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## Managing for volatility on technology projects: A conceptual model

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### Abstract

The purpose of this paper is to create an information technology industry management view and formulation of new theory via exploratory research to understand the impact of volatility and suitable resilience response of project portfolio management in a technology environment. The research includes a quantitative and qualitative study on a significant research sample of information technology professionals in information technology. This approach created the base for the hypotheses testing and formulation of new theory comprising the conceptual model. Some survey test results to initially confirm some aspects of the model are discussed. Future research may include risk reducing management practices that are prevalent in executing information technology projects as well as being able to withstand via resiliency management, factors influencing the project management approach such as exogenous volatility.

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### 1. Introduction

During late 2007 to 2010 deteriorating economic conditions had a major global financial impact on trade and industry including the information technology industry. The information technology industry in 2013 is still experiencing a cautious investment from business due to continued uncertainty in economic conditions (Business Monitor International, 2011). This lack of investment *may have* an impact on new projects being initiated and product development slowing down including:

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- Reduced expenditure in the Information Technology industry (Business Monitor International, 2011).
- Higher inflation during 2009–2010 and interest rates slowing down as a result of weaker global growth which resulted in a decline in demand for South Africa's exports from foreign nations (Donehoe, 2009).
- Reduced availability of credit due to inability or unwillingness of financial institutions to provide funding for projects/new product development (NPD) and illiquidity in short term funding (Kana, 2009).
- The reduced ability of debtors to pay accounts at due dates and creditors pushing for quicker payment; this impacts organizational cash flow of information technology (IT) companies as well (Kana, 2009).

As there are periods of downturn so there are periods of sustained growth such as South Africa has experienced with yearly GDP growth in 2005 to 2007 reaching above 5% growth per year. This is indicative of a good performance in trade, high foreign direct investment, high consumption (its citizens are able to spend and acquire goods) and high government spending on technological advancement, labour development and infrastructure. The demand for IT products and services may potentially stimulate innovation.

In reviewing the ability of businesses to sustain and grow operations, thereby creating value for shareholders, factors like economic and trade conditions can influence the way businesses make decisions on IT expenditure (Gibson, 2008). Many businesses have however learned to work with factors requiring organisational change, adapt strategy and adapt their operational execution of business. They have learned a sense of **resiliency** to be able to operate amidst these changes and retain focus towards longer term business and technology strategy goals.

It is suggested that these factors lead to problems in project portfolio management and product development in the following context:

- IT clients in the formal corporate sector are also in the same business environment as IT companies and they experience the same shocks as a result of volatility. They change their short and long term business strategies as well as requirements for IT systems, products and services.
- The IT business adapts its business strategy to process the changing economic and trade conditions. Although businesses attempt to understand their industry and technology products they can potentially not have sufficient detection mechanisms for volatile conditions and respond too late with too little!
- When business strategy changes, it impacts the project and product portfolio selection. Changes in the output of new technology product conceptualisation, design, development, production and delivery processes will be required in response to changes in project/product portfolio selection. The changed project/product portfolio must be done whilst business operations are being executed. Thus businesses need to change strategy and still get current technology products delivered to clients. The transitional change state requires detail planning for internal process changes and remains risky.
- In high technology product/project environments products may already be ordered before they exist. The information technology business orders will be impacted by changing economic conditions and this means the business needs to adapt their resource allocation and utilisation. Balancing the product/project order book with the limited organisational resources is a constant risk and challenge for businesses.

This research needs to review mechanisms businesses use to balance the order book and technology project/product delivery schedule in light of increasing changes in economic conditions.

## 2. Literature review

The classic work of Knight (1921/1964) proposed theory defining *uncertainty* as a situation where several possible outcomes are associated with an event, but the assignment of probabilities to the outcomes are not possible. *Risk* in contrast permits the assignment of probabilities to the different outcomes. Aizeman & Pinto (2005) formulated theory that economic volatility is more than being the study of business cycles and the composition of economic growth in cyclical and trend components. Aizeman & Pinto (2005) postulated that *volatility* is allied to risk in that it provides a measure of the variation or movement of a particular variable for example economic variables or some function of the variable. Aizeman & Pinto (2005) formulated the model framework in Figure 2 to build theory for explaining the effect of different types of shocks and impact of volatility:



“Pattern-based strategy” is the discipline to enable business leaders to actively seek, amplify, examine and exploit new or novel business patterns. To support pattern-based strategy, organizations must begin to understand in which activities they are investing, and how these investments need to be changed or adjusted to enable them to exploit new patterns within their own businesses. They must also be able to understand new patterns of signals coming from external sources that indicate a business opportunity or threat. Chief executive officers and strategy officers need to expand their investment analysis beyond the two investment categories (defined and creative) (Burton, Austin & Genovese, 2009).

