

INDUSTRIAL ENGINEERING DISCIPLINES FOR THE NEXT MILLENNIUM

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ABSTRACT

The combination of globalisation, new management thinking and technology creates vast new open deregulated markets, wired together by a converging information highway. As new and transformed organisations are re-writing the rules of business, new ways are being sought to address the challenge of this new knowledge era. This paper presents industrial engineering disciplines required to deal with emerging business models in service industries.

1. INTRODUCTION

According to FutureWorld (see <http://asp.futureworld.co.za>) the past two decades have seen three major revolutions transforming world markets. The combination of globalisation, new management thinking and technology creates vast new open deregulated markets, wired together by a converging information highway. New and transformed organisations are emerging as leaders as they re-write the rules of business [1,3,8]. The South African business environment is currently faced with enormous changes, brought about by new technologies and the quest for global competitiveness. A number of these change drivers are well-known information technology (IT) developments such as enterprise resource planning (ERP), electronic commerce and the Internet. This paper presents established and new disciplines required to deal with emerging business models as seen from an industrial engineering perspective.

2. NEW BUSINESS MODELS

The way organisations manage themselves to survive is rapidly changing [1,6]. In the old organisational paradigm alignment takes place between business strategies, resource strategies, business processes and people. This approach changes as the application of IT becomes the main organisational driver, fusing work and technology together. In future digital business strategies will direct streams of work in the supply chain across traditional organisational boundaries, industry boundaries and even international boundaries [1,3]. This is not far fetched as a number of local and international companies such as Dell Computers, Amazon.com, 3Comm, Boland PKS, Mweb, Woolworths and Datatec are involved in billion dollar economic ventures. Besides the creation of deals between large market players, information technology provides the means to level the playing field between all sizes of organisations (see <http://www.salami.com>).

The engineering approach required to support this new business model needs to address the total *business life cycle* of the organisation, the *supply chain*, as well as all *organisational components*. Organisational questions like "What is our strategy?", "How do we manage our supply chain?", "Where do we locate our staff" will have to be dealt with in an integrated manner as well as managing the impact of change [7].

3. VALUE DRIVERS FOR FUTURE ORGANISATIONS

Organisations can be classified into one of three categories, *vertical organisations*, *hybrid organisations* or *virtual organisations* [4]. Vertical organisations own and manage their entire supply chain from processing of raw material to the final product or service, whereas hybrid organisations allow third parties to produce or provide certain products and services in the supply chain. The third and most radical business model places emphasis on vendor management to source and provide all components of the final product and service. This type of organisation focuses on the exploitation of what needs to be done, at what specification level, and how third parties fit together in the “virtual organisational web”.

The business model that fits this thinking evolves around *customer service*, *business process sourcing*, *information technology*, and *knowledge*. This means that a paradigm shift takes place from make-to-stock environments to mass customisation (amazon.com’s service offering), information technology becomes fused into business processes (<http://www.netledger.com>), business process outsourcing becomes the means to manage (3Comm’s Palm Pilot), and knowledge is used as a tangible asset [6]. It is believed that within this business model, three keys will enable organisations to unlock economic value-added, *process*, *change* and *knowledge*.

It is imperative that the approach used to create new business models is based on an engineering strategy which states that a) strategy follows the customer, b) strategy aligns business processes, c) the *process* is the central focal point of the organisation, d) people enable the business process, e) resources support the process execution, and f) values and culture ensure alignment between people, process, strategy and customers [11].

4. BUSINESS ENGINEERING

In this day and age successful accomplishment of large-scale system development projects requires a combination of technical specialties and expertise. Within this we need to realise that engineering is concerned with the economical use of limited resources for the benefit of people. In general, classical engineering has focused mainly on the system performance as the main objective rather than on the development of the overall system of which the product or service is part. *Experience in recent decades indicates that a properly functioning system that is competitive cannot be achieved through efforts applied largely after it comes into being* [8,10].

Industrial engineering is concerned with the design, improvement, and installation of integrated systems of people, materials, information, equipment and energy. It draws upon specialist knowledge and skill in the mathematical, physical, and social sciences together with the principles and methods of engineering analysis and design to specify, predict and evaluate the results to be obtained from such systems (<http://ie.up.ac.za/>).

Business engineering is a systems approach to the analysis, design, development and construction of complex business systems, focusing on business processes as the integrative component of the total system. Using a systemic thinking view, a development foundation for new business models are defined through the following principles:

- a *top-down* approach to view the system as a whole,

- A *life-cycle* orientation which addresses the phases of system design, development, production and/or construction, distribution, operation, maintenance, support, retirement, phase out and disposal,
- better and more complete effort to the *initial definition of system requirements*, and
- Interdisciplinary or team approaches throughout the system design and development process to ensure that all design objectives are addressed in an effective and efficient manner [15].

