

TOWARDS AN EXTENDED ALIGNMENT MODEL FOR A COMPLETE ALIGNMENT OF MANUFACTURING INFORMATION SYSTEMS

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Abstract: Today companies need flexible and adaptable Information Systems (IS) to support their business strategies and organisational processes, as well as to facilitate their adaptation to changes in environment. In particular, in the manufacturing sector companies need flexible IS to make the integration of infrastructures easier, to support production management and to be able to respond to the evolution of support technologies. To deal with these specific requirements the alignment between the manufacturing IS with the organisation's strategy and its outside environment is necessary. However, most of the research in the IS alignment field is related to the alignment of IS with the organisation's strategy, neglecting the alignment with the external environment. Thus, in order to support complete alignment of manufacturing IS we propose in this paper an extension to the Strategic Alignment Model (SAM) of Henderson and Venkatraman (1999). The extended SAM allows the definition of possible alignment perspectives that accentuate elements to be aligned and the alignment sequence. This set of perspectives and the extended SAM are a first step towards tackling the alignments with the strategy and with the environment.

1 INTRODUCTION

Today companies need flexible and adaptable Information Systems (IS) to support their business strategies and organisational processes, as well as to facilitate their adaptation to changes in environment. Corresponding dynamic adaptations of the IS are studied in the field of IS alignment. Contributions to IS alignment focus mainly on the so-called -internal-strategic alignment. Particularly, the Strategic Alignment Model (SAM) (Henderson and Venkatraman, 1999) is interesting because it provides guidelines structuring the domains to be aligned as well as possible alignment processes by proposing alignment sequences in the form of four alignment perspectives.

However, the importance of achieving coherence between the organisation's strategy and its environment has also been acknowledged (Andrews, 1987). Therefore, in (Camponovo et al., 2004) it is suggested studying the IS alignment not only from the strategic alignment point of view, also by considering two additional levels that enable a global and complete alignment of the IS. First, alignment with the environment takes into

consideration the external environment and assumes that the information system has to integrate features for assessing this environment. Finally, alignment with uncertain evolutions over time emphasizes the necessity to design information systems able to evolve according to future changes.

In particular, in the manufacturing IS sector these two additional levels of alignment are crucial and have to be operationalised. Therefore, it is proposed, in this paper to extend the Strategic Alignment Model (SAM) of Henderson and Venkatraman by adding the manufacturing domain. Section 2 gives a brief overview of the SAM with its underlying concepts. Section 3 presents the extended SAM, derived from the original SAM model by analogy of concepts. Section 4 discusses the possible alignment modes between the extended SAM domains. Section 5 concludes with work perspectives.

2 SAM OVERVIEW

2.1 SAM Concepts

The Strategic Alignment Model (Henderson and Venkatraman, 1999) is structured in terms of three classes of concepts:

- *Domains*: Business and Information Technologies (IT);
- *Perspectives or levels* (that split domains): external (strategy) and internal (structure),
- *Components* (that characterize and compose each level): scope, competencies and governance in the external level; infrastructure, skills and processes in the internal level.

IS strategic alignment is conceptualised in the SAM in terms of two building blocks (Henderson and Venkatraman, 1999):

- *Strategic fit* (the interrelationships between external and internal levels of a domain) and
- *Functional integration* (integration between "Business" and "IT" domains).

This functional integration is detailed into: (1) *Strategic integration* related to the external level; and (2) *Operational integration* related to the internal level.

2.2 Towards an Extended SAM

Managing manufacturing IS complete alignment, in particular with the environment, requires to cope with various stakeholders by assessing numerous expectations, and integrating numerous uses while managing the strong links existing between the information technologies to be implemented and the manufacturing infrastructure. Indeed, as shown in

(Goepp and Kiefer, 2006) the actors involved are various from the workshop manager to the operators, and the manufacturing IS has to play an integrating role between the manufacturing infrastructures. Therefore, it is proposed in this paper to extend the SAM by adding the manufacturing domain, which aims at integrating the dimensions linked to the manufacturing infrastructure and actors (cf. figure 1). The structure of the manufacturing domain is derived from the original SAM through analogy of concepts. The next section details this work.

3 MANUFACTURING DOMAIN

The definition of the manufacturing domain is based on the work of (Hayes and Wheelwright, 1984; Hill, 1995) detailing the decision categories involved in the definition of a specific manufacturing strategy. It is proposed to map these categories into the manufacturing components structuring the external and internal levels. By analogy with the original SAM components, some categories of decisions can be easily mapped in the external or internal level. For example, human resources and organisation decisions address issues such as: incentives and compensation, investment in human capital. These match therefore with the internal component termed manufacturing skills.

