IT Business Alignment as Governance Tool for Firm-Internal Relationship Quality: A Longitudinal Case Study

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Abstract

Many business processes are relying on a smooth and flexible IT support. A major finding of IS research is that in order to generate value from IT the complementarities between IT and non-IT resources need to be understood and orchestrated. Especially, IT Business Alignment has been found to be a key driver of both, IT value and business process quality. But how to achieve alignment?

We present the results of a longitudinal case study in a globally active firm from the aerospace industry that shows how a new CEO implemented better business processes by increasing alignment. The results show an enhancing relationship between business and IT resources and concretize key findings from the resource based view. Overall, the case contributes by indicating that business value accrues from a simultaneous change of IS and business practices that was enabled by an increase in the level of IT business alignment.

1. Introduction

It is widely recognized that IT does not provide benefits per se but must be employed together with other factors [17]. This view is also supported by Powell and Dent-Micaleff [18] suggesting that IT only leads to competitive advantage when it leverages or exploits pre-existing, complementary human and business resources [5]. Two activities (or factors) are complementary if performing one increases the benefits of performing the other. This is also highlighted by Melville et al. [14] who distinguish between IT resources and complementary organizational resources that have to be combined into a business process to generate business value jointly.

From the alignment literature it is known that alignment processes are necessary to exploit IT [9]. Empirical studies confirm a positive impact of these processes on performance [11, 12]. But research into the linkage between alignment and complementary effects is scarce. Thus, the objective of this research is to elaborate on the complementarity between IT and business resources. Therefore, the main research question in this paper is:

- *What is the impact of IT business alignment on enabling business-IT complementarities?*

To address this question, we use a single case study in a manufacturing company of the aerospace industry. Applying a process oriented view, it is explored how operational IT business alignment enables complementarities. We investigate the development of the business process over time and focus on an initial stage before a change has occurred and on the current stage after changes have been introduced to work practices and information systems. In both stages the development of alignment is scrutinized. Using the case study, it is shown how indeed alignment at an operational level enables business-IT complementarities.

The remainder of the paper is structured as follows: after the theoretical foundation (section 2), in section 3 the methodology is explained. Based on this, in section 4 the results from the case study are presented. In section 5, key findings, limitations and future research are summarized and critically discussed.

2. Theoretical foundation: complementarities and alignment

Complementary effects between IT and organizational variables and within the set of IT or organizational variables were found in several studies (e.g. [3, 4]). How complementarity can be achieved, however, remains an open issue for research [24]. According to Milgrom and Roberts [15], *complementarity* means that "the marginal returns to one variable are increasing in the levels of the other variables". Furthermore, using lattice theory, Milgrom and Roberts [15] find that complementarity means that increasing one variable might not have an impact on output if the complementary variable is not concurrently increased. This is supported by recent findings [2]. Adopted for IT and business, a higher level of IT will lead to an increase in the marginal returns from business activities, and both IT and organizational resources must be activated. Literature on alignment is engaged in this linkage of IT and organizational resources.

As will be shown in the next paragraph, insights from the discussion on alignment regarding the cross-domain relationships to achieve a fit also suggest a complementary effect between IT and business (see [10]). This is also indicated by the term "Complementary Organizational Resources" of Melville et al. [14].

The alignment literature focuses on the linkages between the IS function and business units. These linkages are viewed as enhancing performance [7, 23] underpinning the significance of the complementarity between IS and business resources in form of an enhancing relationship (see [18, 24]).

Henderson and Venkatraman [9] have introduced alignment as discussed in the form of the strategic alignment model (SAM). They argue that the creation of value from IT investments requires an alignment between business and IT strategy in both strategy formulation (product-market choices) and implementation (choice of firm structure). This alignment model emphasizes the strategic fit between the so-called external and internal domains for business and IT and also the functional integration between business and IT on the strategic (strategic integration) and operational (operational integration) levels.

An important point is that the entire SAM calls for cross-domain relationships between business and IT and between the strategic and operational level [9]. This is also consistent with Keen [12], who states that "the key to alignment is relationships, not 'strategy'". Thus, alignment as a process is essentially based upon relationships. In turn, building these relationships requires processes with human actors exchanging knowledge and forming attitudes [21].

These processes allow knowledge about IT opportunities and competitor actions to be transferred from the IT domain to the business domain. Over time, this interaction leads to greater understanding by developing a common language and symbols, which improves the exchange of knowledge and also guides further actions through the creation of mental maps [8, 16]. Correspondingly, it was found that in addition to the business orientation of the IT staff, "only shared domain knowledge unambiguously distinguishes high from low achievers" over the long term [1, 20].

