IT IN CONSTRUCTION: ALIGNING IT AND BUSINESS STRATEGIES

Albertus Laan[1], Arjen van Leuven[1], Simon Kolkman[2] and Hans Voordijk[2]

[1] *Balance & Result Management Consultants, PO Box 2382, 7500 CJ Enschede, The Netherlands*
[2] *Technology and Management, University of Twente, PO Box 217, 7500 AE Enschede, The Netherlands*

The extent to which information technology (IT) infrastructures and strategies are aligned with business processes and strategies varies widely along firms. The objective of this paper is to explain the success or failure of IT in construction firms by focusing on the alignment (or lack of it) between business strategy, IT strategy, organisational infrastructure, and IT infrastructure. It is hypothesised that the 'fit' among these elements, the domains of the Strategic Alignment Model, is positively related to the Business Value of IT in Construction. The IT Business Value is evaluated in terms of efficiency, effectiveness and business performance. By applying the Strategic Alignment Model to the Dutch construction industry, it is shown that the inadequate alignment between these domains is a major reason for the modest added business value from IT investments in this industry. The first lack of alignment is the technology shortfall: hence IT contributes in an inadequate way to strategic processes of construction firms. The second lack of alignment is the strategy-shortfall: hence the firm strategy impedes the implementation of IT that could generate a high business value.

Keywords: alignment, IT business value, information technology.

INTRODUCTION

The extent to which information technology (IT) strategies are aligned with business strategies varies widely along firms. These differences are reflected in a well-known typology of the three evolutionary roles that IT plays in firms (Grover *et al.*, 1994; Gupta *et al.*, 1997; Johnston and Carrico, 1988). A 'traditional' role for IT represents a supportive role of this technology that involves no integration between IT and business strategy. An 'evolving' role indicates a one way link; IT supports strategy but does not influence it. An 'integral' role represents integration between IT and business strategy in order to improve the organisational effectiveness within the industry.

The objective of this paper is to understand why IT-projects in Dutch construction firms fail or become successful by focusing on the fit (or gap) between IT and business strategy. We follow the systems approach in which it is hypothesised that consistency of 'fit' among these elements is positively related to the level of success of IT in construction (Drazin and Van de Ven, 1985). In this paper, the basic premise is that there are different effective patterns of logical links of 'fits' between IT and business strategies. The method used for explaining these different patterns of 'fits' is the Strategic Alignment Model of Henderson and Venkatraman (1999). In this model four fundamental domains are defined: business strategy, IT strategy, organisational

[1] h.voordijk@sms.utwente.nl

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infrastructure and processes, and IT infrastructure and processes. Firms with a high level of alignment between these domains will derive high benefits from IT investments. These benefits are evaluated in terms of the concept of IT business value by applying the process oriented approach of Tallon *et al.* (2000).

Structure
In the theoretical framework, the fundamental characteristics of the Strategic Alignment Model and the process-level model of IT business value are discussed. In the second part, benefits from IT investments in the construction industry are assessed by applying these models in civil engineering and housing and real estate. In the concluding section, the failure to realise benefits from IT investments is explained by discussing misalignments in construction firms.

THEORETICAL FRAMEWORK

In this section, the alignment between business and IT strategies and processes is analysed by discussing fundamental characteristics of the Strategic Alignment Model, the process-level model of IT business value, and models measuring IT business value.

Strategic Alignment Model
In this paper, the focus is on aligning investments in IT with business goals. For this analysis, we use the Strategic Alignment Model of Henderson and Venkatraman (1999). The basic premise of our paper is that there are different effective patterns of logical links of 'fits' between IT and business strategies. The Strategic Alignment Model is defined in terms of four fundamental domains: business strategy, organisational infrastructure and processes, IT strategy, and IT infrastructure and processes (see Figure 1). We interpret these domains as systems in which it is hypothesised that consistency between these dimensions is positively related to the business value of IT.

