2012

An exploration of applying rules based system modelling into a quality management framework - extending the quality triangle

Lee Styger
University of Wollongong, lstyger@uow.edu.au

An exploration of applying rules based system modelling into a quality management framework - extending the quality triangle

Abstract

The construct of quality management has moved on greatly since the "quality policing" concepts of the 1980's. Continual improvement and customer centric business development philosophies have become the norm within a "total" business environment. Typically, organisations exploit a series of matrices, templates and models to monitor and control their operations. It has however been noted that, often, due to minimal formal user centric instructions being available, even simple quality and business models are misused and fail to deliver their potential to impact on the business. This paper discusses the possibilities of applying knowledge based engineering fundamentals into quality and business frameworks and discusses a scenario where live, interactive benchmarking and predicative analysis could become common place within business design and improvement modelling.

Keywords

applying, exploration, into, modelling, system, quality, rules, extending, management, framework, triangle

Disciplines

Business

Publication Details

Styger, L. (2012). An exploration of applying rules based system modelling into a quality management framework - extending the quality triangle. 15th Toulon-Verona Conference: Excellence in Services

AN EXPLORATION OF APPLYING KNOWLEDGE BASED ENGINEERING INTO A QUALITY MANAGEMENT FRAMEWORK - EXTENDING THE QUALITY TRIANGLE FOR ESTABLISHING THE FIRST PRINCIPLES OF KNOWLEDGE BUSINESS MODELLING

Dr Lee E J Styger
MBA Director
Sydney Business School
Bldg 232, IC Campus
University of Wollongong NSW 2522 Australia
Phone: +61 2 4221 3751
Fax: +61 2 4221 4709
Email: lstyger@uow.edu.au

Abstract

The construct of quality management has moved on greatly since the “quality policing” concepts of the 1980’s. Continual improvement and customer centric business development philosophies have become the norm within a “total” business environment. Typically, organisations exploit a series of matrices, templates and models to monitor and control their operations. It has however been noted that, often, due to minimal formal user centric instructions being available, even simple quality and business models are misused and fail to deliver their potential to impact on the business.

This paper discusses the possibilities of applying knowledge based engineering fundamentals into quality and business frameworks and discusses a scenario where live, interactive benchmarking and predicative analysis could become common place within business design and improvement modelling.

Key Words

Knowledge Based Engineering, Knowledge Business Modelling, Business Modelling, Quality Management, Quality Triangle, Rules Based Systems Modelling, Decision Making, Strategy, Stomp Boxes

1.0 Introduction

The exploitation of matrices and business systems modelling is mandatory in formal quality management frameworks (Evans 2011). This concept is extended moving into the wider arena of business analysis and decision making, where, a plethora of well tried and tested models and matrices are used as analysis tools or aids in explaining the complex interactions and dependencies of the “total” business environment[1] (Harding & Long 1998, van Assen, van den Berg & Pieterma 2009).

---

[1] i.e Porters Diamond and Five Forces, SWOT and PESTLE etc.

2.0 Background

In the context of business analysis, business models provide a valid tool for business improvement if used correctly[2]. Research initially reported in 2011 (Styger 2011), and more recent field observations, have indicated that, whereas many business models and matrices could be used in the day-to-day operations and the strategic analysis of a business, typically few organisations are using many models and matrices beyond superficial exploration. Importantly, it would appear that, in many cases, those who are using business models and matrices have little concept of their application, benefit and the rules that surround them.

Remarkably, even comparatively simple models such as SWOT appear to be only superficially applied in many cases, thus limiting the impact and benefit that could be derived from such models. The superficial application of many business models may be due to the following reasons:

- *Lack of training* - although widely used, most business models do not come with an instruction book (rules) and as such, the application is therefore misinterpreted by the user often leading to significant deviation from the standard.
- *The "Janet and John" principle* - it has long been recognised that individuals can have a bias towards alpha or numerical data, however, what is becoming more understood is that individuals can also have a bias toward graphical data (Davies 2012). Typically, most peoples' early introduction into the recorded word (data) is via early reading books in primary school (i.e. Janet and John) where an illustration or graphical interpretation is used to back up the printed word thereby placing a hierarchy on the word over the graphic. As such, in later business life, it might be assumed that the graphic retains less importance than the word (or represents an adult equivalent to the Janet and John story), and is therefore discounted as nothing more than a page filler. Indeed, there appears to be no early reader equivalent for the graphic (model) and students are left to interpret the "picture" without formal guidance or rules. This appears to continue through professional and personal life outside of certain disciplines such as design and engineering[3].
- *No clear link back to improvement and the bottom line* - whereas many business models provide a clear analytical framework and, indeed when used correctly, a series of quality data, there is no prescriptive outcome or solution and therefore no clear link to business improvement and profit generation.