To shed light on the question how complementarities can be achieved and if IT business alignment enables those complementarities we use a single case study. This case study focuses on the primary business process of a firm. This process is described at two points of time: the initial stage before and the current stage after changes were implemented. The comparison of these two stages shows the effect of simultaneous changes regarding the IT domain and the business domain as well as changes in the assessment of IT business alignment. The transition phase is depicted listing the changes carried-out. These are interpreted under the perspective of disclosing the interplay between alignment and complementarities.

3. Methodology

The methodology chosen for this research is a case study. Due to the longitudinal approach a case was selected that provided access to data in the relevant research area over a period of time. This made it necessary to choose a company where the authors had access to the data.

For carrying out the case study, case and interview patterns were taken from case studies already performed. Therefore the interview questions were developed, discussed within the research community, and already tested before the start of this specific case. These tested interview patterns were used for the actual case study interviews [6, 26]. The interviews were carried out using a structured questionnaire containing indicator questions mostly measured using a Likert scale and a semi-structured questionnaire designed to obtain contextual information. Each interview lasted about one hour per interviewee. Per interviewee two interviews were carried out. The interviewees were the senior manager of the engineering department, his deputy, and six engineers and also the senior manger of the job planning department, his deputy, and three job planners. Similarly, from the IT department the senior manager, his deputy, and two specialists were interviewed.

Data was complemented by extensive reports, internal firm documentation, process documentation as contained in the quality management handbook, and academic literature. The collected data were transcribed within three days after the interviews. The interviewees validated the collected data directly. after transcription. This procedure is concordant with the literature in case study methodology [6, 13, 26].

4. Case Study

This section starts with a description of the case environment, introducing the company, the product, and an overview regarding the primary business process. Then the case results are presented separated into three parts. Because this case covers a timeframe of sixth months,

- first the *initial stage* is depicted showing the procedures and assessments of departments towards working relationships to other departments.
- Second, the *transition phase* is described with focus on changes carried-out. This description is interpreted using the discussion of section 2.
- Third, the *current stage* (actual stage after implementation of changes) and the achieved effects and changes in assessments are presented.

4.1. Case study description

For reasons of anonymity, we will call the company investigated AIS, Inc. It builds and sells interiors (e.g. galleys, stair houses) predominantly for Boeing and Airbus aircrafts. It has a centralized manufacturing plant and sells interiors through direct sales and sales representatives to the carriers (e.g. Qantas) worldwide. The representatives, who normally also sell for other competing manufacturers, serve as "agents" for AIS, doing "front office" sales and some minor post sales customer service. Although AIS has inventories of standard components (some purchased and some manufactured), most parts of an interiors products are customized - usually composed of standard and made-to-order components. Therefore the end product is regularly specific to the customer and to the aircraft it is designed for. The company is among the top five companies of its type worldwide and has the largest market share in two of five market segments, and is second largest in the other three segments. It has approximately 1,000 employees.

The primary business process starts at sales. Once an order is received by sales, engineering starts to work by designing the interiors using CAD tools and creating bills of materials (BOM). The BOM is further processed by job planning; orders for purchased parts are generated and production papers for the in-house production as well as for extended work benches are created. After the release of the production paper in a first step specific metal parts are manufactured in-house as well as panels are cut and routed. Both panels and metal parts are delivered to the extended work benches who assemble them to greater units. Once the units produced by extended work benches are received and the purchased parts are available, in-house production starts with further assembly, electrical work, plumbing, finishing, and final quality inspection. After the final quality inspection, the interiors are shipped to the aircraft producer sites and build into the aircraft. Shipping of the interiors must be in line with the finalization of the aircraft for which the interiors were ordered. The whole process is supervised by project management department who is responsible for the overall fulfillment of a specific order.

The case study covers two points in time. The business process briefly described above is investigated in an initial stage that displays the conditions before a change occurred. The current stage displays the business process after the change has taken place. The following paragraph describes these stages and illustrates it with value stream analysis for each stage. The results presented in the following paragraph are an extract of a larger setting and focus on both the operational level of alignment and the assessment of alignment from a business perspective.

4.2. Results

Our case study is divided into two stages: the initial stage and the current stage. Within these stages we will focus on the development of two important departments engaged in the business process that is engineering and job planning.

This paragraph is structured as follows. First the business process of the initial stage is described and statements of the relevant departments regarding their tasks and the relationship to other departments are depicted. Second the transition phase is described and third the current stage is reported.