The two internally oriented domains consist of three components: infrastructure, processes and skills.

- The first internally oriented domain is *organisational infrastructure and processes.* This domain is primarily concerned with choices about roles, responsibility and authority structures (administrative infrastructure). The second component is the design of specific business processes that support and shape the ability of the firm to execute business strategies. The third component focuses on acquisition and development of the human resource skills necessary for achieving the required organisational competencies.
- The second internally oriented domain is *IT infrastructure and processes*. The technical architecture is de primary focus: choices in relation to applications, hardware, software, and the data architecture. The second component consists of work processes central to the operations of the IT infrastructure such as systems development, maintenance, and monitoring and control systems. A third aspect is training and development of knowledge, skills and capabilities.
- The externally oriented domains of business strategy and IT strategy also involve three sets of choices: scope, competencies, and governance.
- The first externally oriented domain is the *business strategy*. This domain is concerned with decisions such as product-market offering (the business scope) and

the distinctive strategy competencies that differentiate the firm from its competitors (pricing, quality, superior distribution channels), as well as the range of "make-or-buy" decisions, including partnerships and alliances (the business governance).

- The second externally oriented domain is the *IT strategy*. Here, the IT scope is the primary focus: those specific *information technologies* that support current business strategy initiatives or could shape new business strategy initiatives for the firms. Secondly, attention is paid to so-called systemic competencies: those *attributes* of IT strategy that could contribute positively to the creation of new business strategies or better support existing business strategy. The third topic in this domain is the IT governance: selection and use of mechanisms for obtaining the required IT competencies.

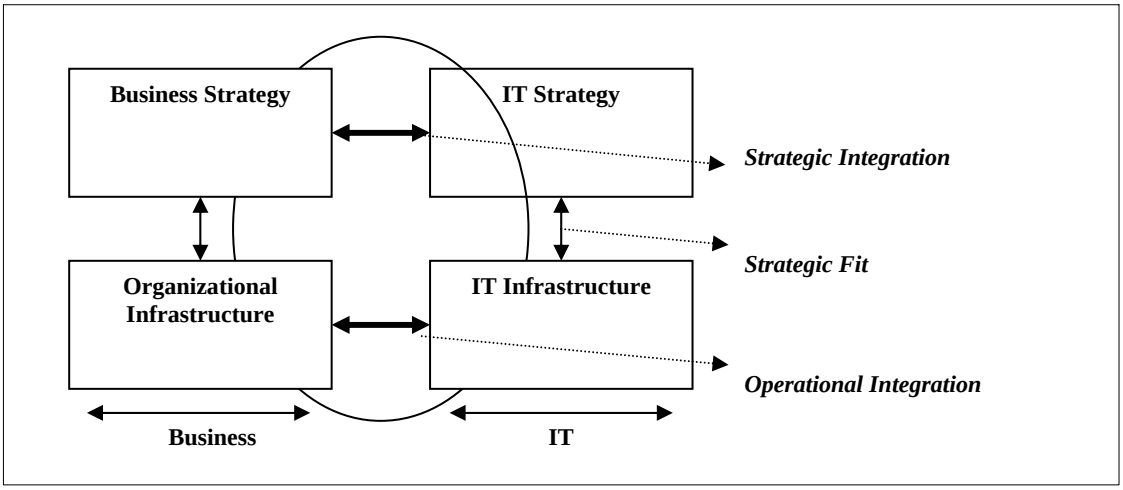

Figure 1: The Strategic Alignment model (Henderson and Venkatraman, 1999)

The basic premise of this model is that an effective management of IT requires a balance among the choices made across all four domains. This strategic alignment is based on two building blocks: *strategic fit* and *functional integration* (see Figure 1).

The *strategic fit* recognises the need for any strategy to address both external and internal domains. Traditionally, IT has often had an internal orientation since the historical view is that IT is a support function not essential to the business of the firm. IT emerged, however, as a critical enabler of business transformation. This development demands for an external focus of IT: the business scope, competencies and governance.