3.0 An Observation of the Application of a Simple Business Model - SWOT

The focus of this work was initiated whilst conducting a series of Supply Chain improvement focus groups during 2010/2011[4]. The focus groups were provided with a series of diagnostic tools (business models, mapping templates and matrices) and asked to complete them as the sessions

---

[2] In the context of this work, the term "model" and "tool" are considered to be interchangeable

[3] It might be argued that this core characteristic begins the soloing of the professions at the primary eduction phase and the principle of data gathering, analysis and interpretation is locked into the educational construct long before tertiary education and the introduction of business modelling (i.e. there is already a learning bias, learning familiarity and expectation, and a deep seated axiom of segregation within the heuristic of many people emulating from their early learning environment).

[4] Styger 2011

progressed. It became evident early in the work that a significant proportion of the participants needed considerable assistance in completing even simple tools such as SWOT.

As the trend was noticed a process of appreciative enquiry was used to establish why assistance was needed to complete a SWOT analysis (Johnson etal 2011). Generally the participants indicated that they were well aware of the typical window-frame model (Keidel 2010), as illustrated in Figure 1., but often lacked the insight into using it. As such they felt obliged to provide some content within the construct of the model, but were not typically motivated to move beyond the superficial.

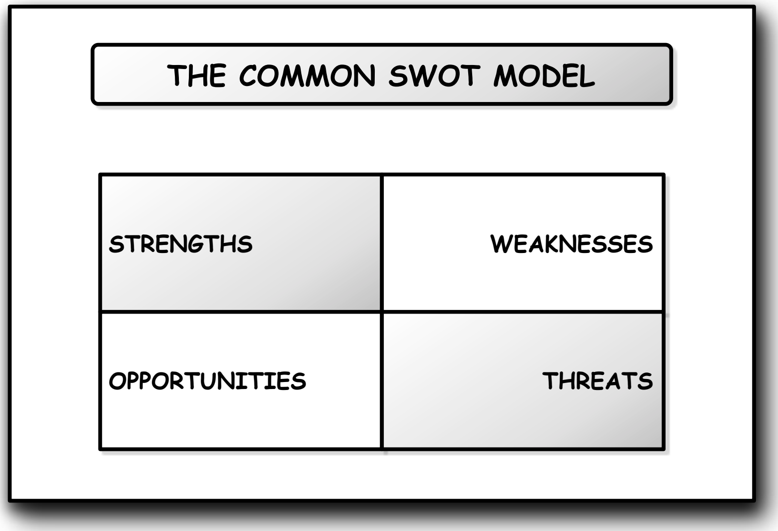

Figure 1. - The Common SWOT Model

It was also noted that the quadrant title words had different meanings for participants originating from different social and professional backgrounds. For example, “strengths” could relate to the concepts of “power”, “position”, “terror”, “oppression” or a personal differentiator depending on the participants personal association with that word. This would typically lead to a judgmental bias being introduced into the model and, as such, lead to deviation from the standard and/or a negative influence being derived from the models application, that in turn, resulted in ambiguous or meaningless results (Bazerman & Moore 2009).

To enable participants to focus their analysis within the SWOT model a more focused positioning of the quadrants was necessary. A publicly available MindMap extension of SWOT (Buzan 1999 & Margulies & Maal 2002) was introduced into the focus groups (see Figure 2.), that extended the common SWOT model by presenting a series of focused questions. These focused questions provided a framework or series of basic rules (i.e. to complete the model, you must answer the following questions). Overall this basic rules based framework delivered faster and better quality results for the participants, in a standardised format, allowing peer benchmarking (measure and improvement opportunity) and importantly the model removed some ambiguity[5].

[5] McGowan (2011) has further expanded on the concept of “frameworks and formworks” within her work that delivers a series of framed diagnostics with a business development context