Both theories of Resiliency Management and Pattern based management suggest that an organization requires mechanisms to be aware of the upcoming market events and take corrective action in advance to the net effects of such market trends. These corrective actions could include optimisation of product development and delivery of new products to clients as a result of focused project portfolio management.

From a technology management perspective the selection of a project/product portfolio supporting the strategic direction with resulting research and product development builds long term competencies in the business. The project product portfolio management decisions may be impacted by the resulting effects of the sources volatility. Consideration must be given to the goals of project and product portfolio management. Cooper & Edgett (2001) indicates five goals of project and product portfolio management:

- Maximise the value of the portfolio via selecting new product projects so as to maximise sum of the values or commercial worth of all active projects supporting a business objective.
- Seek balance in the portfolio in parameters of short vs. long term projects, high vs. low risk, markets, technologies, product categories, project types.
- The portfolio must be strategically aligned and spending across projects areas, markets etc. must mirror strategic objectives.
- Pick the right number of projects with limited resources available.
- Ensure the revenue (or profit) goals set out in the product innovation strategy are achievable given the projects currently underway.

From the goals listed, it can be concluded that businesses have limited resources for product development and need to align organisational resources including product and portfolio optimally to ensure maximum business value. This goal must still be achieved while trade conditions continuously change as a result of volatility.

Whether volatility impacts the pressure for reduced time and cost in product development is unclear (needs to be tested via hypothesis) but the market still requires a product at acceptable quality. The business builds development capability as a result of new product development and this may improve business performance.

Critical factors were investigated in this research that drive product innovation and development at business unit level (Cooper & Kleinschmidt, 2007). The 9 factors which distinguished better performing business are as follows:

- A high quality new product process.
- A defined new product strategy for the business unit.
- Adequate resources of people and money.
- Research and development spending for new product development.
- High quality new product project teams.
- Senior management committed to and involved in new products.
- An innovative climate and culture.
- The use of cross functional project teams.
- Senior management accountability for new product results.

Le (2004) concluded that typically 3 factors affect the quality of the new product performance and highlights the impact of the project portfolio management on the new product performance as a result of successful product development as can be seen in Fig. 2:

The corner stones of new product performance according to Le (2004) include:

- The *project screen process* refers to the discipline of ensuring projects are executed in accordance with expected quality requirements.

- The *portfolio management process* ensures the business prioritizes projects in such a way as to ensure that new product development resources capability is not exceeded. Over utilisation of new product development resources capability can lead to the fire fighting syndrome according to Nelson, Conclaves, & Black (cited in Le (2004)).
- The *new product strategy* ensures that the long term developments receive strategic direction and align with the business's objectives.

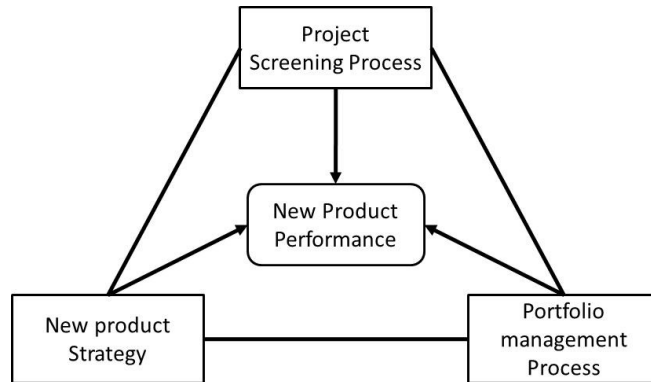


Fig. 2. Corner stones of new product performance

The impact of volatility on the corner stones of new product performance needs to be investigated. This must be linked to the research done by Cooper & Edgett (2006). Cooper & Edgett (2006) have published extensive theory and best practice on the *project screen process*, *portfolio management* and *new product strategy*. The best practices derived from their research identified several aspects which can aid in improving the project portfolio management process and resulting new product development. These include:

- *Focussing on data integrity*: The best project selection is worthless unless data used for project selection are sound.
- Install a *systematic idea-to-launch process* to identify key tasks should be undertaken at every stage of the project and what information is really needed at each selection gate.
- Adopt an *incremental commitment* or options based approach. Limit risk by taking small investment steps before committing fully for the project execution.
- *Know when to walk away*. The correct kill can also be a success since money is saved and trouble is limited.
- *Categorise your developments projects into buckets* to identify differences such as
  - New products.
  - Platform and technology developments.
  - Improvements, modifications and extensions.
  - Customer requests.
- Utilise *multiple selection methods* in combination to hone in on the correct project selection decision.
- Utilise *score cards to rate and rank projects*: The development funnel is a method proposed by Wheelwright and Clark (1992), to select between different product development proposals. Proposed products are reviewed to see which fit the business strategy best. Products of lesser fit are eliminated earlier in the product selection process. Successful product development results in products that can be produced and sold profitably.
- Utilise *success criteria at every stage* in the project selection process to evaluate if projects meet agreed criteria for success and agreed expectations.
- Utilise the *right financial approach to select projects* including, net present value (NPV), sales-to-cost ratio, and probability adjusted NPV and productivity index.
- Build *periodic portfolio reviews* to rank projects ensuring that business has
  - The correct set of projects in execution.

- The right mix of projects.
- The right balance of projects.
- The right priorities of projects and
- Sufficient resources to undertake approved projects.

When reviewing the factors impacting the right project selection as listed by Cooper & Edgett (2006), the impact of volatility on these factors must be investigated further as *there is a theoretical gap*. The impact of volatile conditions on data integrity used for decision making, the killing of project and new product development decisions, types of product categories, financial analysis for break even and profit in limited time, the correct set of projects/products, the mix of projects vs. products and sufficient resources must be investigated. Some of these issues are addressed in the ensuing sections, of this paper the first being the research methodology focussed on exploratory and theory building research. The question is: How do IT related organisations become resilient in detecting, processing and working with volatility?

### 3. Research Methodology

#### 3.1. Research method

The research method comprised the following logic:

*Research Design:* The planned research has scientific value as well as practical value for business.

*Linkage to Theory:* The study combines both exploratory research and theory building research to derive new theories models and methods.

*Type of study:* Elements of hypothesis generating and exploratory research types are present in the research.

*Data acquisition techniques used:* Data was primarily collected from survey questionnaires with structured and unstructured commentary feedback from respondents.

*Data analysis techniques used:* Data classification and analysis techniques:

- Ordinal/Nominal and Likert scale data.
- Graphical data analysis (Univariate Analysis)
- Measures of centre and spread
- Bivariate analysis, association tests and research Hypothesis testing
- Tests for significance : Chi-squared tests

#### 3.2. The research problem

A total of 4 research sub problems were identified and translated to research questions whilst addressing the mechanisms businesses use to balance the order book and technology project/product delivery schedule in light of increasing changes in economic conditions. The problems identified translate into a logical flow of a conceptual model as depicted in Fig. 3.

The identified sub problems indicated in Figure 3 are:

- The market demanding new technology and subsequent client responses to volatility require *clients to change their adoption/procurement of technology during negative periods*.
- The IT business adapts its business strategy to adopt for the changing economic and trade conditions. Although businesses attempt to understand their industry and technology products they can potentially not have sufficient *detection mechanisms* for volatile conditions and respond too late with too little!
- When business strategy changes it impacts the project and product portfolio selection. Changes in the output of new product conceptualisation, design, development, production and delivery processes will be required in response to changes in project/product portfolio selection. The changed project/product portfolio must be done whilst business operations are being executed. Thus businesses *need to change and still get current products to clients*. The transitional change state requires detail planning for internal process changes and remains risky.
- In high technology product/project environments products may already be ordered before they exist. The IT business orders will be impacted by changing economic conditions and this means the business needs to

adapt their resource allocation and utilisation. *Balancing the product/project order book with the limited organisational resources is a constant risk for businesses.*

