Modelling Business Process and Application of Condition Monitoring in the Utility Services Sector

Richard Egelstaff
Gopinath Chattopadhyay

Faculty of Science Engineering and Health,
Central Queensland University, PELM, Gladstone Campus, Qld 4680, AUSTRALIA
richard@wfassociates.com.au
g.chattopadhyay@cqu.edu.au

ABSTRACT

Understanding how business process work is a mandatory requirement for operational performance improvement and innovation. The organisation considered in this paper has utilised a modelling approach to develop a measurement framework for condition monitoring of its business operations. The engineering definitions of condition monitoring is analysed and extended to non traditional areas of human assets. Authors have proposed 'condition monitoring' as measurement methods for work in progress (WIP), earned value management, and accrual management. The benefits of modelling the business process and application of condition monitoring are substantial improvement in asset utilisation, improvement of productivity and profitability.

Keywords: Asset Utilisation, Performance Improvement, Business Process Modelling

1. INTRODUCTION

Understanding business processes is a mandatory requirement to performance improvement and innovation. In this case study, we look at the relationship between business modelling and creating change in an organisation. The firm under study is called firm – TF – mainly for the purpose of confidentiality. It has been experimenting with modelling for many years and look at the business environment it operates in and how changes to the environment are influencing to invest large sums in modelling in many forms. Of specific interest to us is the type of model that leads to better asset utilisation and the means of measuring work in progress through the application of the principles of condition monitoring.

2. BACKGROUND AND OVERVIEW

2.1 Modelling Business Processes

Generally, the longer a modelling technique has been in existence and the more significant it is to the community that interprets the model then the more formal the model and the rules surrounding its construction and operation become. A metaphor for what Henry Mintzberg has identified is the inevitable trend towards mechanised bureaucracy in organisations [1]. This is an interesting parallel thought since bureaucracy is a universal model of organisational design based on legitimate and formal systems of authority manifest as a formalisation of business rules, structures, chains of command [2]. However, the focus here is on how the business processes can be modelled and to what end these processes can be applied. Of particular interest is the relationship between the means of measuring those processes through work in process (WIP) concepts.

A business process under study was first conceived as the means of operating a production line in the beginning of the 20th century [3]. This is well know through the writings of people like Max Weber, F.W.

Taylor and practices by industrialists such as Henry Ford. However, over time business processes have come to represent the whole gambit of organisational operations that link related tasks to produce something of value to the customer [4]. Common with all types of modelling, business process modelling is something that occurs in many forms and for many purposes. Some purposes require highly detailed models, such as when an organisation completes a response to a tender. In this case a model projecting the changes that are going to occur in the transfer of a major government asset to private hands will be developed. The tender response model may cost as much as AUD $20 million (TF has spent as much as this on responding to a tender) and take many years to build. The model will be included with the tender response. The purpose, of which, is to enable the committee that is evaluating the tender responses to understand, in detail, what TF is proposing. Since the assets that are being put up for tender are public assets and may be worth billions of dollars (such as a major hospital, airport or railroad), then the detail contained in the model is proportionately complex and should allow the evaluation committee to evaluate the future of the asset over many years. Details provided by the proposed operators concerning the performance of the asset needs to be finely tuned. It is often an outcome requirement of the evaluation process that, service level agreements are established covering performance response to failures to deliver the service tendered for.

