with minimal entry barriers, marginal or easily replicable complementary assets and incremental innovations. The managing director of a fisheries innovation center funded by the provincial government of Newfoundland and Labrador (who requested to remain anonymous), participated in this research. He explained the situation of the F&FP of NL in the following quotation⁸,

“The seafood sector is intensely competitive, with many suppliers, no effective barriers to entry, and many products that are substitutes for each other. This can lead to innovations in products, processing technologies, and marketing. However, it can also lead to unethical practices, where one species is marketed as another that is more valuable or a poorer quality product is represented as being higher in quality.”

For most of the F&FP industry in NL, innovations are regarded as breakthrough technological inventions that completely redefine markets, as seen by the opinion below⁹,

“In the fishing industry, ground-breaking technologies come along occasionally (emphasis added). The steam engine, radar for navigation, sonar for finding fish, and hydraulics for handling fishing gear have all had major impacts on harvesting. Refrigeration technology transformed an industry that preserved its products through salting, smoking, and canning into one that distributes most products fresh or frozen. In ground fish processing, flow-line technology has greatly improved efficiency.”

Moreover, the interviewee continues¹⁰,

“In the NL industry, most innovations are introduced from outside – OEMs, consultants, universities. Nearly all harvesting and processing enterprises are small and medium sized enterprises (SMEs) and SMEs typically don’t spend much on innovation (emphasis added) in any industry. Our industry also has the added problems of poor ROI and a short operating season, so participants are under ongoing pressure to minimize costs.”

The above interviewed official was asked the question¹¹, “What is the role of Intellectual Property Rights (patents, copyrights, trademarks, etc.) in the F&FP of NL?”

His reply was,

“These do not play a prominent role in the fishing industry in general (emphasis added). We do own some intellectual property rights based on work we have done.”

3.1 Certification Marks in the F&FP Industry: The Case of the Norwegian Seafood Council

According to the Norwegian Seafood Council (NSC) general presentation, the NSC is an organization of seafood producers with the specific aim to promote the consumption of Norwegian seafood products. In terms of marketing objectives, the NSC aims to increase demand and the awareness of Norwegian seafood (NSC, n.d). Legally, the NSC and its trademark

⁸ *Ibid.* supra note 1.

⁹ *Ibid.* supra note 1.

¹⁰ *Ibid.* supra note 1

¹¹ *Ibid.* supra note 1.

guarantee the Norwegian origin of all products bearing the NSC trademark.



Figure 1: Commercialization of Norwegian Individually Packed Salted Codfish in Mexico City.

As per the records of the Norwegian Industrial Property Office (NIPO)¹², the NSC own the trademark “Norge: Seafood from Norway”. The graphical representation of this trademark is an oval shape depicting a fisherman sailing through rough waters with mountains in the background with the transliteration “Norge: Seafood from Norway” on the top part of the oval. When used on seafood, this registered trademark guarantees the Norwegian origin of the seafood products.



Figure 2: Branding of the CM “Norge: Seafood from Norway” in an Exclusive Department Store in Mexico City.

The NSC has, arguably, been successful in gaining recognition for Norwegian seafood products around the world. For instance, Figures No. 1 and No. 2 were taken in an exclusive department store in Mexico City by the authors of this paper. From observation, it was noted that consumers in Mexico recognize and actively seek the CM “Norge: Seafood from Norway”¹³ when looking for premium salted codfish.

3.2 Certification Marks in the F&FP Industry: The case of the Alaska Seafood Marketing Institute.

As per the United States Patent and Trademark Office (USPTO)¹⁴, the Alaska Seafood Marketing Institute (ASMI) owns the trademark “Alaska Seafood: Natural, Wild & Sustainable”. Graphically, this trademark consists of a fishing boat with a triangular-shaped mountain in the background and the words “ALASKA SEAFOOD” over the top of the mountain. In addition, the words “WILD, NATURAL & SUSTAINABLE” are below the boat.

According to the consumer research report of the ASMI, 70% of seafood restaurant patrons that are exposed to the brand “Alaska” or “Alaska Seafood: Natural, Wild & Sustainable” are positively influenced by this mark (Menu Alaska, 2011). In addition to this, the ASMI consumer report claims that, for restaurant use, Alaskan seafood is the most commonly used brand of seafood in US restaurants (Menu Alaska, 2011).

¹² NIPO registration number: 203707

¹³ Figures 1 and 2 are copyrighted figures by Christian Coronado.

¹⁴ USPTO registration number 4062345.



Figure 3: Marketing Activities of the ASMI in Moscow, Russian Federation 2011¹⁵.

4. Case Analysis

The analysis of the case of the F&FP industry of NL, in combination with the two cases above, suggests that IPRs can help boost innovation (through product innovation, process innovation and management innovation) not only in terms of patentability and developing new technologies (process and products) but, most importantly, in terms of creating and sustaining strong trademarks through the use of CMs. Indeed, CMs represent the best-suited type of right for the F&FP industry. The two CMs used for the case studies represent some of the most successful examples available in the F&FP industry and these can serve as a point of reference for the F&FP industry in Newfoundland and Labrador.

Organizing the F&FP of NL and creating a provincial CM is a management innovation that could generate value by creating strong market awareness of the fish products of NL. The NSC and the

ASMI success stories are good examples and can provide evidence for the importance of non-patented IPRs for “low-tech” industries, such as the F&FP industry. As a matter of public economic policy, this research recommends that the government of the NL province and major seafood producers expedite the creation, commissioning and operation of a Seafood Marketing Council/Institute, similar to the NSC or ASMI.

The authors of this research believe in the benefits of branding the seafood products of NL under a CM, consequently conveying the known goodness of seafood products from the bountiful waters of NL. This, if successfully implemented, could bring positive economic returns to the NL province, to Atlantic Canada and, ultimately, to Canada as a whole.

5. Conclusions and Recommendations

Patent rights confer strong temporary protection to the patent holder. However, they can be costly and there are usually high patentability requirements. The literature suggests that these rights are ideal for a handful of “high-tech” industries (Mansfield, 1986) or industries with very specific value creation and value capturing conditions (Miller and Floricel, 2007).

Therefore, GIs are more appropriate rights for the food and food processing industry. In addition, they offer a quasi-infinite length of protection. Nonetheless, these are controversial rights and some jurisdictions have more reticence when enforcing protection for GIs, other than for wines and spirits. In North America, specifically, there is a strong aversion to GIs, since they are perceived as a hindrance to commerce and trade (Viju et al., 2012).

CMs are rights that protect the association of producers, rather than specific products (conversely to GI). CMs also offer a quasi-infinite length of protection and can serve as a platform to protect the common interests of producers who are members of the CM. CMs seem to offer adequate pro-

¹⁵ Figure duly licensed. Credit attribution: nikshor / Shutterstock.com

tection to those producers who are interested in protecting the producer rather than the product itself.

Regarding the limitations of this study, the authors understand that a wider source and a more ample data set would have been beneficial and better when substantiating the results. However, given the sources of information and resources, the authors deem appropriate, for an exploratory study, the results obtained using information made available by the NSC and ASMI.

Overall, the results of the case analysis can be summarized as follows:

- (1) CMs perfectly suit associations of producers in the F&FP due to their quasi-infinite length of protection.
- (2) CMs can be used as a platform to protect the common interests of members.
- (3) CMs can be used to develop customer recognition through product origin and quality.
- (4) CMs increase product differentiation and product awareness. This is because CMs provide legal certainty to consumers and users about the origin of a product, the standards used during processing and the overall quality of the product.

5.1 Applicability of CM to the F&FP in Developing and Less Developed Nations

This research suggests that trademarks, specifically CMs, are ideal rights to protect labour intensive agricultural and fishing products. Developing nations are mostly exporters of fish and fish products, which in most cases are to the final consumers who do not acknowledge the origin of the products they consume. This research suggests that the NSC and the ASMI have achieved a high level of recognition for the origin and quality of their products, which has enabled consumers to make conscious choices on the seafood products they consume. This is particularly important for Southeast Asian countries (e.g. Thailand, Vietnam, Indonesia, Malaysia, Cambodia,

etc.) as their culture, as in Newfoundland, relies heavily on fishing and fish consumption.