4.2.1. Initial Stage. The start event is a so-called works order. The works order contains one or more ship sets (average ten ship sets) and may cover several years for delivery of all the ship sets. A ship set is the collection of all interiors for one specific airplane, and contains for example three galleys for B737 or A319, and up to 18 galleys for an A380. The first ship set of a specific works order is called a prototype and has to be handled by the engineering department. The same holds for changes during the time the works order is active. Ship sets or parts of a ship set that are not a prototype or changed are called follow-on ship sets and are processed only by job planning, because all the drawings and BOMs are already available.

After receiving a works order, the Engineering Department starts work for the prototype by scheduling the drawings needed, assigning an engineering project manager, and assigning an external engineering office to carry out the drawings. The engineering project manager is responsible for controlling the external engineering office, checking the drawings, and communicating engineering changes (induced by AIS people, by the customer, or by the aircraft producer). The external engineering offices follow an officially approved standard procedure and produces CAD drawings and the corresponding BOM. The BOM mostly is entered into the ERP system of AIS. In other cases it is entered into Excel. Each part contained in the drawing has an equivalent master data entry in the BOM. Both CAD drawings and BOM are officially approved construction papers that must not be changed by anybody else than especially authorized personnel that currently are only members of the engineering department. Responsible for authorization as well as for setting-up of standard engineering procedures (and getting it officially approved) is the senior engineering manager. The drawings are converted from CAD format into TIF-format and stored into a digital archive. These conversions as well as the print-outs are provided by a service provider with on-site personnel. Producing all drawings lasts from 3 to 6 weeks depending on the type of aircraft and the customer requirements.

After engineering finished all the drawings and the BOM for a prototype or change or after triggered by project management in case of a follow-on ship set, job planning starts work. The Job Planning Department requests print-outs (all formats, often large formats) of all drawings belonging to a specific order from the service provider. Getting the print-outs lasts up to five days, because the digital archive does not provide indexing which make it hard to search for specific drawings. Therefore a lot of manual work is involved to get the print-outs. The time for getting the print-outs therefore depends on the overall requests and the available workforce of the service provider which is restricted to five people in the short term. Once the print-outs are delivered, the print-outs are sorted according to the single interiors units belonging to the ship set to be requested and within the single interior units the drawings are sorted according to the different types of parts (e.g. milled parts, panels). A small ship set might contain about 400 drawings, a large one thousands. After sorting the drawings job planning has to restructure the BOM. The BOM is build according to engineering standards, specified by the engineering department, and is not appropriate for production and calculation uses. Therefore, and because the original BOM cannot be altered by job planning, the BOM is copied, partly re-entered and restructured; master data are maintained and complemented. In the case of a BOM not entered into the ERP system the complete BOM has to be keyed into the system. The BOM is then split into different sections: one for milled parts, one for panels, one for purchased parts, and one for commissioning. Afterwards work plans for production and the extended work benches are created, purchasing orders are released and production papers (containing what is to be produced when) are created. Per single order, job planning needs around two weeks to fulfill its tasks.

The following value stream analysis shows the activities per ship set showing an extract of the whole process effectively starting with print service and showing the job planning activities.

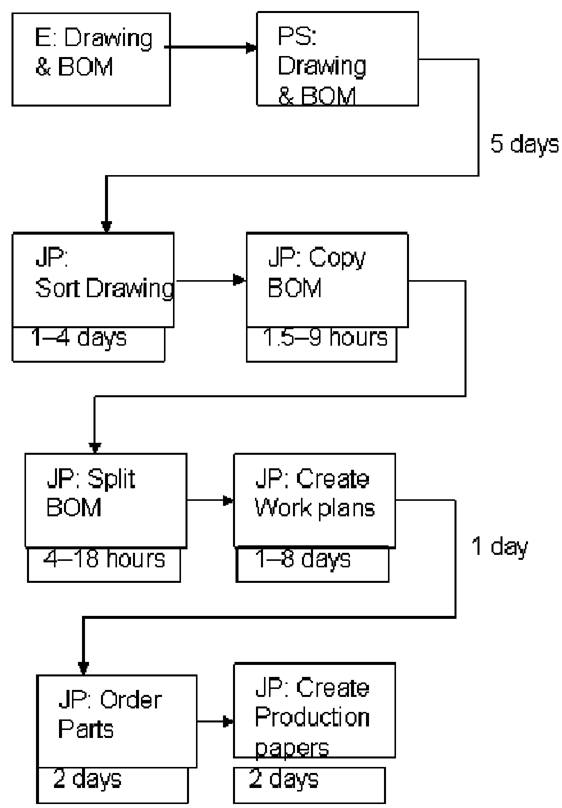

Figure 1: Activities per ship set (before change)

The engineering department is just shown as an anchor point but not evaluated in terms of time. The boxes contain the department (E for engineering, JP for job planning, PS for print service provided by the service provider). After the department the type of activity is named. Below the boxes the processing time is indicated (variances in time depend on type of ship set). A value at the lines between the boxes indicate wait times. If no time is indicated at the lines this time is typically below half an hour.