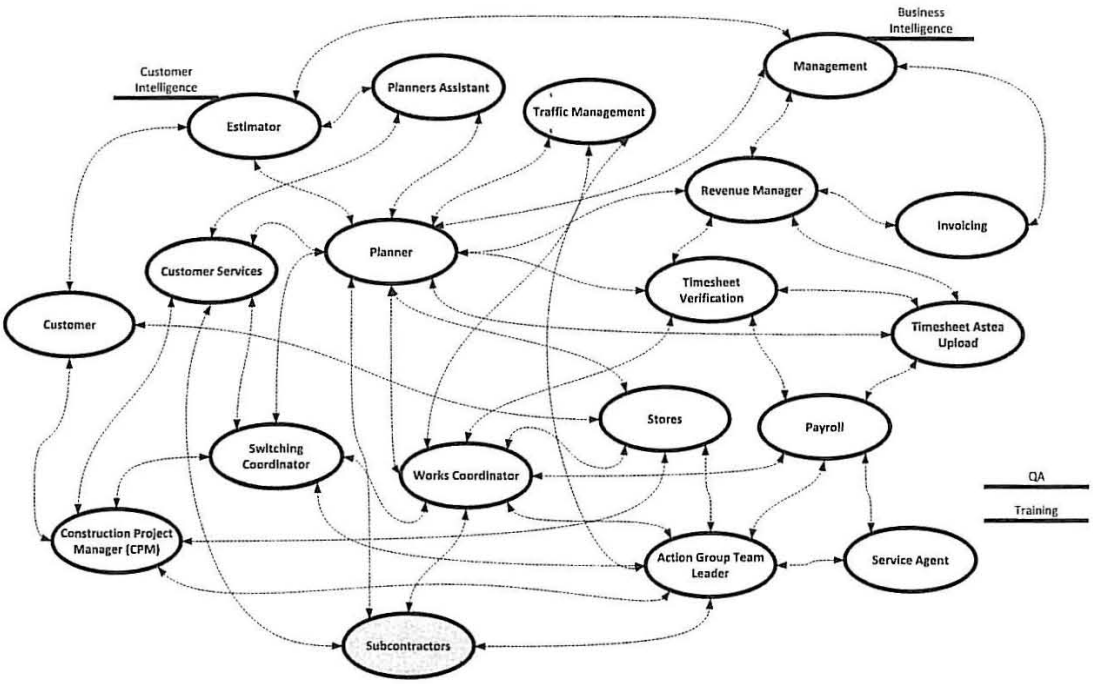

Figure 1: Basic Workflow Model

In many cases models may be relatively simple and a series of bubbles delimiting work flows between workers may be all that is required. An example of such a model is contained in Figure 1: Basic Workflow Model

In this model – the ovals – represent a role being performed and – the arrowed lines – a flow of information between the respective roles. All of the arrows are double headed to ensure that there is a feedback between the sender and receiver. The benefit of this model is that the interaction between the workers can be easily represented. This model shows the interaction in TF's electrical division between work roles. However, as previously stated the model has to be sufficient for its purpose and an important

requirement therefore, is to know what the users of the model are going to do with it. In the TF example, the objective is to be able to optimise the interaction between the people performing the role and ultimately from the optimisation to enable innovation to occur. There is a need for good understanding of the flow of the core processes to meet the customer demands. In the field of operations management this is known as the strategy formulation process [5] and conforms to the first step in systems dynamics – the conceptualisation phase [6].

2.2 Operational Performance Improvement

In a business environment enables TF to achieve an outcome in linear flow where inputs are progressively transferred to outputs to meet a customer demand [7]. An example of such a flow is illustrated in Figure 2: Process Model Value Chain.