These nations, and regions with similar economics and demographics, could benefit more from their fishing resources if they create entities, jointly between government and producers, which are charged with the marketing and stewardship of their fishing resources. This could enable them to create strong customer recognition levels, similar to the levels achieved by the NSC or the ASMI, that could be translated into a sustainable industry.

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Managing Crime Perception Using the TRIZ: A Malaysia Case Study

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Abstract

This paper aims to provide an analysis of the application of the Theory of Inventive Problem Solving (TRIZ) in managing crime perception in the Malaysian context, and to compare the ideas generated by the TRIZ with solutions that have been implemented in Malaysia. TRIZ offers an alternative method of generating ideas to manage the crime perception of Malaysians. The majority of Malaysians still think that the crime rate in the country is very high, even though the fact is that the crime rate has dropped from 2009 to 2011. According to literature reviews, police capabilities, a distrust of statistics, government confidence, fear of crime, and the media have influenced the perception of the public. TRIZ is a powerful tool which can be used in problem solving. Therefore, TRIZ is used to identify the root cause of the problem and to generate solutions. The general solutions or the inventive principles suggested by the TRIZ are preliminary action, rushing through, blessing in disguise, local quality, mechanical substitution, parameter changes and thermal expansion. These inventive principles are used in the generation of the specific solutions. Based on the suggested solutions and the current steps being taken by the country, Malaysia has done its best to manage the public's perception of crime but there is still room for improvement by using the media to lower the perception.

Keywords: TRIZ, theory of inventive problem solving, crime perception, contradiction, cause and effect chain analysis, inventive principles

1. Introduction

Combating crime is a major issue for almost every country, including Malaysia. The crime rate in Malaysia rose from 2003 to 2007 (Centre for Public Policy Studies (CPPS), 2008; Haron, Roosli, and Kamal, 2012). The increase in crime was due to rapid urbanization and the growth of population. 90% of crimes in Malaysia were property crimes, the occurrences of which were mainly in residential areas (Sidhu, 2005). Facing such an alarming situation, a number of steps have since been taken to

combat crime. The Reducing Crime NKRA (National Key Result Areas) under the Performance Management Unit (PEMANDU) of the Prime Minister's Department has come up with various initiatives, such as policing infrastructure, human capital and technology, to fight crime (PEMANDU, 2012). The result is encouraging as the combined effort of these initiatives has led to a reduction in street crime. According to Jala (2012), there were 210,000 crimes in 2009, which had dropped to below 160,000 in 2011. Based on the statistics in Figure 1, it shows that

Malaysia is now a safer country. However, the public still believes that the crime rate in the country is high and blames the government and the police force for not doing enough. In addition, empirical studies on crime perception in Malaysia are mainly based on public opinion of the police (Nair, Luqman, Vadeveloo and Marimuthu, 2012; Nair, Luqman, Vadeveloo, Shanmuggam and Iskandar, 2013).

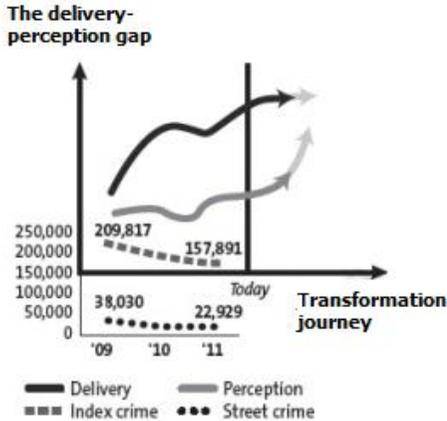


Figure 1: The Crime Statistics and Crime Perception

Source: Jala, I. (2012)

The purpose of this study is not to discover the source of crime but to present an alternative method to compliment the previous studies in generating ideas to manage crime perception. This is done by using TRIZ to compare the ideas with the solutions that have been implemented in Malaysia so far. The TRIZ process to solve the high crime rate perception begins with the understanding of the problem statement. This is followed by the identification of the root cause to find the specific problem to be solved and the use of TRIZ tools to generate ideas that can be used as solutions.

2. Literature Review

2.1 TRIZ

TRIZ is an acronym for the Russian phrase "Teoriya Resheniya Izobretatelskikh Zadatch" or "The Theory of Inventive Problem Solving". According to Guin,

Kudryavtsev, Boubentsov and Seredinsky (2009), TRIZ fills the void, inherent in other conventional product development tools, in the area of idea generation and concept development.

TRIZ was discovered by a Russian engineer, scholar, and inventor Genrich Altshuller in 1946 when he started reviewing patents whilst looking for clues about how inventive people solve problems. (Kaplan, 1996; Altshuller, 1999; Altshuller, 2005). He studied 200,000 patents, which were then narrowed down to 40,000 innovative patents. The three primary findings of the TRIZ were that problems and solutions were repeated across industries and sciences, patterns of technical evolution were repeated across industries and sciences, and lastly, innovations can be achieved by using scientific effects from outside the field where they were developed (Sheu and Lee, 2011). At the heart of the TRIZ, the three main concepts, whereby at least one of them is used in any TRIZ problem solving process, are contradiction, ideality and pattern of evolution (Ilevbare, Probert and Phaal, 2013).

Contradictions are due to the incompatibility of desired features within a system which contains both desired features (improving parameters) and undesired features (worsening parameters). Solving the contradiction is the key element for innovation (Kiatake and Petreche, 2012). Ideality was introduced by Altshuller (1999) to describe how closely a system performs its function to its best possible or to the ideal final result (IFR). Altshuller observed that the development of engineering systems follow certain patterns (trends). According to Savransky (2000), the evolution of the systems can be expressed as a development to achieve ideality.

Since the discovery of TRIZ in 1946, Altshuller and his colleagues developed several tools and techniques. In an overview of the development of the TRIZ tools and concepts from 1946 to 2008, the tools which appear most prominently are 40 inventive principles, 76 standard solutions,

effects database, separation principles, contradiction matrix, patterns of evolution for the technical systems, IFR, fitting, function analysis, substance field (Su-field) analysis, analysis of system resources, nine windows, creativity tools, and Algorithm of Inventive Problem Solving (ARIZ) (Souchkov, 2008; Ilevbare et al., 2013). Cameron (2010) classified some of the TRIZ tools into a model of problems and a model of solutions (Table 1).

Table 1: TRIZ Tools

Model of Problems	Model of Solutions
Technical Contradiction	40 Inventive Principles
Physical Contradiction	Separation, Satisfaction, Bypass
Su-field model	76 Standard Inventive Solutions
Function Statement	Scientific Effects
Search for Trend Solutions	Trend of Evolution

According to Yeoh, Yeoh and Song, (2009), a typical problem solving method is to find a specific solution for a specific problem. If the breakthrough solution cannot be found, then problems solvers can apply the TRIZ way of problem solving (Cameron, 2010) (Figure 2).

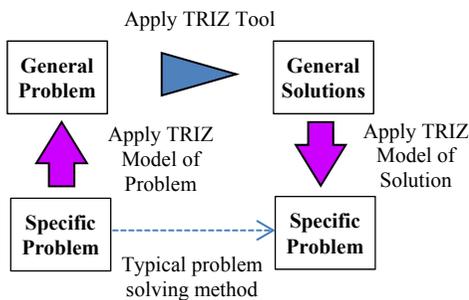


Figure 2: The TRIZ Way of Problem Solving Adapted from Yeoh et al. (2009) and Cameron (2010).

In order to apply the TRIZ tools, problem solvers must re-state the problem in the form of a general problem, such as technical contradiction, physical contradiction, Su-field model, function statement or a search for a trend of evolution. Based on

the general problem, TRIZ provides a list of general solutions in the form of a model of solutions, such as 40 inventive principles, separation, satisfaction, bypass, 76 standard inventive solutions, scientific effects and the trend of evolution. Finally, the problem solvers have to take the decision of which specific solution is to be used (Yeoh et al., 2009; Cameron, 2010).

Recent TRIZ research has resulted in extending the TRIZ applications into non-technical areas, such as business (Mann and Domb, 1999; Mann, 2002), education (Marsh, Waters, and Mann, 2002) service operations management (Zhang, Chai, and Tan, 2003), quality management (Retseptor, 2003), Eco-innovative design (Chen and Chen, 2007) and health service management (Lin, Chen and Chen, 2012).