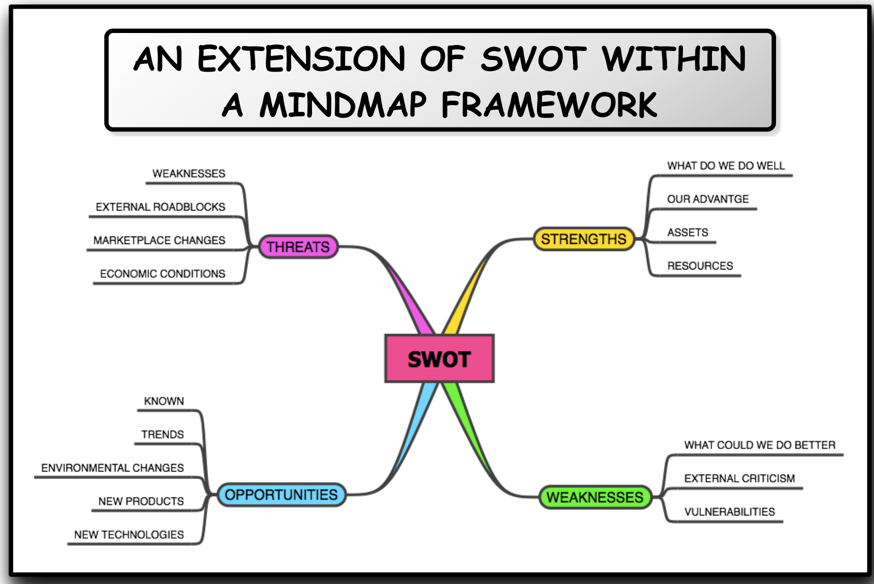

Figure 2. - An Extension of SWOT within a MindMap Framework

4.0 The Hypothesis of Applying Rules Based System Modelling Within a Business Modelling Context

The concept of rules base disciplines are found in mathematics, art, music and science etc. and date as far back as ancient Greece and the acclaimed "Golden Rectangle" or "Golden Ratio". The portrait of "The Virtuvian Man" by Leonardo Da Vinci (1487), depicts a series of rules around the human form (see Figure 3.). Importantly, more contemporary understandings of the applying of rules in a professional or creative context complement the historic views, insofar as modern commentators typically agree that movement outside of a rules based system is likely to create havoc and less than optimal results (Pugh 1991, Barber 2004 & Webb 2010).

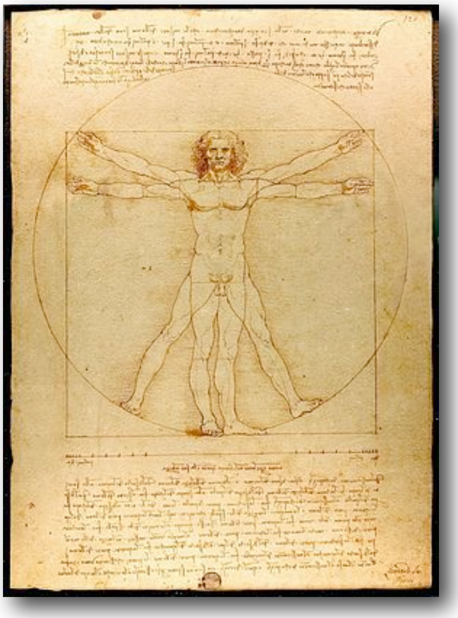

Figure 3. - The Virtuvian Man, Leonardo Da Vinchi (1487)
(Sourced: http://en.wikipedia.org/wiki/File:Da_Vinci_Vitruve_Luc_Viatour.jpg)

It may further be argued that even an emotional concept may also be based within a rules based framework. For example, the question "Is it art" may be analysed via a simple set of rules such as; *art must be*:

1. Original
2. Challenging or pleasing

From the above rules set, a rules based system may be developed as illustrated in Figure 4.

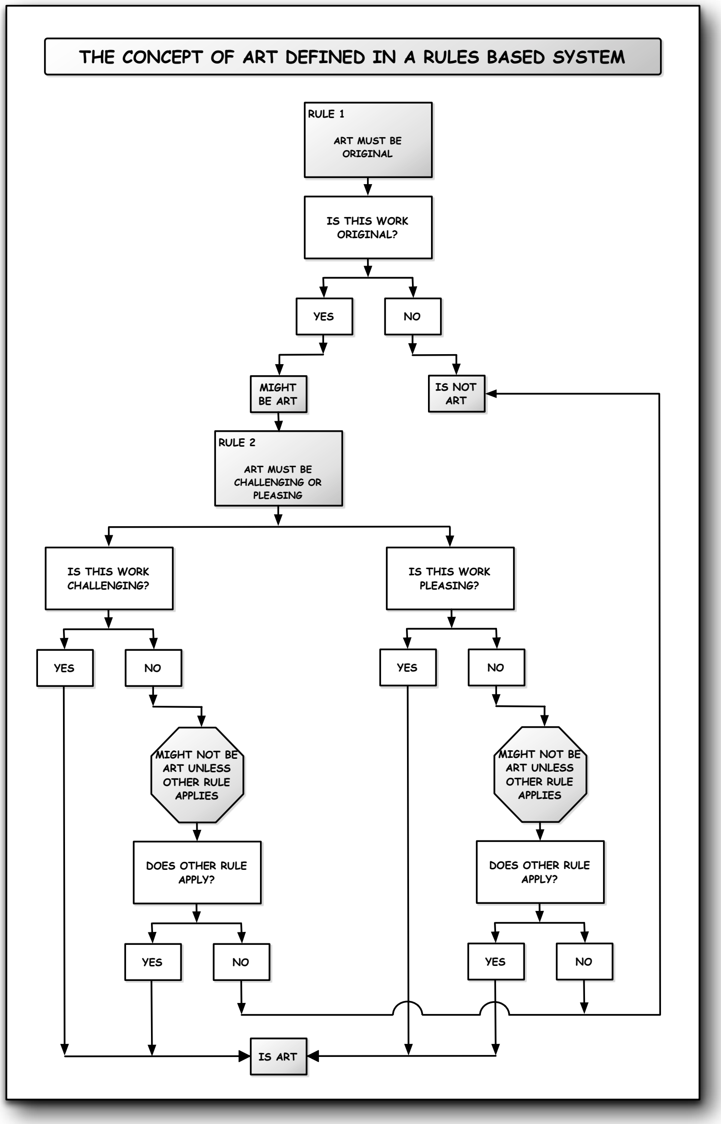

Figure 4. The Concept of Art Defined as a Rules Based System

Rules based systems are perhaps better accepted in more technical scenarios where it is perhaps easier to define a node via a formula, for example:

If A<B then C will result
but
If A>B then D will result

This type of simple formula based rules system occurs in many areas of professional practice, for example in the design of injection moulded plastic components, where one design rule demands that the reinforcing rib thickness must be less than 50% of the wall thickness to avoid sink marks (blemishes) appearing on the surface of the moulding (Campbell 1996). Rules such as these are derived from knowledge, typically built up over time. It is the accumulative knowledge that enables the rules based or a knowledge based system to be designed.

5.0 Making the Link Between Conventional Exploitation of Knowledge Based Engineering, Quality Management Frameworks and Business Systems Modelling

Typically, knowledge based systems have evolved from design and engineering disciplines where they have inherited the term knowledge based engineering (KBE). More recently, KBE has moved out of the engineering sector and is now applied in other sectors such as banking, medicine and healthcare and into some areas of business. KBE systems comprise of an object orientated program ("model"). The body of knowledge about the model is represented in a standard format and a series of rules abut the model embodied in a computational environment (computer) (McMahon & Browne 1998).

KBE systems do not define systems data as a series of graphical or topographical models but rather as a series of rules. A rules based system allows for rapid, multiple iterations and scenarios to be developed. Importantly, the systems promote the reuse of best knowledge (a feature typically associated with TRIZ [6] (Terninko etal 1998)), and modular design (a feature typically associated with Rapid Product Development (Sage 2000)) (Curran etal 2010 & Verhagen etal 2012).

Ammar-Khodja & Bernard (2008) have stated that knowledge management is a deliberate and continual process of generating, communicating, rejuvenating, applying and updating intellectual and asset based knowledge (a concept in accordance with the ISO 9001: 2008 quality management framework) and was further augmented by the following protocol:

- Knowledge capitalisation - learning form the past by knowledge retention and reuse
- Project accompaniment - learning form present activities by knowledge sharing and exchange
- Innovation - moving towards future benefits by leverage organizational knowledge assets
- Cost reductions - achieving cost reductions through right first time adoption enabled knowledge sharing (typically associated with LEAN principles (Evans & Lindsay 2011))

Zhou etal (2012), provide a framework of the basic principles of knowledge acquisition which are:

- Existing knowledge - based on all known current and historical aspects
- Market information - based on design, make or buy decisions, supply capability
- Digital simulation - modelling and analysis
- Prototyping / test - typically within the virtual environment
- User responses - based in internal and external customer (i.e. supply network) feedback

Importantly, Hsu, Tai, Wang and Chen (2011) provide insight into the "missing link" between the engineering and business practice by describing the core benefits of KBE to the engineering discipline in terms of design optimisation and planning. By extrapolating the same objectives into

[6] TRIZ - the process of Inventive Problem Solving

the business environment and using KBE as the basis, it should be possible to design a business with an optimal outcome in mind (i.e. predicative) and also design the sequence, timing and alternative strategies based on current market dynamics (i.e. a closed loop strategy tool).

5.1 The Hypothesis of Applying Knowledge Based Engineering into A Business Systems Modelling Environment

It has been discussed above that, whereas the language of engineering and business may differ, the sentiment and best practice principles are closely aligned. As such the hypothesis is based on the premise that:

If we can apply Knowledge Based Engineering in a rules based and design focused engineering environment, then we should be able to apply Knowledge Based Engineering in a rules based and design focused quality management framework and business modelling environment.

6.0 Experimentation with the Quality Triangle - The First Step into a Knowledge Based Business Model

In order to test the hypothesis it was necessary to select a test model. The Quality triangle was selected because it is comparatively new and does not carry the baggage of more familiar business models. Furthermore it formed a core diagnostic tool in the original research and base observational data was available.

6.1 Rational of the Quality Triangle

The Quality Triangle[7] was developed initially as a basic conceptual model to describe the basic principles of Total Quality Management and condense the fundamental principles of good business operations (see Figure 5).