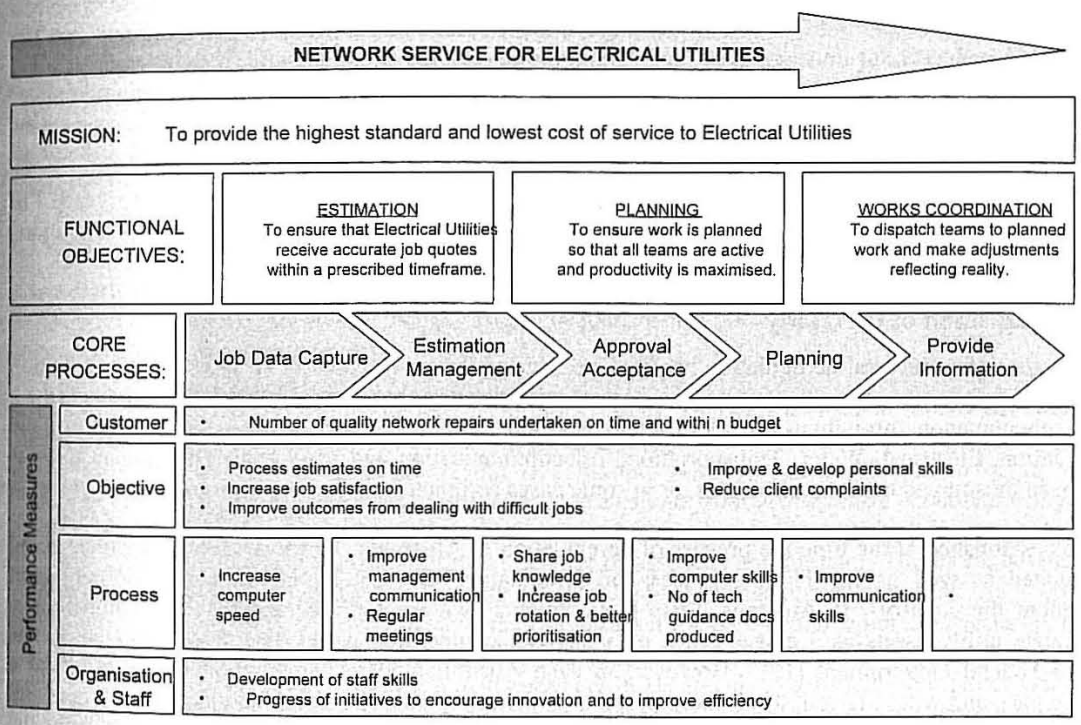

Figure 2: Process Model Value Chain

in this model there are activities that directly affect the creating of the output and there are other activities that do not directly affect but are important facilitators. Where this process includes external parties to TF, such as the suppliers of TF, it is known as Supply Chain Management. Where the process is internal and designed to improve internal processes then it is know as business process improvements (BPI) [8]. The identification of this representation has been popularised over many years by many academics; some of the more notable are Michael Porter and Michael Hammer. In Porter's case, his contribution was to better understand the strategic purpose of TF [9]. In Hammer's it was to enable business process reengineering to occur [10]. In both of these examples, the underpinning objective is to encourage improvements to the operations of TF. BPI's target is to try to enable the transformation of the input to the output either faster, cheaper, to a higher quality level or all of these with greater efficiency and effectiveness. A question is whether the bubble model was sufficient as a model to allow business process improvement to occur. Porter, Hammer and many other academics and practitioners, have identified not only the need to improve processes but also the need to innovate processes.

2.3 Innovation

Innovation is a subtle activity than business process improvement and requires the right condition to be in place for innovation to occur [11]. Several researchers, including Eric von Hippel and Peter Senge, have undertaken considerable research into the phenomenon of innovation and have concluded that to enable innovation to occur then an engagement must occur between a wide number of parties. They have also identified that innovation is something that cannot be forced. Senge, in his book, *The Fifth Discipline*, has identified that there are five component technologies that are converging to innovate learning organisations; Systems Thinking; Personal Mastery; Mental Models; Building a Shared Vision; Team Learning [12]. An important question however, that must be asked is how do you know the conditions are right, in the first place, for innovation to occur? Furthermore, is it possible to place a value on those factors, so that the value of one team can be assessed as greater than the value of another team. In other words is additional capability more latent in the first team over the second? These questions are simialr to those being asked in the field of system dynamics [13], but also differ in their specificity and that the ultimate goal of TF is to understand the comparative value of intellectual assets in their organisational context.

3. CASE STUDY

TF has been operating as a services supplier to utilities in Australia for more than twenty years. In addition, by employing the same business model as exists in Australia, TF has expanded its operations into New Zealand, Asia and recently into the Middle East.

3.1 Background of the Study

In Australia infrastructural deregulation has occurred during the past twenty or so years. The motivation for the deregulation has been the trend in economic rationalisation that started in the 1970's and became a global phenomenon throughout the 1990's and beginning of this century. As a consequence of the deregulation, Electrical, Water, Transportation, Telecommunication and other basic government utilities have been outsourced or divested, in part, or in some cases completely of their operations [14].