TRIZ has the advantage over other methods such as brainstorming, mind mapping, lateral thinking and morphological analysis as these are only able to identify a problem and its root cause but are relatively weak in generating the solutions when compared to TRIZ (Ilevbare et al., 2013). The strength of TRIZ is in idea generation (Guin et al., 2009). As a result, TRIZ is able to reduce the time spent on generating ideas to find solutions.

Many causes of crime rate perception are contradictory (Duffy, Wake, Burrows and Bremner, 2008). According to Yeoh et al. (2009), when using a typical problem solving method to solve a contradictory problem, users may end up generating a compromise solution that circumvents the contradictions instead of solving the root cause. TRIZ problem solving process can be used to resolve contradictions while providing an inventive solution. The following TRIZ process, as shown in Figure 3, is adapted from Yeoh et al. (2009) and will be elaborated further in section 3.

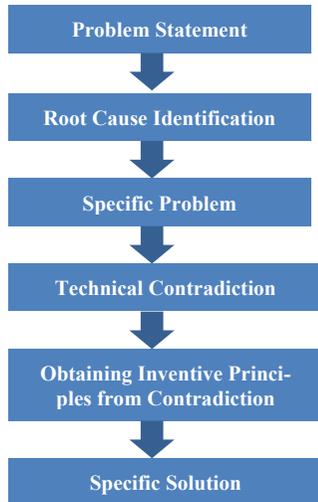


Figure 3: TRIZ Process

2.2 Perception of Crime

The perception of crime is the psychological perception of a society toward their reaction and thoughts of crime. The perception of crime has been noted as one of the indicators that can measure the success of fighting crime. Duffy et al. (2008) cited from the source 'Cutting Crime: A New Partnership 2008-2011' that

"If crime falls but people do not see and feel that fall, their quality of life is affected and the benefits of reduced crime are not being realized" (p.40)

The perception of crime may damage a society as much as the crime itself as people cannot perform their daily routine as they are too scared to socialize and do business. For years, experts have noticed that the perception of crime spikes as crime falls. Experts call it 'trailing indicator', which means the actual crime rate, whether good or bad, will only be matched by the perception some time later (The Choice, 2012). One notable example was reported by The Economist (2012) that in Britain, the perception of local crime took almost 12 years (1998 – 2010) to catch up with overall decline in the crime rate. In 2011, when people started to perceive that they were safe, the crime has actually risen.

Why is there a high perception of crime when the number of crimes has actu-

ally declined? The following reasons are compiled from the local daily newspapers, online news and literature reviews.

The public perceives police incapability as one of the reasons. In certain cases, the public has blamed police officers for ignoring information given to them (Lopez and Lukinbeal, 2010). Police officers ignore information due to their inability to deal with so many cases at once and the public perceives that police are numb when handling crime reports and slow to take action (The Star Online, 2012b). The Star Online (2012a) reported that there are 110,000 police personnel serving 28.3 million people in Malaysia, equating to one policeman for every 257 people. However, at the local level the number of police bases or stations, and the number of personnel often cannot keep pace with the rapid development in many districts where housing estates are quickly expanding. On the other hand, the police blame the public for their reluctance to come forward to give evidence after they lodge police reports and not wanting to testify in court for fear of the lengthy court process and fear of personal safety from any repercussions (Wong, 2012; Lopez and Lukinbeal, 2010). The public are reluctant to cooperate with the police because they are concerned with the level of corruption, brutality, infringement, and the abuse of human rights by the police (Teh, 2008; Nair et al., 2012; Nair et al., 2013). Duffy et al. (2008) and Nair et al. (2012), stress the importance of public relation work by the police and that they need to be more effective in combating crime in order to regain public confidence and win their cooperation. According to Jesilow, Meyer, and Namazzi (1995), lack of public cooperation leads to a demotivated police force and possibly more crime in the future.

The public perception of crime might be a signal of confidence from the public towards the police force and the government. The public distrusts the crime statistics may be due to the fact that the public thinks that the data may have been manip-

ulated, thus not reflecting the true situation of inadequate crime-fighting efforts. This reason could be due to the fact that several such cases have been reported in the local independent media, such as Malaysia Kini and Malaysia Insider. The Choice (2012) and Duffy et al. (2008) claim that there are cases whereby the efforts of the police force and government are undermined by certain parties because of political reasons.

The fear of crime can influence public crime perception and encourage people to have a false sense of insecurity, independent of the crime itself (The Economist, 2012). According to Carvalho and Lewis (2003), the fear of crime generally occurs at higher rates than recorded victimization. Matei, Ball-Rokeach, and Qiu (2001) report that people living in high crime areas have less fear of crime, while those living in lower-crime neighborhoods have more fear. A study conducted by Nair et al. (2013) found that respondents felt that the recently repealed Emergency Ordinance (EO), which enables detention without trial, should be reinstated. The EO is regularly used to detain those deemed to be subversive by the government, such as high profile criminals. However, Puah (2013) refuted the allegation that the repealing of the EO would increase the crime rate. He felt that this would merely mask the inefficiency of the police. He further claimed that

“...only nine percent of the total 120,000 police personnel are attached to the CID departments that is the forefront of combating crimes” (Puah, 2013, p. 25).

The fear of crime is influenced by the media, such as newspapers, and also alternative online media. According to Sandstig (2010), the media reinforces the public personal experience and social experience towards crime. Research by Duffy et al. (2008) shows that, in general, the media coverage of crime is negatively biased. People might generalise ‘signature’ crime reported by the media, particularly homicide, sexual offences and child abduction as a signal that the crime rate in the country

is very high. Nair et al. (2013) found that most of the educated members of the public living in urban areas registered a higher fear level of being a crime victim because they read newspapers. In addition, alternative online media have reported a higher incidence of crime in society. People become frightened by the report that no less than one person gets murdered, raped or robbed daily. Wong (2012), however, claims that crimes are understated because many victims do not report the incidents and the information released by the police press conferences may not fully reflect the actual situation. Sandstig (2010) found that those that believe media coverage on crime is understated have a greater feeling of fear and insecurity

3. TRIZ Process

3.1 Problem Statement

The public’s perception of crime is higher than the actual crime rate. The public’s perception of crime is a key driver of the overall views of the government, as well as the public’s quality of life (Duffy et al., 2008). Therefore, the public perception of crime will have an impact on the well being of the people and the country.

3.2 Root Cause Identification

The literature review in section 2.2 highlighted various reasons for high crime perception. The next step is to identify the root cause. The root cause identification is carried out using the cause and effect chain analysis (CECA). The CECA was described as “logically directed brainstorming” by Cameron (2010). The solution generated will not work if the real root cause is not found. The CECA process that we applied is based on Yeoh et al. (2009) and Cameron (2010). The CECA starts with a target problem which is stated in the first problem box that is “public crime perception is high”. Starting with the target problem, it is possible to determine the possible reasons by asking the question ‘why?’ Each possible answer is inserted into a new box and is then connected to the first problem box.

The root cause analysis ends when a terminal box is reached. A terminal box is the point whereby there is no more ideas to continue (no more 'why') (Cameron, 2010). For example, the theme of this paper is crime perception. The target problem is that the public perceives that the crime rate is very high. Based on the literature review, the high level causes are that the public perceive the police as not being capable, the public fear of crime and the public's distrust of the statistics. Taking one of the causes, such as the public perception of the

ineptitude of the police, the next level cause is the problem whereby police ignore information and are too slow to take action. The same process is carried out for other problems to find the causes to these problems. The CECA for public crime perception is shown in Figure 4. The CECA shows that the root causes reach the terminal at two boxes, one at the media reported and the other one being that the police have too many cases to handle. These two are identified as the potential root causes of the public's crime perception..