Nevertheless, mapping some other categories can be quite complex because they involve aspects belonging both to the external level and the internal level. In this case, we choose to match these categories to the external level in order not to miss a potential impact on the other domains.

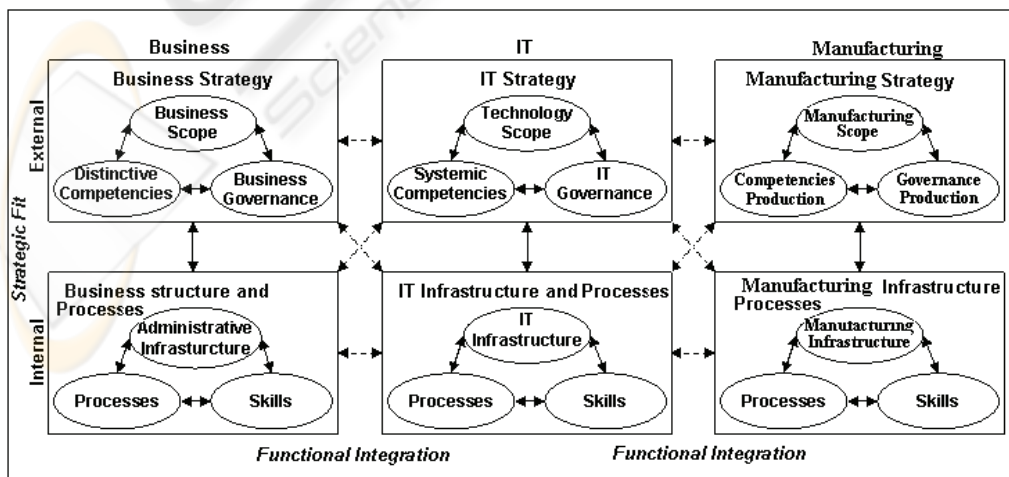


Figure 1: Extended SAM with manufacturing domain.

Thus, for example, manufacturing technology decisions concern choices on specific manufacturing technologies, such as recent innovations in computer-aided design (CAD), that could impact new products and services (business scope) and strengthen business distinctive competencies. Thus such decisions may support or shape the business strategy, this is why they may be placed at the external level, specifically, in the manufacturing scope component. However, manufacturing technology decisions also concern the configuration of equipment into lines, cells, etc. that collectively define the technical infrastructure. In this way, a part of these decisions may be also placed at the internal level, specifically, in the manufacturing infrastructure component. Based on the previous analysis, the categories of decisions are mapped as follows (table 1):

Table 1: Categories of manufacturing decisions mapped on manufacturing domain component.

Manufacturing External level	
Scope	*Manufacturing technologies *Product scope/introduction
Competencies	*Manufacturing capacity *Quality
Governance	*Vertical integration
Manufacturing Internal Level	
Infrastructure	*Equipment configuration *Facilities
Processes	*Manufacturing planning/processes
Skills	*Human resources/organisation

Adding the manufacturing domain to the original SAM is a first step to reach our target. To efficiently support manufacturing IS alignment, it should be completed, with alignment perspectives. These set the paths between the different sub-domains in order to align them. However, to be exploited and extended to our work, the underlying mechanisms and conceptual elements are worked out and discussed for the manufacturing domain in the next section.

4 ALIGNMENT PERSPECTIVES CONCEPTUAL ELEMENTS

4.1 Alignment Principles

For building SAM alignment perspectives the two following hypothesis are made:

- Alignment perspectives involve both strategic

fit and functional integration.

- Strategic alignment can only occur when three of the four domains or set of choices are in alignment. Indeed, change cannot happen just in one domain without impacting on at least two of the remaining three components in some way.

Thus, an alignment perspective can be derived by drawing a line through three of the four domains. This line includes first a strategic fit and later a functional integration or vice versa. To identify the alignment direction, the three involved domains can be classified through as anchor domain, pivot domain and impacted domain (Luftman et al., 1993) (cf. figure 2).

