

Integrated management systems: An agile manufacturing enabler

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ABSTRACT: *Research has shown that organisations are moving towards agile manufacturing in response to a rapidly changing business environment. Agility is the competence of an organisation to respond to unpredictable business forces. This requires that an organisation develop dynamic management systems that are able to support continuous change. This paper examines systems thinking and proposes a holistic approach to developing an integrated management system. A case study of a manufacturing company is reviewed showing the use of a “roadmap for change” in the development of an integrated management system that supports the concepts of agile manufacturing.*

Keywords: Agility, Agile Manufacturing, Systems Integration, Certification Standards, Holistic

INTRODUCTION

Traditional management systems have concentrated on the reduction, or at least control, of cost. This is visible by the amount of energy expended by organisations in such areas as financial and inventory control. However, a shift to a more customer-focused approach was initiated by the introduction of the Quality Management System (now ISO 9000 series) in the 1970's and widespread adoption of TQM principles in the 1980's. Management systems have been seen to bring consistency throughout varying types of organisation and have brought the concept of quality to the general public. The original intended principle for advanced management systems was, and still is, a platform for continuous improvement; this point is reinforced by the developed ISO 9000 (2000 edition) that will include a focus on continuous improvement activities.

Large organisations were first to adopt this procedural approach and began demanding that suppliers become accredited thus ensuring that the principle filtered down through the supply chain. The imposition of such a scheme meant that many of the accredited organisations aimed for compliance rather than striving for continuous improvement. Outwardly an organisation accredited to ISO 9000 was perceived as being a quality organisation; the internal management style was, in most cases, little different from the cost reduction focus endemic of the last fifty years. This is not to say that all organisations followed this path but in general the majority of organisations observed by the research group adopted an accredited quality management system to satisfy a customer requirement and hence collect a 'badge'.

New management systems are being developed and consequently customers are demanding suppliers achieve further certification to systems standards; predominantly environmental (ISO 14001) and Occupational Health & Safety (OHSAS 18001: 1999) and more are likely to follow. The compliance approach favoured by the majority of organisations will be used for the 'bolting on' of these new management systems rather than fully integrate into existing standards. This will inevitably result in more 'badge' collecting with companies using accreditation as a marketing tool only and not a system that adds value supporting continuous improvement.

'SNAPSHOT' REPRESENTATIONS OF ORGANISATIONS

Management systems and hence managers often view organisations as a collection of functions led by an individual director (e.g. Financial, Manufacturing, & Sales) bound by a hierarchy. This perception leads to functions operating predominantly in their own fields and in extreme cases building empires. This introspective view of a function encourages the formation of barriers between departments and in turn discourages the transfer of information, knowledge and experience over these barriers. Cross-functional working is at best uncomfortable for many organisations, and in some impossible, because the predominant view of an organisation is functional and hierarchical. The effort to achieve accreditation is substantial, even to receive a badge, and yet the information collected is never fully exploited. This is particularly true in organisations that have the management systems safely stored in multiple volume lever arch files. The information, knowledge and experience do not exist in a number of documents, as this is only a static representation of the organisation, but in the thoughts,

actions and deeds of the people. The organisational chart as depicted in the top portion of figure 1 traditionally represents a static view of an organisation based around functions and hierarchy. However, the normal flow for work is through the functional departments cutting across the boundaries of the functions. This flow of work is shown by the process flow diagram at the bottom part of figure 1. Most organisational processes consist of cross-functional work, which has to travel across the organisation, hence processes must pass through functional heads. One of the constraints placed upon an organisation when seeking accreditation is the need to document the organisational structure, processes and activities. However, once an organisation is committed to documenting the system of structure, processes and activities this representation of the company is only accurate for a moment and hence is a static representation.