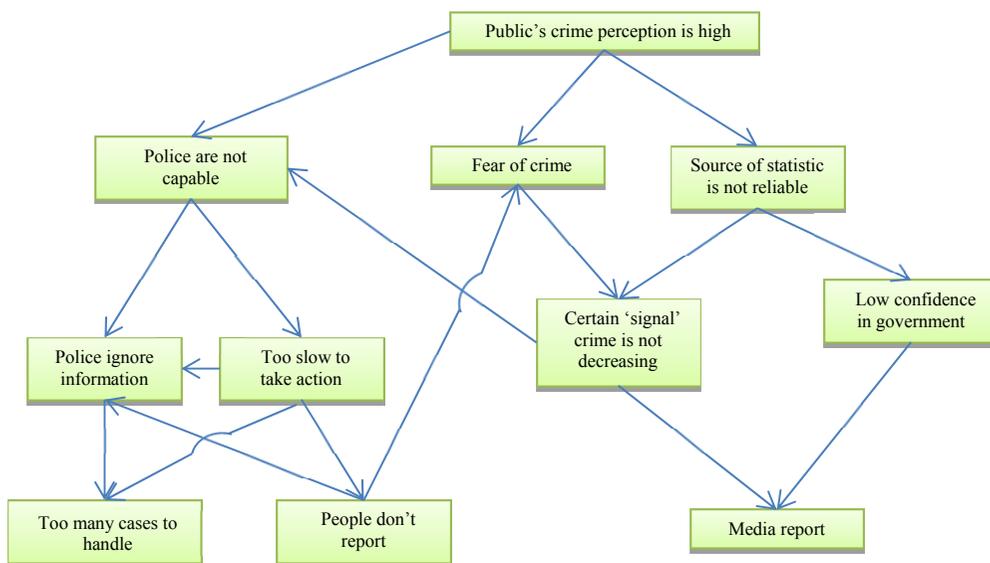


Figure 4: CECA of Public's Crime Perception

3.3 Specific Problem

The CECA above is based on the theoretical evidence offered in the literature review in section 2.2. The CECA leads to a redefinition of the original problem and the definition of a number of different new specific problems to address (Cameron, 2010). A specific problem is the actual problem to be solved (Yeoh et al., 2009). The starting target problem is that the public perception of crime is high. The specific problem, derived after analysis, is how to manage the media reports and the number of cases to handle in order to improve the public's perception of crime.

3.4 Technical Contradiction

TRIZ has many tools to solve a problem, but the specific problem to be solved must be restated in the form of one of the general problems, such as a technical contradiction, physical contradiction, Su-field model, function statement or search for the trend of solution (Cameron, 2010). The original TRIZ contradiction is a technical contradiction, which is when an attempt to improve one characteristic of the technical system results in the worsening of another characteristic (Yeoh et al., 2009). An administrative contradiction normally arises from how management can be converted into a technical contradiction by converting

the various parameters into one of the 39 technical parameters created by Genrich Altshuller. The 39 technical parameters are derived from the patent database that enables problem solvers to describe the features or functions of the technical systems. However, the mapping of real world problems into the 39 technical parameters is not an easy task and requires a certain amount of experience and practice (Gadd, 2011). Gadd (2011) suggested that problem solvers pay more attention to the suggested principles than finding the perfect contradiction. As a result, the authors have made sure that the technical contradiction statements formulated are backed by literature so that the inventive principles can be generalized to solve the problem of high crime perception.

The technical contradiction is normally stated through the use of an “if-then-but statement: if something is done, then parameter *x* improves but parameter *y* worsens”, in order to clearly define the problem and to determine which parameters are in contradiction with each other (Yeoh et al., 2009). Improving the public’s crime perception presents a contradiction. The function of the media is to inform people, but based on the literature review, the public become more frightened as more and more cases are being reported (Duffy et al., 2008; Sandstig, 2010; Nair et al., 2013; Puah, 2013).

The public is also disappointed by the inefficiency of the police (Teh, 2009; Lopez and Lukinbeal, 2010; Wong, 2012; The Star Online, 2012b). However, the police officers are overwhelmed with the large amount of cases, especially in the high population density areas (The Star Online, 2012a), and have insufficient numbers to combat crime effectively (Puah, 2013). TRIZ offers the solution to solve the contradiction instead of trade off. The following are the contradictions and the parameters that go with them.

Contradiction 1:

If the media reports the news, then the public will be informed, but the public may perceive that the country’s crime rate is high.

	<i>Altshuller’s 39 Parameters</i>
Worsening parameter: Public perceives the crime rate is very high	#31 Object-generated harmful factors
Improving parameter: Public is informed	#24 Information

Contradiction 2:

If the police receive many public crime reports, then the police will be able to solve some of the cases, but it will take too much time to solve all of them.

	<i>Altshuller’s 39 Parameters</i>
Worsening parameter: Police take too much time to solve all the cases	#39 Productivity
Improving parameter: Police are able to solve some of the cases	#10 Force

3.5 Obtaining Inventive Principles from a Contradiction Matrix

A contradiction matrix consists of two identical horizontal and vertical axes that include a list of 39 parameters. The inventive principles (solutions) can be obtained from the matrix cells. The vertical axis of the contradiction matrix is the parameter to be improved, whilst the horizontal axis of the contradiction matrix is the parameter that worsens (degraded). The intersection between the parameter to be improved and the worsening parameter provides problem solvers with the most frequently used inventive principles (Figure 5).

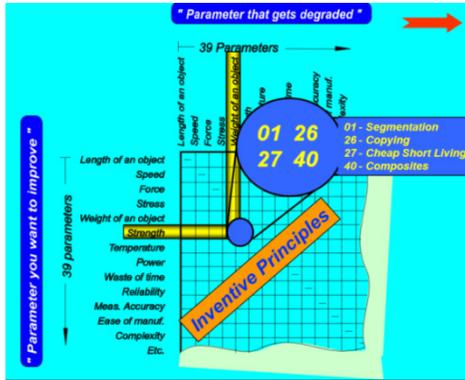


Figure 5: Contradiction Matrix
Source: GEN3 (2006)

Recommended Inventive Principle from Contradiction 1:

Contradiction Matrix	Inventive Principles
#31: Object-generated harmful factors (Worsening)	#10 Preliminary action
X	#21 Rushing through/hurrying
#24: Information (Improving)	#22 Blessing in disguise

Recommended Inventive Principle from Contradiction 2:

Contradiction Matrix	Inventive Principles
#39: Productivity (Worsening)	#3 Local quality
X	#28 Mechanical substitution
#10: Force (Improving)	#35 Parameter change
	#37 Thermal expansion

4. Specific Solutions and Discussions

4.1 Specific Solutions for Contradiction 1

The recommended TRIZ Inventive Principles are as follows:

- #10 Preliminary action
- #21 Rushing through/hurrying
- #22 Blessing in disguise

Some issues that have been driven by the media are beyond governmental control, but there are significant actions that the police or the government can take (Duffy et al., 2008).

#10 Preliminary action means performing an action earlier than the occurrence of another event (Altshuller, 2005).

At present, the Malaysian police are taking steps to boost its information technology security in order to combat the spread of false information and slander through social networks and the Internet (BERNAMA, 2013b). The editors of the news should edit the news before the news can be released to the public to tone down the fear that the news might create. Meanwhile, authorities should perform their duties to the utmost excellence at all times rather than ‘fire fight’ unwanted outcomes due to unprofessionalism.

#21 Rushing through/hurrying provides the idea that news related to a crime, when broadcast on air, should be reported continuously without any commercial break in order to shorten the news exposure time to the public so as to lessen the level of fear that the public might develop.

#22 Blessing in disguise or converting harm into a benefit provides the idea that instead of reporting only the negative aspect of the crime, the media should also report any positive aspect of the crime. According to The Star Online (2012b), authorities must not only do their job, but must be seen to be doing their job. The image of the authorities can be improved if what they do is reported positively by the media. At present, there are media programs that show how crimes are solved through the efficiency of the relevant units, the cooperation of the public and individual heroism. These programs teach crime prevention strategies to the general public that may further deter the crime from happening in the long run and strengthen the cooperation of different races in solving crime. The outcome of a case, such as whether the culprits are punished under law, should be emphasized as well to show the public that justice is being served and that the law enforcement is adequate in combating crime.

4.2 Specific Solutions for Contradiction 2

The recommended TRIZ Inventive Principles are as follows:

- #3 Local quality
- #28 Mechanical substitution

#35 Parameter changes**#37 Thermal expansion**

Altshuller (2005) described #3 local quality as changing the characteristics of something in a specific area (locally) in order to gain a required functionality. The local authority can be tasked to improve safety. In Malaysia, the safe city programme has been implemented by 151 local municipal councils nationwide with 8,329 enhanced lighting posts, 1,311 safety mirrors, and 104.3 km of railings and bollards installed for the public's safety (PEMANDU, 2012). The police must be seen to be doing their job (The Star Online, 2012b), and as a result, policemen can be assigned to use public transport in order to save costs and at the same time monitor the surrounding public safety during the journey. Neighborhood watch or community policing programs can be set up so that the local community works together with the police to fight crime. The public are happy if they have a role in the community policing programmes (The Star Online, 2013b). Police have also suggested setting up crime prevention associations in schools to enhance students' awareness of crime prevention methods (BERNAMA, 2013a).