The *functional integration* focuses on the need to integrate the business and IT domains. The first type of functional integration is the *strategic integration*: the link between business strategy and IT strategy. It deals with the capability of IT to shape and support business strategy. The second type of functional integration, stated as *operational integration*, deals with the corresponding internal domains, namely the link between organisational infrastructure and processes and IT infrastructure and processes. This type of integration stresses the coherence needed between the organisational requirements and the capabilities of the IT function.

The process-level model of IT business value

Major question is how to evaluate the benefits of the different alignments as mentioned by Henderson and Venkatraman (1999). In order to deal with this question,

the process-level model of IT business value is discussed (Tallon *et al.*, 2000). In assessing the payoffs from IT at the process level, this model focuses on how IT affects critical business activities within the corporation's value system. These activities include aspects of production, logistics, sales and marketing, customer service, and administrative support.

In terms of Henderson and Venkatraman (1999) the process-level model starts with analysing the *operational integration* between the internal domains. The process-oriented assessment of IT business value is based on the argument that the first-order impacts of IT investment occur at the process level (Barua *et al.*, 1995). IT creates value for the organisation by improving individual business processes, or linkages between processes, or both in terms of Porters' value chain (Porter and Millar, 1985). This value chain divides an organisation into a sequence of primary activities (inbound logistics, operations, outbound logistics, marketing and sales, and service) and support activities. By analysing the impacts of IT on these 'critical value activities', the IT business value can be evaluated. Tallon *et al.* (2000) present different examples from the literature of ways in which IT impacts different business activities within the value chain. The argument of the alignment between internal domains can be seen as follows: the greater the impact of IT on processes in the internal domains, the greater will be the contribution of IT to firm performance.

The process-oriented approach of IT business value of Tallon *et al.* (2000) elaborate also on the alignment between the business strategy and the IT strategy (*strategic integration* in terms of Henderson and Venkatraman (1999)). In characterising business strategy, Tallon *et al.* (2000) follow Porter again. Porter suggests that firms focus on two key business objectives: operational effectiveness (efficiency and effectiveness) and strategic positioning (reach and structure). Porters' distinction between operational effectiveness and strategic positioning can be translated in goals of the firm for IT (the domain of *IT strategy* in terms of Henderson and Venkatraman (1993)). See also Table 1.

Table 1: The alignment between business and IT strategy (Tallon *et al.*, 2000)

Business strategy	**IT strategy**
Operational effectiveness	***Internal***
Efficiency	Reduce costs, increase productivity and speed
Effectiveness	Enhance overall organisational effectiveness
Strategic positioning	**External**
Reach	Extend existing market and geographic reach
Structure	Change industry or market practices

In Table 2, IT strategies are classified and linked to the business strategy followed. The classification of firms is based on whether the goals for IT emphasise operational effectiveness, or strategic positioning, or both.

Table 2: Classification of IT strategies (Tallon *et al.*, 2000)

High	***Operations focus*** IT focus: cost reduction, improving quality and speed and enhancing overall firm effectiveness	***Dual focus*** IT strategy is a combination of both operations and market focus
Operational effectiveness **Low**	***Unfocused*** IT is not critical to any aspect of the business strategy. IT strategy lacks focus and direction	***Market focus*** IT strategy focuses on extending market/geographic reach and changing industry and market practices
	Low **Strategic positioning** **High**	