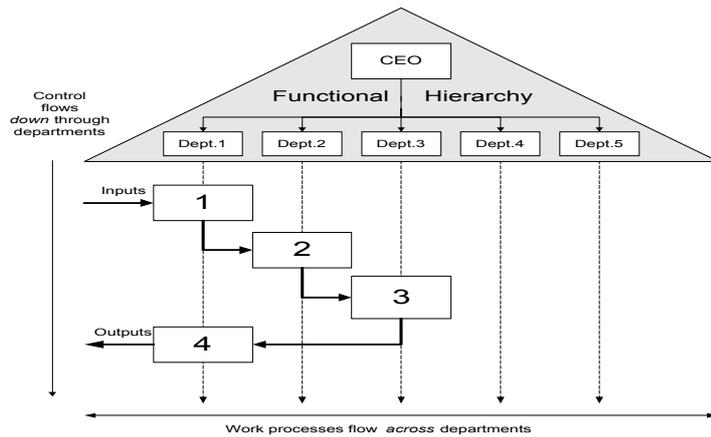


Figure 1: Functional hierarchy vs. product/service flow

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AGILE MANUFACTURING

Management principles have been developed in a reductionist culture even to the point of management being termed a science (Checkland, 1988). The reductionist, functional or scientific view at best leads to sub-optimisation, rather than optimisation, of an organisations performance. The sub-optimisation of an organisations performance is well documented in the works of W.E. Deming (1986). This scientific view endeavours to break a problem down into the simplest form and then make generalisations based upon observations using the principle of Ockham's razor as discussed by Checkland (1988). Lean thinking is a reinforcement of the cost reduction ethos and organisations have increased profits by reducing wasteful activities. A lean organisation cannot adapt to all eventualities and as such cannot cope with changes especially those driven externally (Goldman et al,1999). Hence lean thinking is not always an appropriate response to today's dynamic business environment

Organisations are not static bodies and as a consequence very few organisations operate in a stable arena, therefore organisations should not be represented as a static system. Research has shown that in response to a rapidly changing business environment organisations are moving towards agile manufacturing (Sharp et al,1999). Agility is the competence of an organisation to respond to constant change, uncertainty and unpredictability (Kidd, 1996). This requires that an organisation develop dynamic management systems that are able to support continuous change and hence for a manufacturer a truly integrated management system would be an agile manufacturing enabler.

Modern manufacturing concepts such as agility have not been widely adopted or exploited by traditionally structured companies. The authors argue that agile principles need a management approach, which is not promoted by the functional structure operated by the majority of organisations. Organisations that attempt to constrain the people they employ with a simplistic view of their (working) world will not realise the potential that is greater than the sum of the parts (i.e. holism). There is a need, therefore, for a structure that combines the talent of all the people whilst at the same time satisfying accreditation requirements. A balance must be struck between satisfying the constraints of the organisation such as compliance to accreditation and unleashing the creative potential of the people within the organisation to provide a dynamic system. There is therefore, a need to move away from 'snapshot' representations of an organisation and a need for a representation of a dynamic system.

SYSTEMS THINKING

A system is described as by Checkland (1988) as "a model of a whole entity" and has the characteristics of "emergence, hierarchy, communication and control" when applied to human activity. The reductionist perspective is, as has been shown, to break a problem down into small parts. Systems thinking works on the principle that most organisations do not operate in isolation. A biologist, Ludwig von Bertalanffy, was the first to argue that general scientific ideas were relevant over a range of disciplines; consequently he is regarded as the founder of systems thinking. Systems thinking allows the observation of interrelationships and patterns for change using a body of knowledge and tools developed over the last fifty years. Peter Senge (1997) says:

We have to develop a sense of connectedness, a sense of working together as part of a system, where each part of the system is affecting, being affected by the others, and where the whole is greater than the sum of the parts.

Therefore the first thing, is to realise everything is interrelated, complex and dynamic and consequently we have to change the way we think and interact with each other. The systems approach can be (or is normally) applied in two ways; hard systems thinking and soft systems methodology (SSM). A comparison of the key features of hard systems thinking and soft systems methodology can be seen in table 1.