Based on #28 mechanical substitutions, new technology can be introduced to increase the efficiency of any crime prevention, such as installing cameras in hotspot areas so that the authorities can monitor the area from a distance and have a response team stationed nearby to combat any crime spotted. The police have introduced *MyDistress*, a digital distress button on a hand phone that, when pressed, sends a distress signal with the coordinate immediately sent to the authorities for speedy action (PEMANDU, 2012). Jala (2012) mentions that the police realise that the main complaint against them is the public's difficulty in making reports and taking action. As a result, an online system is being considered to track police investigations and to simplify the procedures for making police reports. At the same time, a crime prevention website has been set up to sup-

ply updated information on regularly held crime prevention public events, such as crime prevention talks, meetings, seminars, conferences, forums and exhibitions which the public can attend for free (The Star Online, 2013a).

#35 Parameter changes means changing the properties of an object or system to accommodate useful benefits (Altshuller, 2005). Increasing the frequency of police patrols requires many police officers and could incur a lot of cost. Therefore, under the omnipresent program, personnel comprising of policemen as well as the RELA (People's Volunteer Corps) and JPAM (Malaysian Civil Defence Department) members have been deployed in crime hotspots nationwide, covering shopping complexes and schools, and interacting with the people to make their presence felt. More than 3,000,000 volunteers have registered with RELA and JPAM. The Skim Rondaan Sukarela (Volunteer Patrolling Scheme) members have increased to 147,000 (PEMANDU, 2012).

According to Altshuller (2005), the principle #37 thermal expansion has been used for linear thermal expansion and contraction. However, it can also be used in other environmental fields to cause change, such as introducing a transparent merit system in the police force to increase their efficiency and productivity in lowering crime and improving the image of the police force. Steps must be taken to ensure that police officers obey the law.

The authors wish to point out that it is not necessary to apply all the inventive principles. TRIZ helps problem solvers to release their psychological inertia. Other principles can be considered if they are able to stimulate problem solvers to think of a better solution. Rantanen and Domb (2008) mentioned that some recommended inventive principles may not help. However, individuals have subjective interpretations in different contexts (Burns, 1995). As a result, different people may have a different interpretation of the same inventive principle.

5. Conclusion

The study serves as an example of how TRIZ solves contradictions which are prevalent in management. The TRIZ tools serve to guide brainstorming that can generate many ideas. In this case study, the crime perception can be managed by applying the TRIZ tools, particularly the inventive principles, such as preliminary action, rushing through, blessing in disguise, local quality, mechanical substitution, parameter change, and thermal expansion. TRIZ helps to generate feasible ideas which may lead to elegant solutions. The result shows that the Malaysian government has taken several positive steps to boost the country's public crime perception, especially in the area of law enforcement. However, more can be done by using the media to lower crime perception. The literature review has shown that lowering crime perception takes time so the result may not be obvious at the moment. Although solutions can be found quickly and systematically using TRIZ rather than using trial and error and unguided brainstorming, TRIZ requires a certain amount of experience and practice. There is also no doubt that different people may have different interpretations of the same inventive principle but these are still useful for creating ideas that can solve problems.

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Exploring Impulse Buying Behavior on In-App Purchase of Game App

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Abstract

The more popular that smart phones become in the global market, the more that people are concerned about the development trends of mobile applications (apps). The main app profit model today has been gradually transformed into an In-App Purchase (IAP) model. Most of the studies in the information management field explore impulse buying intentions or behavior based on the theory of planned behavior (TPB). However, this study argues that the TPB lacks consideration of emotional factors. In the impulse buying field, emotion plays an important role. Therefore, this study proposes a framework based on cognitive emotion theory to investigate the impulse buying of IAPs on game apps. This study employed app characters as cognitive cues on account of the specific situation of mobile games. The app characters consist of sensory attribution, ease of use, and enjoyment. The findings confirm that the proposed model provides an appropriate prediction for impulse buying. This study extends cognitive emotion theory into a mobile game context. Marketers can use this information to assess their own game app in terms of what app characters can trigger impulse buying. Given the prevalence of impulse buying on mobile games and the importance of impulse purchases to an app developer's profit, this study provides useful insights into impulse-buying behavior in an app context. Overall, the study concludes by discussing theoretical implications, empirical implications, limitations, and future research directions.

Keywords: In-app purchase, impulse purchase, urge to buy, cognitive emotion theory

1. Introduction

The IDC (2011) survey report pointed out that app market revenue is expected to grow from US\$10.7 billion in 2012 to US\$182.7 billion in 2015, growing more than 10 fold. Additionally, Gartner's mobile market report showed that the App market is growing quickly, and the main business model of Apps is changing from "direct purchase" to "In-App Purchasing" (Gartner, 2012). An App purchase from the App Store is called an "In-App Purchase", which provides the user with a free or paid App. Additionally, it also provides the user with a channel to buy value-added features, such as virtual items, functions and so on.

Between the plan to buy and unplanned procurement, implicit rational buying behavior and impulse buying behavior may trigger the issues of this study, which is to investigate the research question: is a mobile game app purchase an example of impulse buying behavior? In general, most software purchases are a one-time direct purchase mode, but App profit models are based on repeated purchases. For App software development vendors, how to develop a business model for creating and enhancing profitability is an important issue of operational management. However, the related field of academic research is still scarce. Therefore, questioning the impact factors of emerging

buying patterns is worthy of further investigation.

Consumers often act impulsively when making online decisions. An insight into consumer buying behavior is vital for IAP practitioners as it is important to understand the nature of such IAP buying behavior. Surprisingly, there has been little research into the influence of IAPs on impulse buying behavior. The vast majority of e-commerce research has viewed consumer decision-making as a rational process, based on cognitive problem solving and information processing. Many past studies have adopted the theory of planned behavior (TPB) to explain impulse purchase intentions (Chang, 2012). This study argues that the TPB model lacks consideration of the emotional factors, and that there are findings that indicate that impulse buying behavior is influenced by emotional factors (Rook, 1987; Weinberg and Gottwald, 1982). Therefore, this study proposes emotional theoretical perspectives to explore the impact of the intention to buy on impulse. Reviewing the literature on impulse buying, some scholars have pointed out that negative emotions positively affect the urge to buy (Silvera, Lavack, and Kropp, 2008; Verplanken, Herabadi, Perry, and Silvera, 2005), whereas other scholars find there is a negative impact (Beatty and Ferrell, 1998; Verhagen and Dolen, 2011).

As mentioned above, this study argues whether emotion theory can explain impulse buying of IAPs, and explores the role of app characters. Additionally, these two questions have never been revealed and discussed in past studies. Therefore, the purposes of this study are: (1) to explore the relationship between software characteristic factors and impulse buying intentions; and (2) to explore the impact of positive and negative emotions on the urge to buy.

2. Literature Review

2.1 Impulsive Buying

In the field of impulse buying research there are a variety of definitions for im-

pulse buying. Stern (1962) was the first person to propose the dimensions of impulse purchases. He divided impulse buying into four categories, collectively referred to as the impulse mix (including pure impulse buying), reminded impulse buying, suggestion impulse buying, and planned impulse buying. Weinberg and Gottwald (1982) explored impulse buying from three dimensions, including affective, cognitive, and reactive. The affective dimension is stimulated impulse buying behavior following a strong emotional situation for the consumer; the cognitive dimension is the consumer's lack of rational control when making an impulse buying decision; and the reactive dimension means the consumers' impulsive behavior is spontaneous as the result of specific environmental stimuli. The present study emphasizes impulse buying mainly influenced by emotional factors. These kinds of factor create a sudden desire, but also a spontaneous reaction that lacks rational control.