The following problems, expressed in statements from the department's senior management, arising from the procedure described above are known for years in the company:

Engineering Department Statements:

- Job planning does not process the construction papers in time and accurately.
- Other departments have to follow the specifications from engineering. All relevant data are provided by engineering.
- There might be possibilities to improve the support of engineering by information systems, but if we shall wait for IT to serve us we will stay in the situation the next years. It is better to create our own solution, that is faster and serves exactly the needs of engineering.

Job Planning Department Statements:

- Engineering does not always inform Job Planning of changes in drawings so that production papers cannot be changed accordingly which causes rework in production.
- The manual work of re-entering and restructuring BOM's costs a large amount of capacity in job planning.
- Engineering introduces too many changes. A backlog of orders to be processed has built up in Job Planning.
- Although job planning could start when the first prototype unit is readily constructed, Job Planning has to wait until the last interiors unit of a ship set has been constructed. This accounts for almost three weeks.
- For follow-on ship sets a lot of work has to be done again. Why is it not possible to automate here? It is asked for years but nobody seems to be interested in.

IT Statements:

- IT is only involved after a (IT-relevant) decision was made, but then realization has to be by tomorrow.
- It is hard to set-up an IT plan, because the business direction of the single departments is not really known.
- Business departments tell IT what to do; IT carries out.
- The CEO wants IT to contain costs, not to provide sophisticated ideas.

4.2.2. Transition Phase. After the introduction of a new CEO, the situation changed. The new CEO asks the departments to sit together and talk about possible solutions to the situation. Formal workshops were organized to exchange ideas between engineering, job planning, and the IT department. It took about three months of regular weekly meetings to come along with a solution for the output management which essentially was a restructuring of the print service. Another three months were necessary to find a solution for the processing of the BOM.

Participating in the output management discussion were the service provider, engineering and job planning department, and IT department. The first step consists of discussing the business requirements that is engineering and job planning formulate what they require. The requirements consist mainly of two parts: indexing of documents to allow for a fast retrieval and online print-out requests including a list of the exact drawings needed (for which indexing is needed). These requirements were formulated by job planning. To realize these requirements engineering has to provide such index right from the start when drawings are created. IT then sits together with job planning and engineering to detail the requirements and IT also sits together with the service provider to understand how the current solution of the digital archive works. It was quite a new experience seeing IT actively talking with the departments and finally coming up with a proposal for a solution that finally was realized with minor changes. The solution consists of a content server that is integrated into the ERP system and allows for indexing and moreover for a connection to each single part contained in a BOM. With this solution job planning can process the BOM from engineering and based on the BOM automatically all drawings belonging to a specific interiors unit can be ordered from the service provider. The service provider in turn does not have to search for drawings but simply takes care of the print service. Manual work reduces to maintaining the printers and converting CAD files.

Simultaneously to the activities regarding output management, the discussions about the future processing of the BOM proceed. Although regular meetings took place no progress was made for about two months. Job planning demanded a new BOM structure that is relevant for production and calculation and can be processed automatically once the BOM is structured accordingly. This would provide for tremendous time savings for all follow-on ship sets, because orders and production papers can be released without processing the BOM again. IT was allowed to engage a consultant helping them to provide a solution. Finding a solution required another two months, and another two months to get the solution hammered out and agreed on. The solution required a change of work procedures in job planning that causes an adaptation of the process procedures in the quality handbook and it requires a change in job description, because some manual activities are simply eliminated and others are changed. The solution also required a change in engineering to completely enter BOMs into the ERP system and also to improve the BOMs with respect to production and calculation purposes. Job planning and IT together finally could convince engineering that not only the company as a whole but engineering itself is better of with the solution, because it allows for more accurate construction papers in the future reducing the workload on changes. On the IT side, implementing the solution also required an upgrade of the ERP system in place that was agreed on by the CEO after a common presentation of job planning and IT department about the effects of the solution. Finally the ERP system was upgraded and customized. BOM processing then avoided several manual steps such as “split BOM” that was fully automated and allowed for a very fast processing of follow-on ship sets. In effect the step “sort drawings” was eliminated due to the content server and its indexing capability. Therefore, drawings were printed in the sequence needed. Further, the step “copy BOM” was altered into “maintain BOM” which essentially means master date maintenance and check of the structure. Entering BOMs from other formats were avoided completely because all BOMs were entered into the ERP system. The step “split BOM” was fully automated so that job planning could proceed with the creation of work plans. Finally the steps “order parts” and “create production papers” were accelerated by a better structure and an equivalent type of BOM allowing the ERP system to perform some automatic procedures.