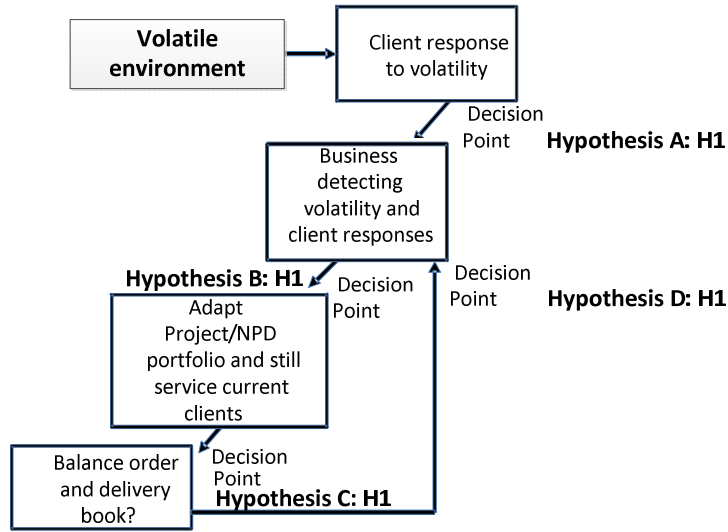


Fig. 3. Interaction conceptual model of research problems

### 3.3. The research questions and hypotheses

The research problem depicted in the conceptual model of Fig. 3 was translated to research questions and with a research hypothesis being formulated for each question in Table I. The relationships between the research hypothesis and research question are depicted in Table I:

Table 1: Relationship between research questions and hypotheses

HYPOTHESIS NUMBER	RESEARCH QUESTION	RESEARCH HYPOTHESIS
A	How do IT clients respond during periods of trade volatility with the adoption/procurement of new technology?	H1: There is a <i>negative association</i> between new technology adoption/procurement and periods of exogenous volatility in the business environment.
B	What impact does the resulting client response have as a result of volatility shock on IT business project portfolio and new product development?	H1: The 3 elements of a clear understanding of customer requirements, customer operational impact as a result of volatility as well as one on one customer interaction activities has a <i>positive association</i> on IT business IT projects and supporting product development growth.
C	How do businesses adapt their IT project with resulting product portfolio selection and still maintain product delivery to clients during volatile conditions?	H1: New high technology product development selection is <i>more dependent</i> on correct project portfolio selection during periods of volatility.
D	How do IT businesses balance the order and delivery books during periods of volatility?	H1: IT businesses balance their order intake with ability to deliver <i>more focused</i> work during periods of volatility than in stable periods of trade.

## 4. Results and discussion

### 4.1. *The research population and sample*

The research population included both consumers and creators of IT products/systems but having several years of experience in the IT industry. From a consumer focus perspective the research population needs to interact with IT product, project and services providers to create product demand for the IT industry. A smaller group of seven respondents was requested to complete the first release of the research questionnaire developed. This proved helpful to make the questions understandable for the target audience, ensure the research variables as used in the hypothesis support the research questions adequately, create a first level data analysis review to see if the answers make “sense” as well as addressing security concerns for personal data of respondents.

A questionnaire of 13 structured questions (5 options each) with 13 commentary unstructured fields was compiled and after review published in several stages using Survey. *The questions addressed the dependent, independent variables as well as the hypothesis itself as a whole.* During the period February 2013 until end of June 2013 a total of 1165 knowledgeable IT professionals were approached either by direct email or via “LinkedIn” commercial service to participate in the research. The structured as well as commentary (unstructured) fields provided sufficient room for feedback as required by the respondents. The responses received were also analysed using the Altas.ti® qualitative data analysis tool to obtain a view on the industry representation of the respondents.

Since the questionnaire was supplied to suppliers / producers and consumers of IT a diverse supplier industry representation was expected with potentially more suppliers of IT projects / products. A total of 115 respondent answer sheets eventually qualified with an almost even split between IT supplier and IT client/consumers. The balance provided for a reasonable representative view on the questionnaire answers between IT supplier industry (57/115) and consumer industries (58/115). The executive who makes up 55 of the 115 respondents formulates the project and product portfolio decisions in response to the business environment.