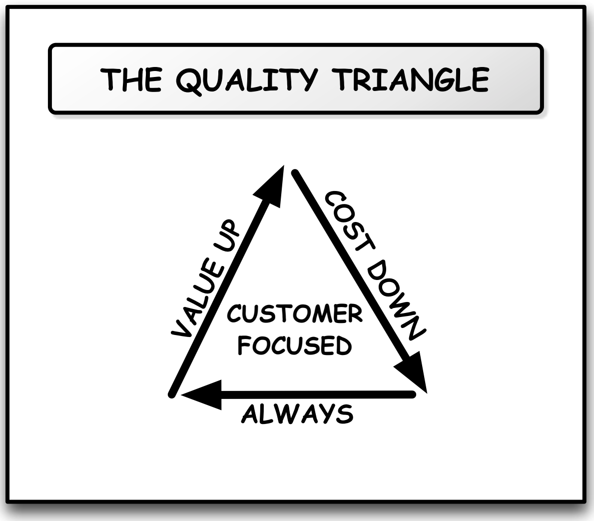

Figure 5. The Quality Triangle

---

[7] The Quality Triangle was described by the author in "An Analysis of the Restrictions on the Competitive Readiness of Australian Businesses Due to Their Lack of Formal Quality Management Systems", 14 Toulon-Verona Conference, Alicante, 2011

The model became a standard teaching and consulting node, however, as it became embedded into programs, it became apparent that, although the Quality Triangle was undoubtably conceptually robust, and when used correctly effective, it was however often misused and open to misinterpretation because there were no formal recorded rules available to users and no accumulative knowledge within the user base. The solution was to develop a set of basic rules consisting of order of analysis. These rules were:

1. Begin by defining the customer first
2. Develop operational cost down strategies
3. Develop customer value up strategies
4. Balance risk and reward between cost reduction and customer value strategies
5. Continue (always) the basic analysis

6.2 Extending the Quality Triangle

It was thought that users would gain a richer data set by applying the basic rules to the Quality Triangle, however, this was not the case. It was discovered that the basic rules set still enabled a level of ambiguity and therefore confusion. As such, the model was extended to include more focused questions with a view to removing ambiguity (see Figure 6).

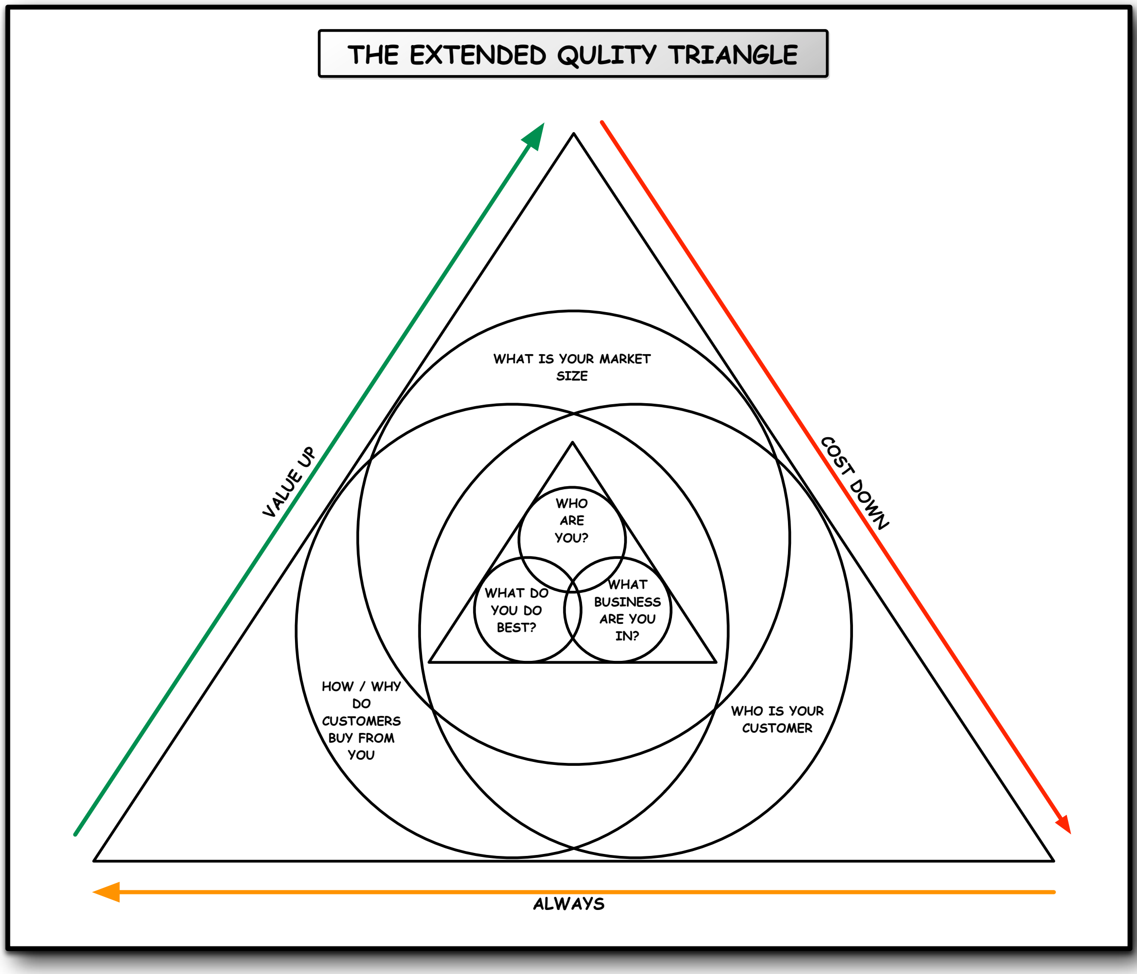

Figure 6. The Extended Quality Triangle

Whereas the extended model provided more depth of inquiry, users were typically not able to quantify basic questions embedded in the model and were therefore still not able to develop an unambiguous and rich data set.