The urge to buy proposed by Rook (1987) in his impulse buying research, stressed the urge is sudden and immediate. The higher extent to which it is possible to impulse buy occurs when people encounter products that generate an urge to buy, without any thoughtful consideration for the reason why it is necessary to buy the product. Sometimes, the urge to buy is uncontrollable, and consumers may, therefore, feel temporarily out of control (Verhagen and Dolen, 2011). The sensation of the urge to buy is a desired state when encountering the product (Beatty and Ferrell, 1998). Wells et al. (2011) explored online environments for context impulse buying behavior. Although this improvisation or impulsive purchase intention is intense and sometimes unable to resist, consumers do not necessarily take the action to purchase every time (Rook and Fisher, 1995). In fact, consumers will use many tactics to gain control of the urge to buy (Hoch and Loewenstein, 1991).

2.2 Cognitive Emotion Theory

Some of the past literature on impulse buying discusses consumer impulse buying behavior by rational factors and emotional facets. Verhagen and Dolen (2011) explored the emotional impact of factors that lead to impulse buying behavior based on impulse buying literature, and proposed the cognitive emotion theory (CET). The cognitive emotion theory has been employed in many fields, and has provided an important explanatory power than other perspectives (Frijda, 2010).

The authors propose a research framework which is based on the literature on impulse buying and derives its theoretical structure from the CET. According to this, observing a stimulus, and the consequent formation of evaluative perceptions, causes emotions. Thus, beliefs can be assumed to precede emotions (Reisenzein, 2009). This structure has been shown to be robust in many consumer emotion studies and is empirically favored over other views. The authors further propose an emotion–action tendency link, because it is expected that emotions led to impulsive action tendencies and thus to impulse buying (Frijda, 2010). The conceptualization of impulse buying in the consumer behavior literature, the urge to buy, and overt impulse buying behavior were included as facets of the impulsive actions that are determined by emotions.

The cognitive emotion theory is based on the four emotional elements proposed by Kleinginna and Kleinginna (1981), including affective, cognitive, conative, and physiological concepts. Emotion is a combination of the four factors and can be given different weights (Wirth and Schramm, 2005).

Much of the research on emotions has pointed out in most of the time and most of the emotion need to cognitive as antecedents in fact (Elster, 1999; Nussbaum, 2001; Solomon, 2008). If a person interprets an event or object as either good or bad it will lead to different emotions (Andrew, Clore, and Allan, 1988; Smith and Lazarus, 1993).

Affection or mood has been confirmed to be strongly influenced by a variety of actions, including impulse buying behavior (Gardner and Rook, 1988; Rook, 1987; Rook and Gardner, 1993). There are many emotional views presently, but most of these are divided into two categories, positive affection and negative affection (Laros and Steenkamp, 2005). Positive affections and negative affections are two distinguished dimensions (Watson, Clark, and Tellegen, 1988), similar to positive and negative emotions (Rook and Gardner, 1993).

Positive affection reflects the degree to which a person feels warm, active, and astute, and it is also a state of high energy, concentration, and is enjoyable to participate in (Watson, Clark, and Tellegen, 1988). Rook and Gardner (1993) stated that the majority of respondents represented that the more the positive affective, the higher the probability of impulse buying. Negative affection is a psychological state of feeling depressed and unpleasant, and other bad emotions, such as anger, disgust, and guilt (Watson et al., 1988).

2.3 App Characters

Using cognitive emotion theory as a theoretical lens, the authors proposed and empirically tested a model relating to three IAP beliefs about sensory attributes, ease of use, and enjoyment related to consumer impulse buying behavior, mediated by the consumers' emotions. The selection of these three IAP beliefs was considered relevant for three reasons.

First, they have proven to be vital elements of a purchase environment image, as consumers deemed them important. Purchase environment image is assumed to stimulate impulse buying, making an investigation of its key beliefs of particular interest.

Second, these three beliefs were expected to play a crucial role in emotional and less-planned purchase situations, making an empirical examination worthwhile.

Finally, these beliefs mirror important online store features that online retailers

apply in order to serve their customers. Thus, the managerial value of this study lay in proving the importance of the beliefs in impulsive buying settings.

Reviewing the impulse buying literature, some argue that the urge to buy or impulse behavior is affected by emotions (Beatty and Ferrell, 1998; Rook, 1987; Rook and Gardner, 1993; Verhagen and Dolen, 2011; Weinberg and Gottwald, 1982). Some studies on emotion point out that most emotion has cognition as an antecedent factor (Elster, 1999; Nussbaum, 2001; Solomon, 2008).

Impulse buying researches on online shopping or online gaming proposed that there are many emotional antecedent factors that lead to impulse buying, such as attractiveness (Tao, Cheng, and Sun, 2009; Verhagen and Dolen, 2011), playfulness (Chiang, Sunny, Cheng, and Liu, 2011; Hsu and Lu, 2004; Shin, 2010; Tao et al., 2009), and perceived security (Shin, 2010; Wells, Parboteeah, and Valacich, 2011). These factors are proven to influence positive or negative emotions.

Some scholars argue that consumers usually need to obtain ample information on sensory attributes before purchasing specific products, such as color, design, pattern, fitness and so on (Bei, Chen, and Widdows, 2004; Kim and Knight, 2007; Park and Stoel, 2002; Watchravesringkan, and Shim, 2003). For instance, when women go shopping they will collect pop-

ular seasonal colors and styles before making purchasing decisions (Rowley, 2002).

Ease of use is often used in studies about technology acceptance model (TAM) or theory reasoned action (TRA). Davis (1989) defined these as when individuals believe the degree of using a particular system is easy. Because of the wide usage of TAM by many researches, ease of use is also widely adopted by many empirical studies across time, race, and technology (Agarwal and Karahanna, 2000; Chau and Hu, 2001; Hong, Thong, Wong, and Tam, 2002; Hu, Chau, Sheng, and Tam, 1999; Hans van der Heijden, 2003). Therefore, ease of use can be regarded as a stable measured variable in any research context, and it has been applied in impulse buying studies in recent years.

For the past few years, enjoyment has been regarded as a hedonic factor in many researches (Shin, 2010), and can be defined as the degree to which implemented activities are perceived as providing pleasure and fun, aside from performance results.

Finally, the study focused on the distinction between functional convenience (sensory attribution; ease of use) and representational delight beliefs (enjoyment). It has been suggested that these elements are likely to lead to impulsive buying behavior (Madhavaram and Laverie, 2004).

3. Methodology

3.1 Research Framework

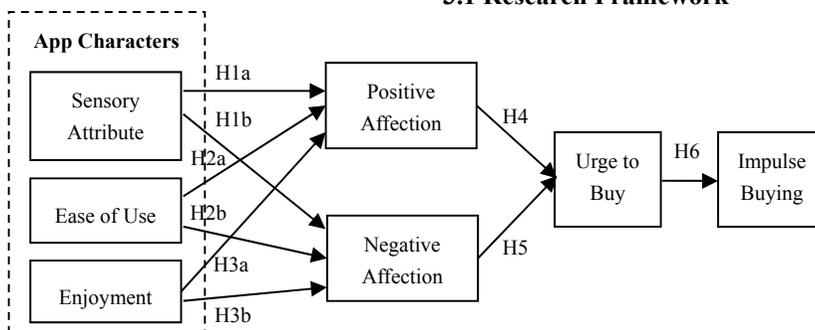


Figure 1: Research Framework

3.2 Hypothesis Development

The senses perceived by consumers from productive attraction will affect the generation of affection (Rook, 1987). The timing that consumers emerge purchasing desires when considered the product have strong attraction after collecting the relative information is the most difficult to resist (Jones, Reynolds, Weun, and Beatty, 2003; Rook, 1987). Once the desires emerge, the reference point for the consumer products will change (Hoch and Loewenstein, 1991). Kim and Knight (2007) explored impulse buying behavior on shopping websites, and pointed out that websites should provide products with aesthetic sense for customers, such as color and design attributes. The sensory attributes can affect consumers in different ways, either emotionally or affectively, producing the urge to buy. In summary, the study proposes:

H1a: The sensory attribute is positively associated with positive affection.

H1b: The sensory attribute is negatively associated with negative affection.