Ensuring that the respondent selection and resulting questionnaire responses can be applied in the industry in general if it was to be retested, was a key focus of the study to ensure integrity in the results obtained. The research must be repeatable and leading to a similar unbiased process result list if executed again.

### 4.2. *The quantitative results*

The quantitative results pertaining to volatility issues in IT related businesses following the conceptual model in Figure 3 were mainly obtained using Chi-squared tests for significance:

#### *Hypothesis A:*

IT clients experience volatility as a result of interest rates, commodity process skills shortage in their business environment which impacts their business in the longer term on a *high impact* level. IT clients adopt/procure *somewhat less* IT projects/products during negative conducive volatile periods. IT clients adopt/procure *somewhat more* IT projects/products during positive conducive volatile periods.

The association analysis between independent and dependent variable indicated a negative association between the variables during negative volatility.

In the case of negative volatility, the Null hypothesis H0 is rejected and research hypothesis H1 *is significant* (Chi-square sum = 24.78696462, df = 9, p<0.05).

The association analysis between independent and dependent variable indicated a positive association between the variables during negative volatility.

In the case of positive volatility, the Null hypothesis H0 is rejected and research hypothesis H1 *is not significant* (Chi-square sum = 11.64207431, df = 12, p>0.05).

#### *Hypothesis B:*

Having a clearer understanding of IT client requirements has a *high impact* on assisting in growing the project



portfolio and supporting product development. Having a clearer understanding of the impact volatility has on client operations have a *high impact* on assisting in growing the project portfolio and supporting product development. Having one on one interaction with clients has a *high impact* on growing the IT project and supporting product development during periods of volatility. IT client response during volatility has a *high impact* on IT project and supporting product development. The respondents indicated *strong agreement* as to the positive impact of the independent variables (customer requirements, understanding customer operational impact as result of volatility as well as one on one customer interaction activities) on the dependent variable (IT business IT projects and supporting product development growth).

The association analysis between independent and dependent variable indicated a positive association between the variables. The Null Hypothesis H0 is rejected and the research Hypothesis H1 *is significant*. There are three independent each having being tested with the dependent variable:

(Chi-square sum = 37.54347188, df = 12, p<0.05)

(Chi-square sum = 42.60763069, df = 12, p<0.05)

(Chi-square sum = 21.44486032, df = 9, p<0.05).

#### *Hypothesis C:*

The selection of sellable products to be developed by IT business is of *higher importance* during volatile periods. The selection of projects for the IT business as offered by clients to execute is of *higher importance* during volatile periods than non-volatile periods. IT businesses *have mature processes* in place for planning what organisational capacity (people, infrastructure, financial resources) is required to execute projects. The formulation of the right product portfolio in support of potential projects to clients *is more critical* during periods of volatility than in periods of less volatility.

The association analysis between independent and dependent variable indicated a strong positive association between the variables.

The Null Hypothesis H0 is rejected and the research Hypothesis H1 *is significant*

(Chi-square sum = 36.98701919, df = 16, p<0.05).

#### *Hypothesis D:*

There is *high to very high importance* for IT businesses to increase focus on their order book as a result of volatility. There is *medium to high importance* for IT business to increase focus on delivery of projects successfully as a result of volatility. IT businesses balance their order intake with ability to deliver focused work during periods of volatility *more* than in stable periods of trade.

The association analysis between independent and dependent variable indicated a positive association between the variables.

The Null Hypothesis H0 is rejected and the research Hypothesis H1 *is significant*.

(Chi-square sum = 51.20687157, df = 16, p<0.05).

### 4.3. *The qualitative results*

The qualitative data analysis provided realistic feedback on why questions were rated with answers the way they were. The descriptive level information provides direct support for the quantitative answer and also new ideas on how the function should operate vs. currently operating. Key words and concepts were identified, counted and grouped into families. These were analysed using semantic and topology networks to understand a causal base for the relationship and association between dependent and independent variables in the quantitative data questions.