TF was established at the time the process of deregulation in Australia. However, for the Utilities being deregulated as well as for TF, the process of deregulation was not highly structured or consistent throughout the country. In Australia, State Governments own the Utilities and they are compelled to corporatise utility assets as a consequence of a national competition policy that was legislated by the Central Federal Government [15]. However, in each Australian State deregulation has occurred at a varying pace and with different local interpretations of the rules. In short, there were no prior models that existed that would have allowed the Governments, the Utilities, or TF to see a roadmap of how the business domain should evolve. In addition, the political process driving the deregulation varied over the years as a consequence of the changing of political parties that is part of the democratic condition. And finally, lobbying from third party bodies such as the union movement, or capitalist business interests seeking opportunities to sell new infrastructure equipment or processes added to the inconsistencies of the deregulation process.

Therefore, TF's operational processes business evolved, often lagging behind the opportunities that were captured by TF's sales efforts. A good example of this is a recent opportunity in the telecommunications broad band project in Australia, announced by the Federal Government. As a consequence there has occurred a rapid mobilisation of resources to develop systems and approaches to meet the needs of the opportunity. In effect, the lack of a clear and consistent model has meant that many business processes within TF are established on ad-hoc basis and contain inconsistencies and redundancies. Coupled with this situation is that environmental instability has brought on an inevitable consolidation in the industry and smaller players have been and are being swallowed up by major players.

3.2 Efforts related to business processes

During the past, there have been several computer systems developed by TF to capture the data that drives the business. There have also been different variations of the bubble model [figure 1] explored. Additionally, there have been attempts at alternating the centralising and decentralisation operational hierarchy of TF. The current direction of TF is to centralise operations, so that all electrical business is planned to be grouped under one central team, waste management is grouped under another team, etc. Prior to this change each business line was managed in a geographic manner, so that the Western Australian operation had a single management team responsible for all business lines; waste, water, electrical and so on. The same condition applied in other states and territories. Regardless of the way in which TF's chain of command flows and in spite of the type of utility that it is providing service to, the core operations of TF follow a fairly consistent work pattern not dissimilar to the one illustrated in the bubble diagram [figure 1]. The common characteristics of this operational process are that the work required is identified, an estimate is made. The estimate is accepted or rejected and then detailed planning of how the work is going to be performed takes place. The work is then scheduled and the labour undertaken by the workers to perform the job. The labour time, and resources such as plant utilised or materials consumed and other expenses are recorded and the customer is invoiced. Regardless of whether the work is undertaken for a water utility or an electrical utility or the work is in telecommunications or a transportation infrastructure it follows a similar core process.

4. ANALYSIS OF THE PROPOSED MODELS

The models that have been developed in TF is focused to have a common outcome, namely to enable the transformation of the input to the output faster, cheaper, to a higher quality level or all of these with greater efficiency and effectiveness.

Assets for TF are regarded as all people performing labour, all plant utilised in labour activities, and material consumed in labour activities. This view of assets is a different view from the normal way that assets are considered in an organisation, but is consistent with the greater definition of an asset – *resources controlled by the entity as a result of past events and from which future economic benefits are expected to flow* [16]. Assets in TF are considered as eminently disposable. As the business cycle waxes and wanes then TF will acquire more assets or,dispose of assets as appropriate. Therefore, having good computer systems that captures the productivity of assets and their utilisation is important. As good as the computer systems are, they can only achieve their potential if the data being captured is accurate, timely, complete and relevant to the organisation [17]. TF has found that there are inherent inaccuracies in the data it is able to capture around assets. Human assets are fickle and always difficult to monitor. However, there is a symbiotic relationship between the human asset and the plant asset. Therefore, measurement concepts such as those manifest in 'condition monitoring' are seen as a means of being able to capture useful information about the utilisation of the human/plant asset. Knowing where the asset is in the value chain [figure 2] then becomes extremely important. Unfortunately for this plan to be successful then the knowledge domain for condition monitoring; which is usually focused on the engineering or mechanical systems rather than the human or services systems; needs to be refocused within a more holistic measurement medium.