Measuring IT business value

The IT business value can be measured by analysing the impacts of IT on the 'critical value activities' of Porters' value chain. Determining this value in a structured and meaningful way requires an operational description of what IT is in those critical value activities. Therefore, the concept of IT-based infrastructure (Renkema, 2000) is used. The IT-based infrastructure is the shared system of staff/skills, tools and procedures in the field of IT that is used for a longer period of time. Not all IT-based infrastructures have the same impact on the business processes or on the products and services of a business. In order to be able to assess the main differences in business impact, two main types of infrastructure can be discerned: direct and indirect. The direct infrastructure consists of all shared, relatively permanent capacities and capabilities in the field of IT and to a large extent integrated within business processes. Indirect infrastructure is all shared, relatively permanent capacities and capabilities in the field of IT, which enable the use of IT in business processes. The first type of infrastructure concerns the shared applications of software, databases and knowledge bases of an organisation. The second type of infrastructure concerns the 'traditional' infrastructure of shared technical computing facilities. The indirect facilities create the enabling conditions for the well-directed deployment of the direct facilities, while in turn the use of direct infrastructure necessitates the use of indirect infrastructure. Direct infrastructure generally has a much more tangible business impact than indirect infrastructure, therefore it is often easier to identify IT business value in the value chain for direct than for indirect infrastructure.

How the IT-based infrastructure precisely looks like in practice depends on the decisions taken by the firm. Therefore a checklist of infrastructure components is used (Renkema, 2000). The components can be divided into the value chain processes (planning & support, inbound logistics, operations, outbound logistics, marketing and sales, and service). To determine the added value of IT the direct infrastructure in the value chain processes is charted first. It is assumed that the percentage of the available direct infrastructure components is an indicator of the relative importance of these processes for the company. This percentage gives the ratio between components that are actually available within the firm and the infrastructure components available from the checklist. After that the contribution of IT to the direct infrastructure in the processes is measured, which is an indicator of the possible value of IT to those processes. This percentage gives the ratio between the amount of IT components in comparison to the infrastructure components that are available in the firm.

The possible value of IT only leads to real added value when the IT is functioning properly within the processes. By applying the IS Assessment and Contingency Theory of Myers *et al.* (1998) the functioning of the available IT infrastructure can be measured. The dimensions critical to the success of the IS function are shown in Figure 2. Service quality (the service function), system quality and information quality (reliability) jointly affect both use (usage) and user satisfaction. Additionally, the amount of use can effect the degree of user satisfaction – positively and negatively – as well as the reverse being true. Use and user satisfaction are direct antecedents of individual impact (performance); the multi-individual impacts lead to workgroup impact (synergy); and lastly, this individual and workgroup impact should have organisational impact (business performance).

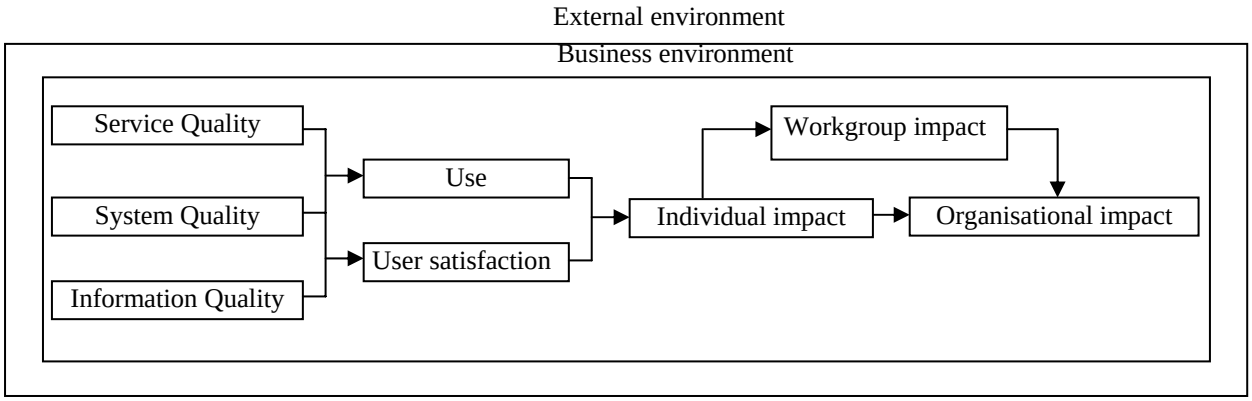

Figure 2: IS Assessment and Contingency Theory of Myers *et al.* (1998)

IT-ALIGNMENT IN THE DUTCH CONSTRUCTION INDUSTRY

In this part, difficulties in realising benefits from IT investments in construction firms in general are explained first by discussing two patterns of misalignments. Secondly, the process-level model of IT business value is applied in civil engineering and housing and real estate. Thirdly, IT business value is measured in three case firms.