6.3 Applying Rules

It became apparent that if a rich data set was going to be delivered from the model then an embedded structure of rules needed to be allied to each sector of the Extended Quality Triangle (i.e in a given context if A=B then C must follow but if A>B then D must result). In the context of supply chain configuration for example the rule could be:

If you need n units, then your suppler must be able to produce >n x 10 units
and
If your supplier is only capable of producing <n x 10 units then there is a risk factor in your supply chain

Whereas it may be argued that a rules based approach is a straight forward methodology in a quantitate area such as supply, it is often argued that in more "interpretive" areas of business, such as defining a tangible framework of a customer, a rules based approach cannot be applied because of the nuances and "interpretation" (i.e. black art approach) needed. Whereas a customer might appear to be a basic requirement for any business, the initial research (and indeed later focus groups) indicated that many participants were unable to categorically pinpoint who their customers were.

One of the original diagnostic tools provided a simple rules set for a customer, the rules set was; a *customer is someone who has:*

1. Demand
2. The ability to pay

By adapting this principle in a similar manner to Figure 4., a rules based system may be applied to this sector of the Extended Quality Triangle (see Figure 7.) that delivers an unambiguous outcome, that in turn generates quantifiable "knowledge" within the framework, and a knowledge business model (KBM) is established.

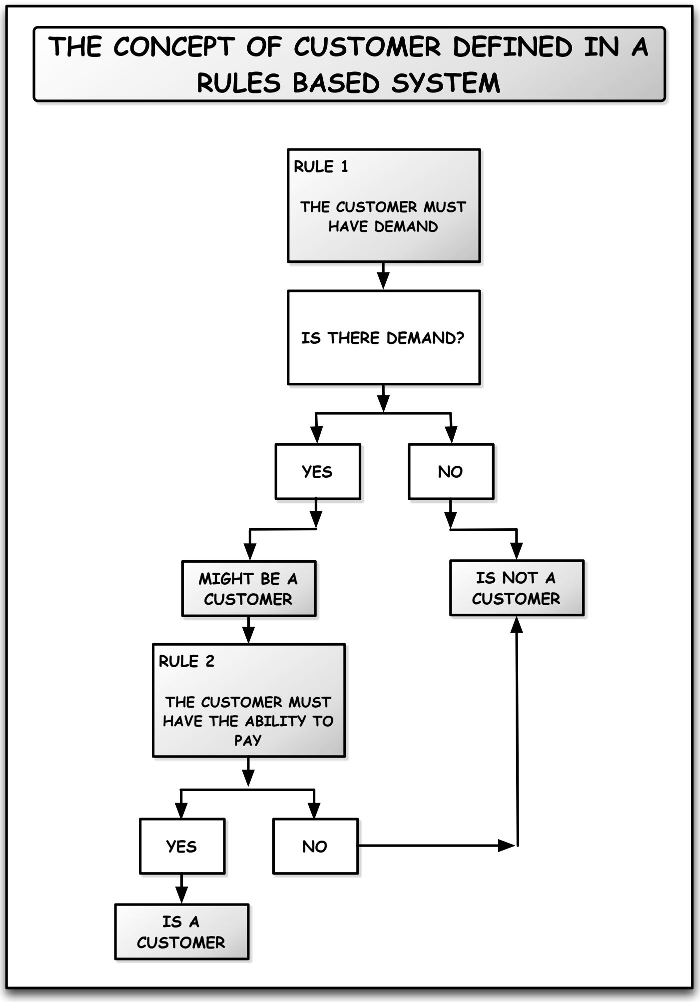

Figure 7. The Concept of Customer Defined in a Rules Based System

7.0 Can Computational Analysis Be Applied to the Knowledge Business Model

By reducing the rules based system to a "yes/no" decision framework (Styger 2001), ambiguity is eliminated from the model. Importantly, the basis of a binary platform (i.e 1 or 0) is introduced into the decision process. As such, the design of a knowledge business model should be compatible with computational methodologies and it should be possible to develop an algorithmic program around the knowledge business model.

Furthermore, as knowledge is expanded and shared, it is logical to suggest that it should be possible to develop a predicative environment where the probability of success/failure and/or where gaps in a business system can be illustrated in a virtual prototype of the business. Moreover, it should also be possible to simulate the optimum business system for a given scenario (i.e. establish what the success factors are for any given business and then design the business for those success factors based on knowledge based engineering principles inherent in the knowledge business model).