Éthier, Hadaya, Talbot, and Cadieux (2006) investigated the behavior of impulse buying, and found a consumer's awareness to the product included ease of use, and that positive affection and negative affection have positive and negative effects. Verhagen and Dolen (2011) showed that ease of use affects positive and negative affections. This study speculated that ease of use will thereby affect the urge to buy when playing mobile game apps. For example, during a game, an App may show a notification to users "if you want to go to the next level, please buy it!" when the game is in full swing and users may then have the urge to buy. The opportunity for impulsive buying may be higher if the purchase steps are also very easy and just need a few clicks. Therefore, this study hypothesizes:

H2a: Ease of use is positively associated with positive affection.

H2b: Ease of use is negatively associated with negative affection.

In many studies, enjoyment is regarded as a hedonic factor (Shin, 2010). In the past literature in the field of online games, some argue that enjoyment is the most important driving factor for users to continue playing online games (Childers, Carr, Peck, and Carson, 2002; Dabholkar and Bagozzi, 2002). Some findings on impulse buying behavior research have mentioned that consumers consider the higher enjoyment of the product will enhance the generation of positive affection and increase the urge to buy (Dholakia, 2000; Rook and Fisher, 1995; Shiv and Fedorikhin, 1999). Some findings showed that enjoyment positively influences positive affection and has a negative impact on negative affection (Parboteeah et al., 2009; Verhagen and Dolen, 2011). Hence, the present study proposed:

H3a: Enjoyment is positively associated with positive affection.

H3b: Enjoyment is negatively associated with negative affection.

Consumers who take part in impulse buying are affected by affective factors (Rook, 1987; Weinberg and Gottwald, 1982). Individuals who produce the urge to buy usually lack rational control, but are affected by affective factors (Weinberg and Gottwald, 1982). Nevertheless, the urge to buy doesn't preclude the process of information, so in this process, affection plays a key role (Laros and Steenkamp, 2005). Verhagen and Dolen (2011) investigated the emotional factors that lead to the urge to buy using cognitive emotion theory. The results showed that a consumer's positive and negative affections have a significant impact on the urge to buy.

Rook and Gardner (1993) pointed out that most respondents said the probability of producing the urge to buy increased with positive affection. It means that positive emotions may stimulate people to get instant gratification through the purchase of a

product and satisfy the desire to buy (Verhagen and Dolen, 2011). Individuals will be more likely to produce the desires of shopping and use impulse buying in order to attain a better mood than in normal time if consumers have negative emotions (Piron, 1991). However, some scholars find that negative affection will negatively affect the urge to buy (Verhagen and Dolen, 2011). Therefore, the study hypothesized:

H4: Positive affection is positively associated with the urge to buy.

H5: Negative affection is negatively associated with the urge to buy.

Several marketing academics have investigated impulse buying and whether purchase intention is formed before the resulting purchasing behavior. Kollat and Willett (1967) considered “whether purchase intention is formed before buying the product” and “actual purchase behavior”, as the basis of consumer behavior, can be divided into five consumption types. One kind of consumption type is when “consumers don’t generate demand for the product until seeing the product and suffer stimulation”, and it can be regarded as pure, impulsive buying. Some scholars have defined an impulse purchase as the result of a purchase that doesn’t form a purchase intention first, but results in a strong desire suddenly and immediately (Beatty and Ferrell, 1998; Parboteeah et al., 2009). With an increase in the urge to buy, the possibility of impulsive buying behavior will increase (Beatty and Ferrell, 1998). The study proposes:

H6: The urge to buy is positively associated with impulse buying.

3.3 Instrument Development

Rook (1987) proposed the urge to buy in impulse buying research, and emphasized that the urge is a sudden and immediate purchasing desire. In this study, the urge to buy is defined as “a psychological state whereby the individual generates a strong purchasing intention urgently, sud-

denly, and immediately”. The operational definition of the urge to buy refers impulse buying studies developed by many scholars. Adjustments and modifications have been made, based on the context of this study, to suit the three purposes proposed (Verhagen and Dolen, 2011; Wells et al., 2011; Wittmann and Paulus, 2008). Respondents were required to answer based on their recent purchasing experience if they have bought an “In-app purchase” item.

Sensory attributes, ease of use, and enjoyment are summed up through the past literatures regarding the field of online shopping and online gaming. The three dimensions are the emotional antecedents of the urge to buy. Additionally, Madhavam and Laverie (2004) considered that “impulse buying” isn’t limited to any particular type of product or environment, so the items of the three dimensions were developed and modified based on past researches to appropriately measure the context of this study.

Sensory attributes include three items which are modified from the scales developed by Hans van der Heijden (2003), Peck and Childers (2003), Tao et al. (2009), and Heijden (2003). In this study, sensory is defined as when “consumers perceived the multimedia effects in the mobile game apps”.

Ease of use is developed by the TAM, and Davis (1989) defined it as an individual’s belief in the degree of easiness when using a particular system. In this study, the definition of ease of use is “the degree of ease to use a mobile game app for consumers”. Operation of the dimension is also integrated and the modified sales developed from past literatures about impulse buying or online game behavior, a total of three items (Éthier et al., 2006; Hsu and Lu, 2004; Verhagen and Dolen, 2011).

Enjoyment is a hedonic factor (Shin, 2010) and can be defined as the degree to which implemented activities are perceived as providing pleasure and fun, aside from performance results. The definition for the present study is “the pleasure obtained in

the gaming process for consumers". The three items of enjoyment are modified from Shin's study (2010), which investigated users' behavior in massively multiplayer online role-playing game (MMORPG), and Heijden (2003) who explored user behavior when using information systems. In addition, the study also makes reference to several researches that proposed enjoyment as an antecedent of behavior (Nysveen, Pedersen, Thorbjørnsen, and Berthon 2005; Koufaris, 2002; Wu and Liu, 2007) and which were revised in accordance with "in-app purchases" of the research context.

In the present study, the definition of positive affection is "a positive mental state whereby consumers feel positive emotions and have the enthusiasm to participate"; negative affection is "a negative mental state whereby consumers feel negative emotions, such as dispirited, disgust, depression and others". The scales for impulse buying behavior that developed online shopping or other online environments (Éthier et al., 2006; Silvera et al., 2008; Verhagen and Dolen, 2011; Watson et al., 1988) are the basis for modification of the two dimensions, a total of seven items.

An online survey was used to collect empirical data. Survey information was published on PTT BBS, the largest online bulletin board system in Taiwan. The authors posted invitations on mobile phone related forums of PPT. The invitation included a link to our web-based survey, which elicited data for In-App Purchase and user demographics.

4. Results

4.1 Sample Profile

The study authors developed a questionnaire and conducted a survey to collect data. A total of 267 responses were received, of which 20 were dropped due to incomplete data or no experience of purchasing an IAP. The valid respondents were 247. Most of the respondents were university students, including 157 males and 90 females. The main age group was between

16 and 20 years old (42.5%). Most of the respondents were college (61.5%) and graduate (55.5%) students. Most of the respondents stated that they spend 4-6 hours (33.2%) playing mobile game apps every week.

Partial least squares (PLS) is a theory-based approach to conceptualization that has been designed to integrate both theory and data, and hence, provide a better platform than traditional multivariate techniques from which to construct and verify theory. Given the prediction-oriented nature of this study and the complexity of the model, PLS was the preferred technique for testing the structural model. Instrument reliability and validity were assessed using confirmatory factor analysis (CFA). CFA was performed in this study using the smart PLS and the results are shown in Table 1. All of the item loadings were greater than 0.7, and all Cronbach's α , composite reliability (CR), and average variance extracted (AVE) exceeded the criterion values of 0.7, 0.7, and 0.5, respectively (Bagozzi and Yi, 1988; Gefen, Straub, and Boudreau, 2000; Nunnally, 1978). The correlation matrix in Table 1 indicates that the square root of AVE (listed within parentheses alongside the principal diagonal) of each construct was higher than the corresponding correlation values, thereby assuring discriminant validity. Table 1 shows the instrument had an acceptable reliability and validity.

Table 1: Instrument reliability and validity.

Variables	SA	EOUEJ	PA	NA	UTB	IB
SA	.823					
EOU	.443	.857				
EJ	.641	.459	.890			
PA	.465	.332	.587	.834		
NA	-.339	-.341	-.438	-.227	.889	
UTB	.407	.340	.410	.374	-.326	.855
IB	.160	.247	.219	.328	-.104	.502
Cronbach's α	.759	.820	.868	.854	.867	.815
CR	.862	.892	.919	.901	.919	.891
AVE	.677	.734	.792	.695	.790	.731
R ²			.360	.218	.201	.252

Note:

SA: sensory attribute, EOU: ease of use, EJ: enjoyment, PA: positive affection, NA: negative

affection, UTB: urge to buy, IB: impulsive buying.