The strategic alignment model applied to construction

The inadequate alignment or fit between external and internal domains is a major reason in the construction industry for the failure to derive benefits from IT investments. This lack of alignment is manifested in two ways. The first lack of alignment is the technology shortfall: IT contributes in an inadequate way to the business strategy. The second lack of alignment is the strategy-shortfall: the firm does not maximally exploit the IT-possibilities (see Figure 3).

The lack of alignments of IT investments in the construction industry is an example of a technology shortfall. IT-implementations in construction are generally focused on the back-office processes of the construction company. The functions that are provided by IT are supporting and integrating traditional back-office functions like cost control, equipment planning and calculation. These functions are recurrent and stable and can therefore be standardised. They are not frustrated by industry characteristics as the temporary coalitions realising construction projects, location bound production and the one-off nature of the work. Back-office functions do, however, not have the primary attention of the management. IT is applied as an intra-company tool, while primary processes in the construction industry are characterised by inter-firm activities (the front office activities of the firm). On inter-firm level, the

strategy of operational effectiveness can be realised. Existing IT-tools do, however, not support this strategy. This explains why one can speak of a technology shortfall of IT.

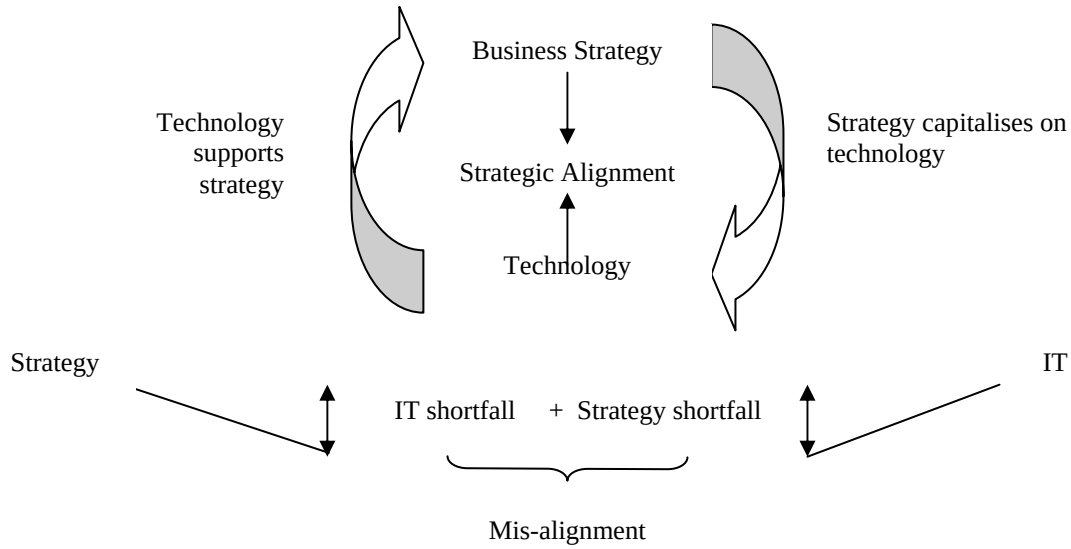

Figure 3: The technology shortfall and the strategy shortfall

The lack of alignment of IT investments in the construction industry is also an example of a strategy-shortfall. This misalignment can be explained by the dominance of operations effectiveness and more specific cost reduction strategies of firms in the construction industry. Cost-driven strategies of firms, in combination with tendering and the one-off nature of a building project, result in temporary project coalitions of an architect, contractor(s) and supplier(s). This temporary and multiple organisation structure in construction still is a major obstacle for applying inter-organisational IT tools. In other words: the firm strategy followed impedes the implementation of IT that could generate a high business value.