The vertical implication of this approach is that the whole life cycle approach is process-based, from the customer need identification to conceptual design, implementation and maintenance. The horizontal implication is concerned with three specific business life cycles, the process of the product/service manufacturing/construction, the product support process and the service capability process [3].

5. ESTABLISHED INDUSTRIAL ENGINEERING DISCIPLINES

These trends show that from the industrial engineering perspective the ability to design, maintain and manage organisations will center on *process-*, *change-* and *knowledge* capabilities. In the identification and definition of “new” or emerging disciplines to the current Industrial Engineering field a number of assumptions have been made, given the direction and importance of new business models. They are:

- Business value gets generated either through productivity enhancement, exploitation of current markets, or through the creation of new markets.
- Change occurs as a result of thought leadership, strategy formulation and implementation initiatives.
- Organisations use methodologies, tools and techniques such as Total Quality Management (TQM), Continuous Improvement (CI), Business Process Reengineering (BPR), Knowledge Management, Value Chain Analysis [9], Learning Organisations [11] etc. to improve the organisation.
- Innovative new solutions are primarily the result of organisational knowledge with regards to the market place, the organisation business mandate and internal work structures [14].

Within context, the following disciplines are selected from industrial engineering curricula, believed to be of value for creating new business models, that is operations management, engineering economy, total quality management, continuous improvement, project management, simulation/resource optimisation, and information system development (<http://ie.up.ac.za/>).

6. EMERGING DISCIPLINES

Given the requirements to assist the engineering of organisations, the following new or emerging disciplines are proposed to compliment and supplement the selected disciplines (see paragraph 5); *performance management*, *knowledge management*, *business architectures*, *change management* and *business process engineering*.

Performance Management's [12] core focus is to ensure that *alignment* takes place between the vision, strategy and operations within the organisation. This means that work done in the organisation has to contribute towards the achievement of the stated business objectives. The

fundamental approach with performance management is to combine individual performance areas in the organisation and cluster them together in a logical fashion around a financial perspective, a customer perspective, an internal process perspective and a learning and growth perspective. Implementation of these objectives, measures and targets are linked via process ownership to team goalsheets and finally individual goalsheets, ensuring ownership and implementation of strategy.

Knowledge Management [14] is traditionally seen as the management of information and secondly the management of people. Combining these two focus areas, knowledge management follows a discipline through which value is created from an organisation's non-tangible assets. By managing non-tangible assets, organisations can increase economic value-add many times over.

The objective of knowledge management is to integrate the collective knowledge of employees in such a way that the whole is greater than the sum of the parts. It develops the organisation's ability to learn, undergo a continual process of change, and by doing so, improve and enhance the performance of the organisation [14]. Knowledge management applications focus mainly on the organisations external structures (customers and suppliers), its competencies, and internal work structures.

Business Architectures [13] are models of the organisation, used to blueprint organisational components and the interface and/or integration of organisational components. This may include strategic -, process-, resource-, information-, or human resource architectures defined at conceptual levels, logical levels, and physical levels. Business architectures are used in a number of applications such as enterprise resource planning package implementations, business process reengineering projects, etc. [10].

The **Change Management** [3] discipline deals with organisational change in two ways, first the work activities required to implement changes in the organisation, and secondly dealing with people experiencing changing conditions in the organisation [2]. Work actions need to be planned around the change of process, structure, people, resources and strategy in the organisation through plans, deliverables, timetables and supporting infrastructures.

The difficult part of change is the "soft" side, that is dealing with people through training and education programs, communication, organisational development, and human resource interventions (recruitment, placing, retraining, exit processes). As change management is *the* critical factor to ensure implementation success, change management interventions run in parallel with work activities, aimed at the appropriate people, executed within selected timeframes of the project.

Business Process Engineering [6,7] is an engineering approach used to change business processes. Organisations execute business process engineering projects with the aim to achieve breakthrough innovations which will result in the creation of business value. However to achieve this, business processes should be treated in a holistic manner dealing with customer, process, people, structure, resources and strategy [8,15].

Performance management, knowledge management, business architectures, change management and business process engineering deal with with *process-*, *change-*, and *knowledge* keys as required to design and implement emerging business models.

7. CONCLUSION

It is believed that the field of Business Engineering is based on a number of current and emerging industrial engineering disciplines. Current disciplines include operations management, engineering economy, total quality management, continuous improvement, project management, simulation/resource optimisation, and information system development. New disciplines to add are *knowledge management* (to transform knowledge from an intangible asset to a tangible asset), *business architectures* (to allow organisations to build organisational blueprints), *change management* (to assist in organisational change and implementation), *business process engineering* (to manage business processes) and *performance management* (to align change to organisational goals). Combining these disciplines with established industrial engineering disciplines allow organizations to plan and implement business solutions in the organisation, changing all organisational components in a holistic manner to create business value-added.

8. REFERENCES

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