4.1 Condition Monitoring

A search through the key words of many of the more recent articles shows that the authors of these articles believe that condition monitoring is a situation that is related to mechanical and electronic equipment such as, induction motors, wind turbines, electrical machines, machine tools, and so on. Although, clustered amongst the mechanical and electronics applications are references to other application areas for condition monitoring such as with databases and data streams [18]; or to physiological condition monitoring that is applied to monitoring the health of premature babies [19]; or to

biological health and air quality condition monitoring of forests [20]. Our investigation shows that the measurement principles embraced by condition monitoring is wide and varied and that condition monitoring can be thought of as a framework that can be applied across a broad scope of discipline areas such as information technologists, in medicine, and in forestry and environmental management and human assets.

5. ILLUSTRATIVE EXAMPLE

TF has proposed 'condition monitoring' as measurement methods for work in progress (WIP), earned value management, and accrual management. These are all interrelated and lead to the financial reporting and financial management. TF proposed establishing a regime whereby these elements are captured and reporting is then built around the three main models expressed in figures 1, 2 and 3. There are twelve primary methods, however what is important is the relationship – the arrowed lines – between these methods. Significantly, in the diagram [figure 3] not all of the lines have double headed arrows. There are two primary measurement methods namely, condition monitoring and work in progress (WIP). These are considered as base or primary drivers to the other methods with there being a focus on an information flow towards the higher measurement criteria of Management and Financial Reporting.

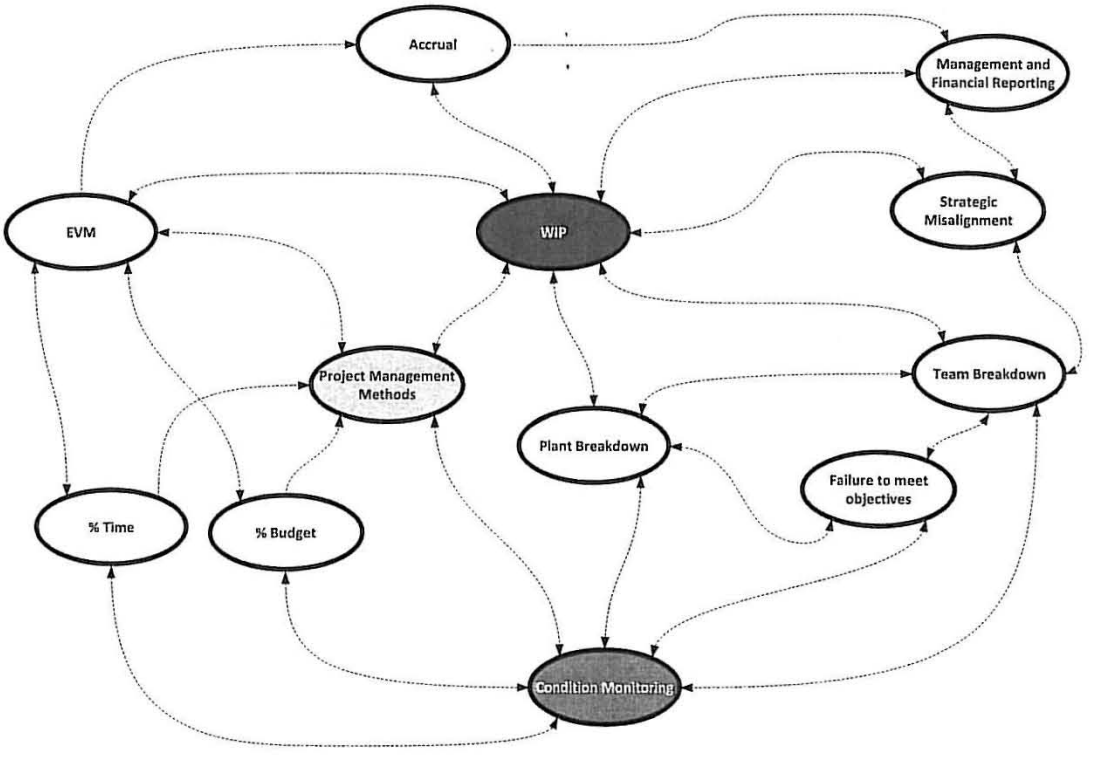

Figure 3: Measurement Interrelationship

6. CONCLUSIONS

The significance of this paper is to provide an understanding on how business process works in a service sector. Authors have utilised a modelling approach to develop a measurement framework for monitoring business operations of an Australian firm from service industry. The engineering definitions of condition