The process-level model of IT business value applied to construction

The Dutch construction industry is traditionally divided into two market segments: civil engineering and housing and real estate construction. This partition is relevant for determining the IT business value for a construction firm since value depends on the market in which a firm operates.

In both market segments, public tendering dominates: the bidding price of a firm is the major criterion for acquiring a building project. Public tendering results in firm strategies focusing on costs and operational effectiveness. In the context of these strategies, the goals for IT are cost reduction, increased productivity and improvement of speed. Firm strategies are supported by industry wide initiatives dealing with improvements of the operational effectiveness. Thus, according to the IT-strategy classification of Tallon *et al.*, the expected most common strategy in the Dutch construction industry is an *operations focus* strategy. A restricted number of firms follows a *reach* strategy, in particular firms active in the market of housing and real estate. Because of the location bound nature of construction, these firms acquire existing construction firms or set up new offices in order to increase the region of their market. In some cases, this reach strategy is combined with an IT strategy focused on customer relationships. In this market, more often a *dual focus* strategy occurs.

Table 3: Major cost categories (Economic Institute for Construction, 2001)

Cost categories	Civil engineering	Housing and real estate
Equipment	40%	10%
Personnel	20%	30%
Purchasing	40%	60%

The dominant strategy of construction firms is, however, focused on operations effectiveness and more specific on cost reduction. Therefore, reduction of major cost categories is the major incentive for construction firms to invest in IT. These cost categories of firms in civil engineering and housing and real estate are shown in Table 3.

Table 4: Expected IT business value for different activities of the value chain

Activity value chain	**Expected IT business value**	
	Civil engineering	***Housing and real estate***
Process planning & support	High: in particular planning and exploitation of equipment (40% of the total costs)	High: in particular planning and exploitation of personnel (30% of the total costs) Project planning is also critical because of the large number of parties at the construction site.
Inbound logistics	High (40% of the total costs)	High (60% of the total costs)
Production & operations	Moderate	Moderate
Product & service enhancement	Low	Low
Sales & marketing support	Low	Low
Outbound logistics	Low (restricted number of principals)	Reasonable, high in reach-strategy

IT adds value by improving different activities of the value chain and the linkages between these activities. Based on the cost structures showed, we expect business value of IT on activities of the value chain of construction firms as shown in Table 4. The major focus of IT investments is theoretically the improvement of the utilisation and productivity of equipment and personnel. Secondly, IT should support the planning and execution of projects and preventing stagnation of building processes, in particular in housing and real estate construction. Thirdly, IT can contribute to improvement of purchasing performance of construction firms.

Measuring IT business value in Dutch construction

In order to verify our expectations, three companies in the Dutch construction industry were analysed. In two of the companies the responsible IT-managers were interviewed using a semi-structured questionnaire. In the third case firm the CEO was interviewed. The key figures of the companies are given in Table 5. The *business strategy* of the firms can be described in terms of Porter (1985). The *information strategy* is described in terms of Tallon (2000). By applying these theories we derive the critical business processes form the activity value chain (Tallon, 2000).

To determine the added value of IT in the case firms, the direct infrastructure in the value chain processes is charted first. It is assumed that the percentage of the available direct infrastructure components is an indicator of the relative importance of these processes for the company (Table 6, columns ‘(a)’). This percentage gives the ratio between components that are actually available within the firm and the infrastructure

Table 5: Business and information strategy and critical processes of the case firms

	Firm D	**Firm T**	**Firm H**
Activities	Gardening	Civil Engineering	Housing/ Real estate
Turnover (million Euros)	60	70	40
Employees (FTE's)	450	220	450
Profit 2001 (%) (sector average)	3,6 (unknown)	2,0 (2,7)	2,1 (1,8)
Business strategy	Market (reach)	Operations(efficiency)/ Market (reach)	Market (reach)
Information strategy	Operational	Operational	Dual
Critical Processes	Plan. & Sup. Inb. Log. Prod.	Plan & Sup. Inb. Log. Prod.	Plan. & Sup. Inb. Log. Prod. Sal. & Mar. Outb. Log.