The difference, at the simplest level, is described by Checkland et al, 1990 as “Hard systems engineers tackle rather well-defined problems, while soft systems methodologists address messy, ill-structured, problem situations.”

<i>School of thought</i>	<i>Essential conception</i>	<i>Theory</i>	<i>Focus</i>	<i>Activity</i>
Hard	Rational	Positivist	Quantitative	Optimisation
Soft	Accepts irrationality	Interpretivist	Qualitative	Management

Table 1: Contrasting hard and soft systems thinking (Flood et al, 1991)

A hard systems thinking approach contains the disciplines of operational research, systems analysis and systems engineering and as such have many similarities with traditional management systems. Soft systems methodology has great potential for organisations as Forbes (1995) points out;

1. *it firstly deals with the [world view] held in the situation by making the beliefs held an explicit part of the debate.*
2. *it secondly arrives at a description of the activities required in the situation as well as the information required by the activities and the measures of performance that could be applied to those activities.*
3. *finally it requires their user to improve their skills in using the methodology through a process of action research.*

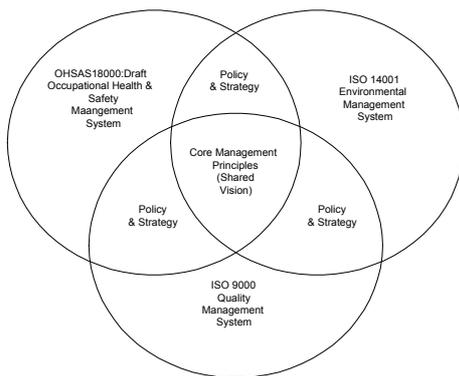


Figure 2: Integrated Management System

Traditional management structures have developed individual management systems for each area of responsibility (e.g. quality, environmental, health & safety and financial). This is partly due to the reliance on software packages “each focused on enabling localized efficiency and productivity” (Singh, 1997). A more effective method is to develop one Integrated Management System (IMS), which takes a holistic approach.

At the operating level, each management system has unique processes, which are undertaken. A representation of this can be seen in figure 2, which, in turn, is a development of an earlier idea (Bamber et al, 1999). Successful business integration has been recognised as an important factor for competitiveness of a manufacturing business (Bittici, 1998). This approach is not limited to a manufacturing scenario and evidence exists for the application to railway engineering management (Chan et al, 1998) and service organisations (Karapetrovic, et al, 1998a).

SYSTEMS INTEGRATION

Common to all management systems is a set of core management principles (or the *shared vision*, Senge, 1997). This shared vision is then used to develop the policy and strategy where some areas of commonality exist between the various management systems.

The perception of integrated management systems is one where two or more systems are brought together and linked (Karapetrovic, et al, 1998b). This is not the approach taken in this paper. The bolting together of several management systems will lead to some commonality, and hence reduction in waste. However, true value will be added by developing a management system, which can sustain and develop a business and as an outcome satisfy accreditation audits.

There is evidence that whilst certification bodies have not been active in promoting integration they are now showing interest (Wilkinson et al, 1998), hence no precedent exists for an audit methodology of a fully integrated management system. As such this paper proposes the audit of an integrated management system can benefit from the use of a matrix, such as the hypothetical example in figure 3. The corporate mission document (figure 3) is an overview of the entire organisation, which correlates change-plans (i.e. similar to the Oakland, 1999 critical success factors and critical processes) and organisational processes with the accreditation standards. Included within the document are the shared vision, policies and strategies of the organisation but these are intended to aid the overview of the audit rather than show direct correlation. Hence, the audit matrix is intended as a sign-posting document directing internal or external auditors towards relevant processes and change-plans. This

corporate mission document also aids the understanding of the interrelated and dynamic nature of the organisations processes and strategies and indicates that changes to the management system must take into consideration this connectedness. For an integrated management system to succeed a change in the people’s perception of the organisation is required accompanied with a change in the activities performed.