#### *Hypothesis A:*

In the case of negative volatility clients procure somewhat less IT as volatility increases. According to the qualitative data new market required technologies require IT clients to adopt /procure new technology to remain

efficient in the delivery of their products and services. Budgets are reduced and clients later play catch-up during improved economic conditions. Value for IT investment (money) becomes more critical. During positive volatility clients do tend to adopt slightly more IT technology. The relationship is not of negative association however as more positive volatility does not restrict funding and IT investments improve leading to more procurement of IT. IT clients are more inclined to take risk during positive volatile periods leading to high amounts of procurement of IT projects/products. From a business management perspective, investment in IT projects/products must still be value based and satisfy the requirements of the business case in question.

#### *Hypothesis B:*

According to the quantitative analysis IT client response during volatility has a high impact on IT project and supporting product development. The qualitative data indicated that clients focus on optimizing their business processes and this leads to interfacing with potential IT suppliers of projects and products. As clients are impacted by the volatility shocks they are looking for avenues to reduce IT maintenance/overhead costs and create the IT product that can ensure growth. A customer centric IT business will attempt to understand the impact of the volatility on the customer and create products to assist the customer via project deliveries.

#### *Hypothesis C:*

According quantitative data, the selection of sellable products to be developed by IT business is of higher importance during volatile periods. The dominant aspect listed by the respondents in the qualitative data analysis is that IT business must have a diversified product portfolio with lower unit cost, mature and sellable products also available to be sold off the shelf to customers. Not all products must be “in progress, but not yet available” development status. Many changes to products as a result of project change due to volatile conditions inhibit the ability to create a diversified product portfolio.

#### *Hypothesis D:*

According to quantitative data analysis, IT businesses balance their order intake with ability to deliver focused work during periods of volatility more than in stable periods of trade. According to the qualitative data South African IT related Companies have an attitude of taking up all possible orders, and then quickly adapt capacity (resources, personnel and infrastructure) to fulfil execution to balance the order book or lose some projects later as a result of client cut backs. The attitude of first get the business then worry about execution or volatility is acceptable! Since there are often budget constraints during volatile periods, more standardized less expensive projects are realized which use standardized products. Many companies non sales management, realize that an order for a project does require the ability to deliver on the order quicker during volatile periods. In this area there is risk as the visibility of order intake vs. fulfilment lacks in project personnel teams. Capacity planning during volatile periods has to be clear on the impact of volatility on order book as well as the delivery book (project/product deliveries) to ensure the full value chain can be stabilized. This is done more successfully in large business.

## **5. Conclusion**

The IT related business's ability to anticipate and respond to changes induced by volatility that can impede it to generate earnings, will define the level of robustness and resiliency of the business. As indicated in the findings of the study the IT related business needs to be aware of the market it operates in, know its products, how these products can be deployed in projects, know its clients, competition and how it will secure business. When volatile conditions arise the business must be able to have sufficient skill, resources and willingness to change to work with the volatility. The business must adjust its business and technology strategy to be able to capitalise on opportunities, realise and implement trends as well as consume threats to retain focus on its core goals and vision. In summary initial research results presented in this paper indicated mostly acceptance for the hypotheses generating the conceptual model pertaining to IT related organisations becoming more resilient in detecting, processing and working with volatility

From a practical view point, the business and technology management in the business need to be open minded to:

- Be witness to changes, willing to adjust strategy and realise that change is part of normal business.
- Be constantly aware of competition that is also reviewing, responding and interfering in the market place with existing and new customers.
- Have a short and longer term focus with the future viewed as an opportunity and provide channels of communication with employees who can provide worthwhile input into the future business strategy of the company.
- The business strategy focus towards realising sales orders from customers is the starting point of business. Ensure that sufficient resources are focussed on collaboratively realising orders. During volatile periods having sufficient sales orders ensures sufficient resources to continue project and product portfolio development.
- Be practical and realistic in executing these orders with sufficient resources (people, time, funding and infrastructure) to ensure quickest possible delivery to customers during volatile periods. Prioritise focus on specific deliveries on a weekly basis and address customer unique requirements without losing project and product portfolio focus.

Managing the effect of volatility effectively and efficiently in project and product development should extend beyond best practises and also become part of the organisation culture to organisation to overcome negative volatility and capitalise on opportunities created as a result of volatility.