8.0 Knowledge Business Modelling Moving Forward

Moving forward, it is reasonable to suggest that Knowledge Business Modelling could provide a significant paradigm change in business planning and analysis (strategy), because the virtual prototype of a business would generate a total business view and as such remove much of the silo thinking that is endemic in the corporate world (Mintzberg 1983 & Kaufman 2010).

8.1 The concept of Stomp Box Chain Design and Sequencing

It is likely that the paradigm change possible with knowledge business modelling will result in the accumulation of knowledge derived from multiple sources that becomes linked, perhaps as a "chain" where the choice and sequencing of models could influence the overall business "signature".

This scenario might be likened to the music industry, where for example a series of independent designers have produced effects pedals or "stomp boxes" that are used by guitarists to effect the sound of the instrument. Each stomp box creates a unique effect and in certain cases the effect from some stomp boxes can cross over into others. However, the guitarist is free to choose from any design and specification of stomp box, knowing that all stomp boxes will link together, in any order, via a standard interface.

Chains of stomp boxes produce different sounds (outcomes) and often guitarist design their chain for their sound (see Figure 8). In a similar manner it would be possible for a number of knowledge business models, from different designers to be "chained", via a common interface, to deliver a specific outcome[8].

Figure 8. An Example of a Stomp Box Chain

8.2 The Possibility of Applying Knowledge Business Models to a Matrix of Thematic Focus and Technology Carriers

Entrepreneurial endeavor (including a new business start up, ongoing business development and business reconfiguration) are best undertaken around the concept of developing a matrix of focused thematic areas that are intersected by so called carrier technologies (including business processes etc.) (see Figure 9).

[8] Perhaps generating a new App bonanza or even new modules within current ERP products

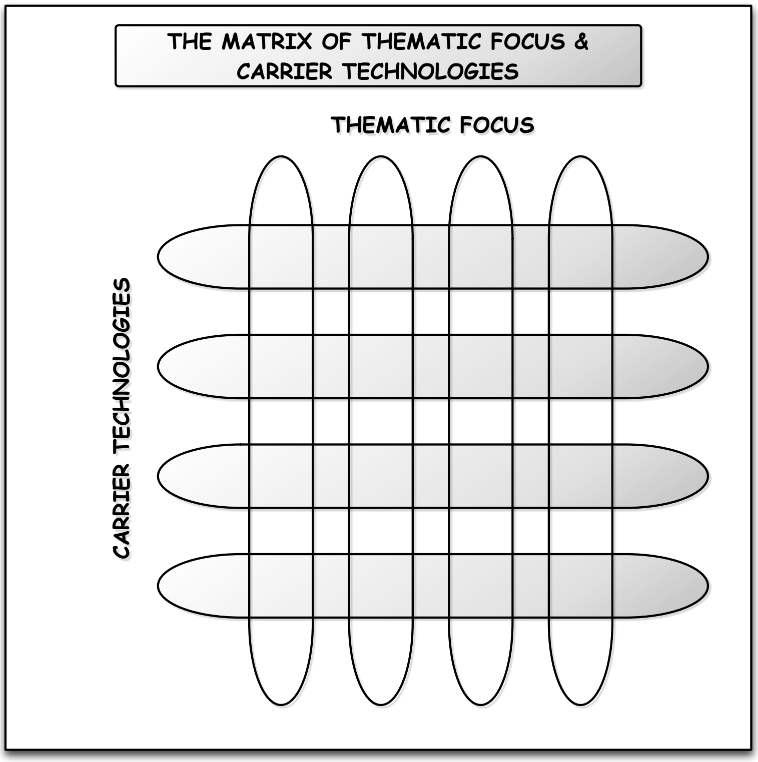

Figure 9. The Matrix of Thematic Focus and Carrier Technology

The concept of a series of knowledge business models being chained to deliver an outcome can be further extended by the notion that specific models could be overlaid at the intersection points of the thematic areas and carrier technologies to deliver the right rules based systems, at the right point and time, in what is often a tumultuous environment. In short, the right knowledge business models could inject order and reduce risk in periods of change and crisis.

9.0 Conclusions

Business modelling is often poorly executed. This can typically be attributed to lack of training and/or the lack of objective rules being placed around the model and as such, poor data, analysis and decisions result. Rules based design has been a basic principle for many hundreds of years and has recently found an extension of expression via knowledge based engineering.

By applying similar principles from knowledge based engineering into business modelling it becomes apparent that it is possible to move from a typically ambiguous environment into a knowledge rich environment. This transformation is not centered around the old world "quality policing" mentality of the 1980's but rather focused on providing rules within the knowledge business model aimed at solving the complex challenges of a post modern business.

The introduction of computational algorithms could further enhance the opportunities and chains of knowledge business models could provide live, interactive benchmarking and predicative analysis.

To accept the concept that credit card companies have algorithms to predict the pending divorce of their customers based on spending profiles (even before their customers know themselves!), then is it legitimate to assume that similar algorithms could be developed and incorporated into knowledge

business models to design the most robust businesses and/or predict the success or not of new and current businesses into the future.