Corporate Mission Document			Accreditation standards			
			ISO 9000	ISO 14001	OHSAS 18001	Other
Shared Vision			●	●	●	●
Policies	Strategies	Change-plan 1	●	●	●	●
		Change-plan n-1	●	●	●	●
		Change-plan n	●	●	●	●
	Processes	Process 1	●	●	●	●
		Process 2	●	●	●	●
		Process 3	●	●	●	●
		Process 4	●	●	●	●
		Process n-2	●	●	●	●
		Process n-1	●	●	●	●
		Process n	●	●	●	●

Strong Correlation ● Medium Correlation ● Weak Correlation ●

Figure 3: Audit matrix for an integrated management system

The successful integration of management systems hence, cannot be achieved by the bolting together of several management systems, which were developed independently to satisfy accreditation. Systems integration inevitably leads to change with some system redundancy being inescapable, but this might only be achieved by functions relinquishing existing power in favour of the holistic view. The management of change is a subject, which is difficult for any organisation to avoid but one that few deal with effectively. Several models have been suggested for managing change (Cooper 1993, Wheelwright 1992) but these are open systems, without feedback loops, and as such do not promote continuous improvement and hence agility. The HPO research group based at the University of Salford has developed the roadmap for change as a guide for change agents.

ROADMAP FOR CHANGE

The roadmap for change, seen in figure 4, can be divided into four sections which simply equate to why, what, how and when of the proposed change. The first part establishes *why* the change should take place. Before a journey can take place a final destination must be known or, how else does anyone know when they have arrived? This is captured by considering Covey (1990) and the concept “begin with the end in mind” or for the purposes of the roadmap “end in mind”. The second stage of the roadmap examines *what* needs to change. The ‘as is’ establishes the current status of the organisation and methods to determine this state are dependent upon the nature of the change. The ‘to be’ is the position that is to be attained at the end of the change. This is not always the same as the ‘end in mind’ as an organisation may choose to take several small steps towards an ultimate goal or vision. The difference between the ‘as is’ and ‘to be’ is the way forward also referred to as creative tension (Senge, 1997). The *how* stage takes the way forward and uses this information as the planning stage for Deming’s cycle of continuous improvement (i.e. plan-do-check-act or PDCA). This then passes through the remainder of the cycle and constitutes *when*. Each element of the cycle of continuous improvement operates inside a secondary cycle thus promoting continuous improvement at each stage. The aim within the operational environment is that learning and working are integrated through adoption of the PDCA cycle. The adoption of PDCA supports the principle of an accredited system in that the plans become the standardisation of practice while continuous improvement is accepted and the structured approach enables

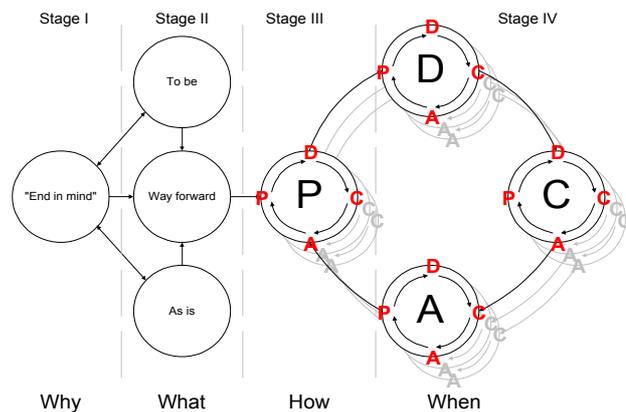


Figure 4: Roadmap for change

controlled change. The competency to deal with change, uncertainty and unpredictability has been termed agility. The roadmap enables organisations either at strategic, tactical or operational levels to manage change whilst at the same time learning new skills which are agile core principles.