The statement from theory: “Recession teaches businesses to be prepared even during the good times, because a recession is like a battle- When you are in it, it is almost too late start training for it; if you are no prepared for it, you will pay for it!” (Navarro, 2009) need not be a threat or warning but rather an opportunity to have a “can do” attitude, an aptitude to become resilient yet flexible to achieve focus on the fulfilment of the goals in business strategy and technology management.

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## References

- Aizeman, J., & Pinto, B. (2005). *Managing economic volatility and crisis* (pp 45–65). New York: Cambridge University Press.  
<http://dx.doi.org/10.1017/CBO9780511510755>
- Burton, B., Austin, T., & Genovese Y. (2009). *CEOs and chief strategy officers: Balance Investments with pattern-based strategy*. Gartner, viewed 9 January 2010.  
 <[http://my.gartner.com/resources/168500/168573/ceos\\_and\\_chief\\_strategy\\_offi\\_168573.pdf?h=127D532DE9ACC9419ACAF094425C394758BBE8CF](http://my.gartner.com/resources/168500/168573/ceos_and_chief_strategy_offi_168573.pdf?h=127D532DE9ACC9419ACAF094425C394758BBE8CF)>
- Business Monitor International, (2001). *South Africa Information technology report* (pp. 5–7). quarter 1 edn., BMI Industry Report & forecast Series, London. UK: Business Monitor International.
- Cooper, R.G., & Edgett, S. J. (2001). *Portfolio Management for new Products. Picking the winners* (pp. 3–5). US: Product development Institute Inc.
- Cooper, R.G., & Edgett, S.J. (2006). *10 ways to make better portfolio and project management selection decisions*. US: Product development Institute Inc, 3-7., at [http://www.stage-gate.net/downloads/working\\_papers/wp\\_24.pdf](http://www.stage-gate.net/downloads/working_papers/wp_24.pdf), accessed 27 July 2013.
- Cooper, R. G., & Kleinschmidt, E. J. (2007). *Winning business in product development: The critical success factors*. Industrial Research Institute 2000–2010, 6–7, at [http://www.stage-gate.net/downloads/working\\_papers/wp\\_26.pdf](http://www.stage-gate.net/downloads/working_papers/wp_26.pdf), accessed 27 July 2013.
- Dedee, J.K., & Vorhies, D.W. (1998). Retrenchment activities of small firms during economic downturn: an empirical investigation. *Journal of Small Business Management*, 36 (3), 46–61.
- Donehoe, M. (2009). *What the credit crunch means for South Africa*. Africa Institute, 53-56.
- Gavin, M., & Hausmann, R. (1996). *The Roots of Banking Crises: The Macroeconomic Context* (pp.2–11). US: Inter-American Development Bank.
- Gibson, S. (2008). IT budget 2009. *Eweek*, 25 (27), 42–49.

- Grant, R.M., (2003). Strategic planning in a turbulent environment: evidence from oil majors. *Strategic Management Journal*, 24 (2), 491–517. <http://dx.doi.org/10.1002/smj.314>
- Hamel ,G., & Prahalad, C.K. (1989), Strategic Intent, *Harvard Business review*, 67 (3), 63–76.
- Kana, S. (2009). Understanding the financial impact of the current global financial crisis on business, *Accountancy SA*, 10 (1), 20–21.
- Knight, F. (1921/1964). *Risk, Uncertainty and Profit*, Hart, Schaffner & Marx Prize Essays, no.31 (pp.19–20). Boston and New York: Houghton Mifflin.
- Le, J. (2004). Portfolio management for projects, International Engineering Management Conference, Institute for Electrical and Electronic Engineers, 1012–1013.
- Repenning, N., Concalves, P., & Black, L.J. (2002). Past the Tipping Point: The Persistence of Fire fighting in Product development, *IEEE Engineering Management Review*, 30 (4), 29–41. <http://dx.doi.org/10.1109/EMR.2002.1167282>
- Weeks, R.V. (2009). Resiliency Management within a global economic network. *Acta Commercii*, 9, 24–40.
- Wheelwright, S.C., & Clark, K.B. (1992). Creating plans to focus product development. *Harvard Business Review*, 70 (2), 70–82.