monitoring is analysed and extended to non traditional areas of human assets. It is observed that without cross-pollination from other disciplines condition monitoring may become less relevant to non traditional areas. Authors have proposed 'condition monitoring' as measurement methods for work in progress (WIP), earned value management, and accrual management. These are all interrelated and lead to the financial reporting and financial management. This model is applicable to businesses involved in building and maintaining electrical transmission and distribution services, whether they are provided underground or over ground services for non traditional areas such as human assets and Intellectual assets.

ACKNOWLEDGEMENTS
The authors thank the anonymous reviewers for their helpful suggestions with the paper and particularly for identifying the relationship between the models contained in the paper and with the approaches embraced by systems dynamics.

Contact details of authors: Faculty of Science Engineering and Health, Central Queensland University, PELM, Gladstone Campus, Qld 4680, AUSTRALIA, Phone +61 7 3864 2865,
richard@wfassociates.com.au, g.chattopadhyay@cqu.edu.au

REFERENCES

1 Clegg S., Kornberger M., and Pitsis T. 2005(b). *Managing and Organizations: An Introduction to Theory and Practice.* London: Sage Publications, p. 132.
2 Davidson P., and Griffin R. 2006. *Management 3rd Australia Edition.* Brisbane: John Wiley, p. 373.
3 Clegg S Kornberger M., and Pitsis T. op. cit p. 374.
4 Hammer M. 1996. *Beyond Reengineering.* New York: Harper Collins. p5, 101.
5 Russell R., and Taylor B.W. 2000. *Operations Management.* N.J. USA: Prentice Hall. p31.
6 Forrester JW. 1994. 'Systems Dynamics, Systems Thinking, and Soft OR'. *Systems Dynamics Review* Summer 1994, Vol. 10, No 2. p. 12
7 Russell R., and Taylor B.W. op. cit p373.
8 Harrington H.J., Esseling E.K.C., and van Nimwegen H. 1997. *Business Process Improvement Workbook: Documentation, Analysis, Design, and Management of Business Process Improvement.* N.Y. USA: McGraw-Hill Professional. p. xv.
9 Davidson P., and Griffin R. op. cit p. 248.
10 Hammer M. op. cit p. 191.
11 von Hippel E. 1998. *Economics of Product Development by Users: The Impact of "Sticky" Local Information* Management Science; May 1988; 44, 5 p. 629.
12 Senge P. 1992. *The Fifth Discipline: The Art and Practice of the Learning Organization.* Sydney Australia: Random House, pp. 6-10.
13 Forrester JW. 1994 op. cit.
14 Hoj J, Kato T, Pilat D 1995 *Deregulation and Privatisation in the Service Sector* OECD Economic Studies No. 25/II.
15 National Competition Council. *Energy: Electricity* http://www.ncc.gov.au/sector.asp?sectorID=4 visited March 2009.
16 Hogget J., Edwards L., and Medlin J. 2003. *Accounting 6th ed.* Brisbane: Wiley. p. 1108
17 Davidson P., and Griffin R. op. cit p. 726
18 Urban S.D., Dietrich S.W. and Chen Y. 2007. '*An XML Framework for Integrating Continuous Queries, Composite Event Detection, and Database Condition Monitoring for Multiple Data Streams*' Dagstuhl Seminar Proceedings 07191 http://drops.dagstuhl.de/opus/volltexte/2007/1142/ visited March 2009.
19 Quinn J.A., Williams C.K.I., and McIntosh N. Factorial Switching Linear Dynamical Systems applied to Physiological Condition Monitoring 'IEEE Transactions on Pattern Analysis and Machine Intelligence' http://omnipresence.org/jq/papers/tpami08.pdf visited March 2009.
20 Merilä P., Kilponen T., and Derome J. (eds.) *Forest condition monitoring in Finland – National report 2002–2005* Working Papers of the Finnish Forest Research Institute 45 http://www.metla.fi/julkaisut/workingpapers/2007/mwp045-en.htm visited March 2009.