DISCUSSION THROUGH A CASE STUDY

Company A is a subsidiary, situated in the North West, of a pan-European group of companies manufacturing electrical installation materials and installation systems for the building industry. Company A have a turnover of approximately £20M and represent 20% of the group turnover. The production capability of the plant consists mainly of sheet metal processing and assembly areas, with areas dedicated to pre-wiring of cable management systems. Within Company A the experience of implementing a company quality management system, certified to ISO 9002 nine years previously, had shown that little benefit is gained from developing an expansive documentation system that is imposed on the people of the organisation. Consequently, because the quality documentation system was imposed and hence not supported, it had taken the company several years to improve the system into an effective management system adding value to the business. Thus the management team had spent considerable effort streamlining the documentation system and developing a co-ordinated and cohesive document structure. Prior to implementing ISO 14001, the ISO 9002: 1994 quality management system standard provided the basic structure for the quality management documentation. However, it was still seen that the quality management system documentation was rigid and inhibited change and to become agile Company A needed to develop a dynamic system, including documentation, that enabled change.

Valuable lessons had been learned from the way the company's ISO 9002 quality system was imposed and consequently became a burden on the company. The example of the quality system being imposed and not integrated demonstrates that lack of integration with other related systems leads to failure and that people object to change being imposed on them. The roadmap for change was used as the enabler of the integrated management system. The "end in mind" was embodied in the corporate mission statement as:

We see restructuring, reorganisation and reengineering of our strategies as an ongoing process to secure our future competitive strength.

An initial audit was conducted to determine the 'as is' status. The audit showed a dominant Quality Management System (QMS) with elements of an Environmental Management System (EMS) and an Occupational Health and Safety Management System (OH&SMS). Further to this the audit team recognised that, although the quality systems documentation structure was appropriate prior to the total integration effort, it needed a further up-date to incorporate the goals and objectives of the EMS (ISO14001) which directed the development of an environmental programme. Consequently a review of the documentation system revealed a missing component of the QMS (ISO9002) and the OHS&SMS (OHSAS 18001); namely goals and objectives for these sub-systems had not been defined or communicated.

The implementation of an integrated management system followed the plan-do-check-act of the roadmap. The main differences in the new operations are; firstly the mission of the organisation now becomes more visible and the policies directly support it; secondly the quality policy does not head the documentation system, rather the operating policies of the wider system are seen; thirdly the quality manual no longer exists at Company A as it has been replaced by an operations manual which incorporates goals and objectives of the integrated system, therefore more clearly identifying the system boundaries and expectations; fourthly there is a recognition that an improvement program is an integral part of the procedural operations. Thus Company A has developed a more holistic system with integrating sub-systems (such as QMS, EMS, and OH&SMS) and with the adoption of the PDCA philosophy provide an agile enabler in-line with the corporate mission statement mentioned above. The development of the integrated management system through the adoption of the roadmap for change is the foundation for the company's agile manufacturing capability, because this moved the organisation's people away from thinking solely in a functional manner into a holistic systems perspective. Competence can only be achieved through learning and this is especially true when developing an agile competence. The lessons learned by Company A from this were:

- The implementation of a new system must be fully integrated to existing strategies, processes and practice and other developing initiatives.
- The implementation must be supported through the involvement of all affected employees.
- Communication of progress and goals shall be a key initiative.
- A steering group with knowledge of the whole system is established to co-ordinate activities.

Further work at Company A is aimed at continually developing the skills and competencies of the work force within the framework of the IMS program. This emphasis on learning supporting the goals and objectives of the integrated manufacturing system provides the structure required by the Investors in People (IIP) scheme and as

such the company is currently working toward an IIP assessment schedule. The continuing support of the training and personnel development function is aimed at providing a structured progression for increased agility.

CONCLUSION

In developing an integrated management system an organisation must use a holistic approach incorporating systems thinking. Change is inevitable when implementing an integrated management system and successful change only comes about when there is a clear “end in mind” that is shared by the people involved in the change effort. An integrated management system can become an agile enabler when the system that is developed is dynamic and incorporates continuous improvement and learning.

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