Numbers on the diagonal (in boldface) are the square of the average variance extracted.

4.2 Hypothesis Tests

The results of the PLS analysis of the research model are presented in Figure 2. It shows the results of the structural model with moderator variables. Sensory attribute had a positive influence on positive affection ($\beta=.137$, $t=2.666$), and had a non-significant influence on negative affection ($\beta=-.056$, $t=-.832$). Ease of use was non-significant for positive affection ($\beta=.054$, $t=.973$), and had a negative influence on negative affection ($\beta=-.166$, $t=-2.737$). The influences of enjoyment on positive affection ($\beta=.475$, $t=8.801$) and

negative affection ($\beta=-.326$, $t=-4.402$) were significant, respectively. Positive affection exhibited a positive effect with the urge to buy ($\beta=.317$, $t=6.991$). In contrast, negative affection was exhibited as a negative effect with the urge to buy ($\beta=-.254$, $t=-5.427$). Finally, impulse buying was successfully predicted by the urge to buy ($\beta=.502$, $t=10.547$). In this model, the total variance explained was 25.2% for impulse buying, 20.1% for the urge to buy, 36% for positive affection, and 21.8% for negative affection.

The findings supported all the hypotheses except H1b and H2a. The results of the present study demonstrated that the proposed model might be appropriate for explaining the consumption behavior of IAP.

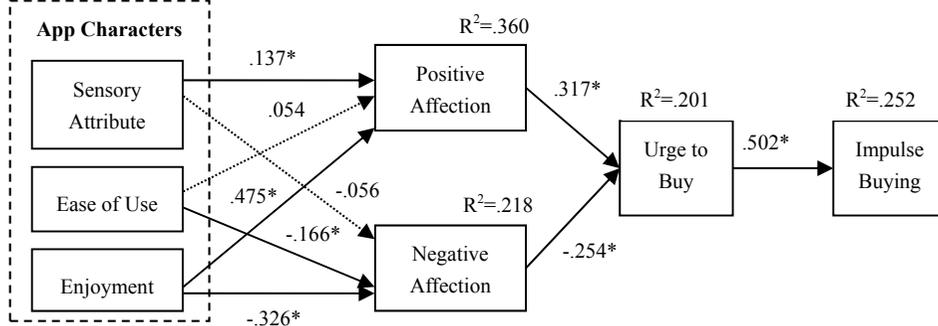


Figure 2: Result of Data Analysis

5. Discussion

Most the impulse buying studies are based on physical stores or online shopping websites. Consequently, it's rare in the emerging mobile device applications. Moreover, the game app market has developed a new profit model, in-app purchase, and this has become the main source of profit. However, literature for the impulse buying field that has investigated "in-app purchase" is scant. Therefore, this study has attempted to fill this research gap.

This study provided three important results: (1) a conceptual understanding of the impulse buying process on IAP; (2) the role of user emotions between app beliefs and impulse buying, thus confirming the applicability of CET in impulse buying

situations; and (3) how app beliefs may function as cognitive determinants of online impulse buying.

5.1 Theoretical Implication

Most of the studies exploring impulse buying intention or behavior are based on the TPB (Chang, 2012). This study argues that the TPB lacks consideration of emotional factors. Some researchers have shown that impulse buying consumers will be affected by emotional factors (Rook, 1987; Weinberg and Gottwald, 1982). Hence, the authors proposed a CET framework to interpret impulse buying relating to the IAPs of the game apps.

The findings from the past literature are not consistent in the relationship between negative affections and the urge to

buy, and some have pointed out that it's positively affected (Silvera, Lavack, and Kropp, 2008; Verplanken, Herabadi, Perry, and Silvera, 2005), others demonstrated that it's negatively affected (Verhagen and Dolen, 2011). This study proposed that negative affections have a negative effect on the urge to buy. The effect of negative affection negatively affecting the urge to buy was significant, and the result was consistent with the previous researches (Beatty and Ferrell, 1998; Verhagen, and Dolen, 2011).

The impact of sensory attributes on positive affection was supported. The result matches the findings of past studies (Kim and Knight, 2007). The result indicates that sensory attributes play an important role in the antecedents of positive affection. However, the influence of sensory attribute on negative affection is not supported. It might be that the influence of sensory attributes on negative affection is not strong enough. The authors also suggest that future researchers elaborate this issue deeply.

The relationship between ease of use and positive affections was not consistent with the past research (Verhagen and Dolen, 2011). Ease of use in Verhagen and Dolen's findings are not supported for both positive and negative affections, but are significant on the negative affection in this study. The reason might be that users think that being easy to use is one of the essences of the mobile game app market. Users might not feel more pleasure when playing game apps that have the feature of ease of use, and might feel more aversion to mobile game apps that are hard to use.

Finally, this study proposes an impulse buying model to explain IAP purchasing behavior, and demonstrates that emotional factors play an important role in impulse buying behavior. It is also argued that cognitive emotion theory can explain impulse buying intention, in addition to the theory of planned behavior.

5.2 Empirical Implication

In the study, it is suggested that game app designers should pay more attention to

providing a user interface, and that the rules of the game are that users don't spend a lot of effort and time to understand how to use the game, how many functions, and how to obtain enjoyment. It is also suggested that businesses must provide good multimedia experiences for consumers, such as color, content design, page layout, sound and light effects, etc. These factors will affect users' in-app purchase decisions. Businesses should consider how to design game apps with enjoyment, fun, and playfulness, and these may raise the user's positive emotion, which then results in impulse buying behavior.

From a managerial perspective, this study has several implications. First, it can be seen that sensory attributes, ease of use and enjoyment were important to impulsive buying settings. In order to stimulate impulsive buying, app developers should create a friendly, knowledgeable, fun app, providing pleasure when a user plays an app game. Second, this study provides the first indication that game apps should focus on stimulating positive affections rather than reducing negative affections. By making the playing experience exciting, enthusiastic and inspiring, positive emotions are triggered with possible impulsive buying as a consequence.

Moreover, the findings of this study might help enterprises to understand the purchasing behavior of In-App Purchases in depth, and enable them to develop an appropriate marketing strategy to increase profits.

5.3 Limitations

This study has some limitations that should be considered for future research. First, it was carried out within a specific domain of the IAP of game apps, so it is uncertain whether the generalized theoretical findings can be used broadly or for other types of apps. Second, typical limitations are associated with the research design because of the cross-sectional nature of the study. Finally, the authors suggest a mixed methodology for future research to explore the powerful variables that might help ex-

plain and improve the prediction power of the model.

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Appendix A. Measurement scales

Sensory attribute

1. Overall, I find that the game app looks attractive.
2. The visual effects of the game app are attractive.

3. The audio effects that are used on the game app are attractive.

Ease of use

1. It is easy for me to become skillful when playing this game app.
2. Learning to play this game app is easy for me.
3. This game app is easy to play.

Enjoyment

1. Using this game app provided me with a lot of enjoyment.
2. I am happy when I use this game app.
3. I enjoyed using this game app because it is exciting.

Positive affection

1. While playing this game app I was excited.
2. While playing this game app I was enthusiastic.
3. While playing this game app I was proud. <Reverse>
4. While playing this game app I was inspired.

Negative affection

1. While playing this game app I was distressed.
2. While playing this game app I was upset.
3. While playing this game app I was irritable.

Urge to Buy Impulsively

1. On playing this game app, I experienced a number of sudden urges to buy things.
2. On playing this game app, I saw a number of things I wanted to buy even though they were not on my purchase list.

3. On playing this game app, I experienced no strong urges to make unplanned purchases on this trip. <reverse>
4. On playing this game app, I felt a sudden urge to buy something.

Impulse Buying

1. My IAP purchase was spontaneous.
2. My IAP purchase was unplanned.
3. I did not intend to do this IAP purchase before play this game app.
4. Before play this game app, I did not have the intention to do this IAP purchase.

I could not resist this IAP purchase at the site. <Reverse>

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