components available from the checklist. After that, the contribution of IT to the direct infrastructure in the processes was measured, which is an indicator of the possible value of IT to those processes (Table 6, columns '(b)'). This percentage gives the ratio between the amount of IT components in comparison to the infrastructure components that are available within the firm (Table 6, columns '(a)').

The possible value of IT only leads to real added value when the IT is functioning properly within the processes. By applying the IS Assessment and Contingency Theory of Myers *et al.* (1998) the functioning of the available IT infrastructure was measured (Table 6, columns '(c)' - overall score). If the IT is functioning properly in the critical value processes and the contribution of IT is high then the IT business value will be high. Finally in Table 7b the expected business value of IT (see Table 4) was compared with the outcomes of the three case studies (Table 6a/b).

Table 6: Case study results

	Firm D			Firm T			Firm H		
Act. Value Chain Proc.	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
Plan. & Sup.	100%	65%		67%	44%		80%	81%	
Inb. Log.	80%	40%		100%	60%		100%	100%	
Prod.	100%	25%	High	75%	67%	Low	75%	100%	High
R&D	100%	0%		0%	0%		50%	100%	
Sal. & Mar.	100%	67%		50%	0%		100%	50%	
Outb. Log.	67%	100%		67%	0%		100%	100%	

Table 7a: Classification of the scores

Low	Moderate	Reasonable	High
< 20%	20-49%	50-80%	> 80%

Table 7b: Comparison of expectations (Table 4) and outcomes (Table 6 column '(b)')

	Expectations	Firm D	Firm T	Firm H
Plan. & Sup.	High	Reasonable	Low	High
Inb. Log.	High	Moderate	Moderate	High
Prod.	Moderate	Moderate	Low	Reasonable
R&D	Low	Low	Low	Reasonable
Sal. & Mar.	Low	Reasonable	Low	Reasonable
Outb. Log	Moderate/ High	Reasonable	Low	High
IT Bus. Value		Moderate	Low	Reasonable/ High

Based upon the results in two cases, there is evidence for a lower added value of IT to the business strategy than expected. In case D, the IS performance is good while the contribution to the critical processes is lower than expected. Therefore, the lack of alignment can be classified as a technology shortfall. This is underpinned by the fact that the business strategy is market focused and the IT strategy is operational focused. Therefore, the lack of alignment can be classified as a strategy shortfall. In case T, the IS performance as well as the contribution to the critical processes is poor. The firm does not maximally exploit the IT-possibilities. Consequently we can speak of a strategy and a technology shortfall. In case H the IS performance is good as well as the IT contribution to the critical processes. So we identify a fit between IT as Business Strategy.

CONCLUSION

The objective of this paper is to explain the success or failure of IT in construction firms by analysing the alignment between business strategy, IT strategy, organisational infrastructure and processes, and IT infrastructure and processes. The basic premise is that firms with a high level of alignment between these domains will also realise high levels of IT business value. Any attempt to increase IT business value must consider the extent to which IT is aligned with the business strategy. The potential value of IT was evaluated by applying the process-oriented approach of Tallon *et al.* (2000). This analysis showed that the expected IT business value is high in process planning and support (planning and exploitation of equipment and personnel) and supplier relations (purchasing). In order to verify these expectations, three companies in the Dutch construction industry were analysed.

It can be concluded that, based on this study, the Strategic Alignment Model seems to give a valid explanation for the failure of construction firms to derive the most benefits from IT investments. IT contributes in an inadequate way to the most effective business strategy (the technology shortfall) or the strategy followed impedes the implementation of IT that could generate a high business value (the strategy-shortfall).

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