Recommendations for Further Work

The recommendations for further work include:

- The design and development of a series of robust rules based knowledge business models
- The design and application of algorithms and interfaces applicable to the business environment
- The design and development of a standard interface and chain sequence for knowledge business models

References

Ammar-Khodja, S. & Bernard, A. (2008), "An overview on knowledge management. In A. Bernard & S. Tichkiewitch (Edt), Methods and tools for effective knowledge life-cycle management. Springer

van Assen, M, van den Berg, G & Pietersma P (2009), "Key Management Models, the 60+ models every manager needs to know", Prentice Hall. ISBN 978-0-273-71910-6

Barber, B. (2004), "Through the Eyes of Leonardo Da Vinci", Gramercy Books, ISBN 0-517-22469-0

Bazerman, M, Moore, D. (2009), "Judgement In Managerial Decision Making", John Wilely & Sons Inc., 7th Edition. ISBN-13: 978-0-470-04945-7

Buzan, T. (1999), "The Mindmap Book", BBC Books, ISBN 0 563 37101 3

Campbell, P, D, Q. (1996), "Plastic Component Design", Industrial Press Inc., ISBN 0-8311-3065-2

Curran, R., Verhagen, W. J. C., van Tooren, M. J. L. & van der Laan, T. (2010), "A multidisciplinary implementation methodology for knowledge based engineering: KNOMAD", Expert Systems With Applications, vol 37, no 11, pp. 7336-7350

Davies, T, N. (2012), "Drawing the line", Engineering Designer, The Journal of the Institution of Engineering Designers, vol 37, No 2. ISSN: 00137898

Evans, J, R. (2011) "Quality & Performance Excellence", South-Western CENGAGE Learning, Sixth Edition. ISBN-13: 978-0-324-82706-4

Evans, J, R. & Lindsay W, M. (2011), "Managing for Quality and Performance Excellence, South-Western Cengage Learning. ISBN-13: 978-0-324-78320-9

Harding, S, Long T. (1998), "Proven Management Models", Gower Publishing Limited. ISBN 0 566 07674 8

Hsu, Y., Tai, P., Wang, M & Chen, W. (2011), “A knowledge-based engineering system for assembly sequence planning”, The International Journal of Advanced Manufacturing Technology, Vol 55, no 5, pp. 763-782

Johnson, G, Whittington, R & Scholes K, (2011), “Exploring Strategy”, Prentice Hall, Ninth Edition. ISBN: 978-0-273-73202-0

Kaufman J. (2010), “The Personal MBA”, Potfolio Penguin, London,. ISBN 978-0-670-91951-2

Keidel, R. (2010), “The Geometry of Strategy, Concepts for Strategic Management”, Routledge. ISBN 13: 978-0-415-99925-0

Margulies, M, & Maal, N. (2002), “Mapping Inner Space”, Corwin Press, Second Edition, ISBN: 978-1-5697-6138-0

McGowan, C. (2011), “Aspiering to Good Business - Defining, Communicating and Describing Your Business”, Wiggly Tin Company. ISBN-13: 978-1463527938

McMahon, C, Browne, J. (1998), “CAD CAM, Principles, Practice and Manufacturing Management”, 2nd Edition, Prentice Hall. ISBN 0-201-17819-2

Mintzberg H. (1983), “Structure in Fives: Designing Effective Organizations”, Englewood Cliffs, NJ. Prentice Hall.

Pugh, S. (1991), “Total Design Integrated Methods for Successful Product Engineering”, Addison Wesley. ISBN 0-201-41639-5

Sage, L. (2000), “Winning the Innovation Race”, John Wiley & Sons, Inc. ISBN 0-471-33346-8

Styger, L. E. J. (2001), “A Site Selection Model for SMEs Based in the Rapid Product Development Sector”, A thesis submitted for fulfillment of a PhD, De Montfort University

Styger, L. E. J. (2011), “An analysis of the Sustainability and the Future of Innovation Readiness within the Australian Supply Base – a Cross Sectorial, Cross Regional Snapshot”, Enterprise Resource Planning and Supply Chain Management Conference, Penang Malaysia, 14-15 March, 2011

Terninko, J, Zusman, A, & Zlotin, B. (1998), “Systematic Innovation, An Introduction to TRIZ”, St. Lucie Press. ISBN 1-57444-111-6

Verhagen, W. J. C., Bermell-Garcia, P., van Dijk, R. E. C. & Curran, R. (2012), “A critical review of Knowledge-Based Engineering: An Identification of research challenges”, Advanced Engineering Informatics, vol 26, no 1, pp. 5-15

Webb, J. (2010), “Design Principles”, AVA Publishing. ISBN 978-2-940411-36-8

Zhou, X., Huan-Wu, S., Nan, L., Wei, D. & Jie, Y. (2012), “Research on Rapid Design System for semi-trailer Based on KBE”, Information Technology Journal, vol 11, no.3, pp 368-371