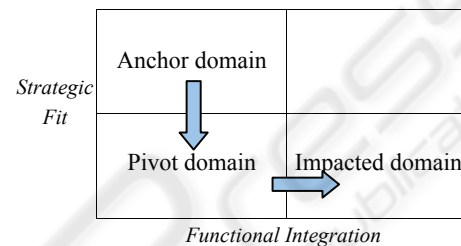


Figure 2: Types of domains.

4.2 Alignment Mechanisms

Keeping the previous elements in mind, the four alignment perspectives (Strategy execution, Technology transformation, Competitive potential, Service level) detailed in by (Henderson and Venkatraman 1999) have been analysed. As a result the following underlying alignment mechanism are worked out:

- *Alignment mechanism A:* The alignment perspectives imply always two relationships between the four domains: a strategic fit and a functional integration.
- *Alignment mechanism B:* the anchor domain takes always place at the external level because it is the interaction with the external environment, it is the domain that drives change.
- *Alignment mechanism C:* the impacted domain always takes place at the internal level because short term changes take place in the infrastructure.

4.3 Possible Alignment Perspectives

Applying the alignment principles and mechanisms ten alignment perspectives (cf. Figure 3) are defined for the extended SAM. These perspectives are set up into three categories depending on the anchor domain: (1) *Business* as the driver (perspectives 1 to 3); (2) *IT* as the driver (perspectives 4 to 7); (3) *Manufacturing* as the driver (perspectives 8 to 10).

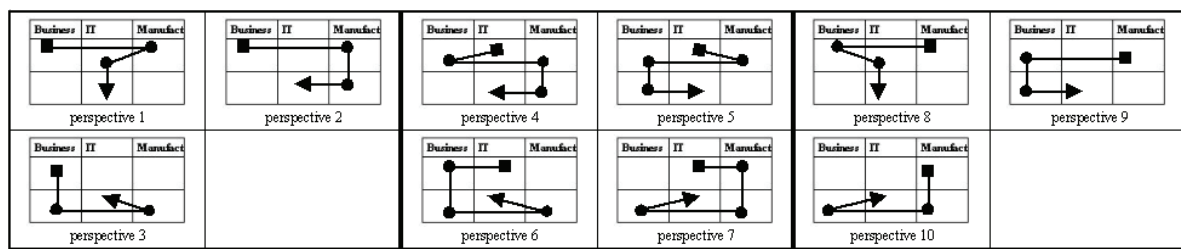


Figure 3: Alignments perspectives for the extended SAM.

5 CONCLUSIONS AND PERSPECTIVES

In order to support the complete alignment of manufacturing IS an extension of the Strategic Alignment Model (SAM) has first been proposed. The structure of the manufacturing domain was derived from the original model by analogy of concepts. The conceptual elements that structure "original" alignment perspectives were pinpointed in the form of alignment mechanisms. As a result, ten potential perspectives impacting the IS infrastructure have been identified. Among the perspectives impacting the IS infrastructure these with the business strategy as driver of change are, probably, the most common. They explore the different paths enabling to implement a given business strategy through related manufacturing capabilities either directly (perspectives 1 and 2) or indirectly (perspective 3). The perspectives driven by the manufacturing strategy underline the fact that the manufacturing domain could impact and shape the business domain. However, business and manufacturing driven perspectives consider the IT domain as a support. This is among other linked to the fact that manufacturing technologies evolve slower than IT. As a consequence the design of manufacturing IS is usually conditioned by the evolution of manufacturing technologies and has to be adapted consistently. The perspectives driven by the IT explore how IT strategy might drive change asking therefore for new IS functionalities. They underline the fact that IT capabilities play a central role in order to improve organisation performance and increase value. For example, perspective 4 involves the five domains related by perspectives 1 and 2 in combination. The main difference is that in perspective 4 the IT strategy is the initiator of change, shaping thus the business strategy and later manufacturing strategy with its corresponding infrastructure. The set of proposed perspectives and the extended SAM are a first step towards tackling alignments with the strategy and with the

environment. Indeed, the proposed elements emphasize what should be aligned and in which sequence. However, the question how to choose the best perspective remains open. Moreover, the alignment with uncertain evolutions can not only be tackled with the extended SAM and its related alignment perspectives. This kind of alignment requires a "dynamic" view on alignment by, for example, integrating the temporal perspective. By doing this the problem becomes more complex because it implies to work out "dynamic" alignment perspectives. These deal with the interactions between several extended SAMs from time horizons. To do this the multi-screen tool exploited in (Goepf et al., 2006) to perform a coarse IS alignment, could be developed and completed.

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