From the description of the transition phase, the following steps and insights can be deduced using the discussion in section 2:

First, formal communication links were established by creating a formal meeting sequence and workshops.

Second, intention was (and it happened over time) to transfer requirements, needs, and goals of the business departments to the IT department and within the business departments.

Third, the transferred knowledge was used to create solutions to business problems

Fourth, these solutions encompass both IT means and changes in business procedures to achieve the desired effects

Starting with the fourth item we have evidence of complementary effects between IT and organizational variables and an example of the effects Milgrom and Roberts report (see section 2). There is evidence that these effects occurred due to the prior establishment of links between the IT department and the business department at an operational level (i.e. regular meetings). These links then allowed for the establishment of relationships between departments and the transfer of knowledge (see section 2 regarding building relationships). Further knowledge was transferred between IT department and business departments allowing for the development of solutions. This relates to the discussion of knowledge transfer in section 2.

After all these changes, the current stage was achieved that is shown in the next paragraph.

4.2.3. Current Stage. After implementing these changes value stream analysis looks like this per ship set (for explanations see above Figure 1):

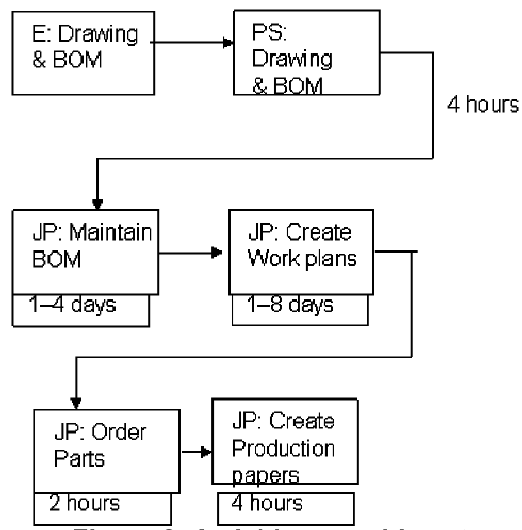

Figure 2: Activities per ship set (after change)

In the following, some statements from the department are highlighted to provide more context to the current stage.

Engineering Department Statements:

- Finally, job planning found a way to better serve our company. Without engineering’s help they would not made it.
- Although engineering can think of better solution for the print service the implemented solution is appropriate.

Job Planning Department Statements:

- The capacity of job planning has increased. More orders can be processed and the cycle time has reduced. The backlog of work starts to decrease.

- The consultant hired by IT had good expertise. It was quite easy to discuss with him.
- In the last months our IT department seems to be more proactive and has a clue of what we are doing. Probably the consultant has taught them.

IT Statements:

- IT department is not always involved in business decision. For example, engineering department set-up a new file structure without telling us but caused problems afterwards. Anyway, in some major steps IT department was involved and provided viable solutions.
- The new CEO allows being productive for the company.

An excerpt of the case study results in terms of alignment indicators is shown in table 1 and 2. Please note that both a structured and a semi-structured questionnaire were used. Indicators with ratings like "average" are employed using a 5-point-Likert scale within the structured questionnaire (extrema: fully agree – fully disagree). Contextual information as well as statements concerning indicators were collected using a semi-structured questionnaire. Columns three and four of the following tables contain the assessment of the indicators as well as statements.

Table 1. Summary of the case study results (initial stage)

Construct	Indicator (reference)	Engineering	Job Planning
Alignment	The IT employees are very competent. [19]	Disagree The competence is very low. They hardly can manage to repair the desktops.	Indifferent Competence is average. There are people who know to handle the ERP system.
	The IT unit is very responsive regarding needs of the business unit. [22]	Fully disagree Cooperativeness is rated very low	Disagree Cooperativeness is low. Only in cases of severe errors help is fast enough.
	The IT employees are knowledgeable about the business activities. [25]	Fully disagree Clearly no. They do not have a clue of our needs.	Disagree Understanding is low. They just know very high-level procedures
	There are regular meetings between the IT and the business unit to discuss potential process improvements [25]	Fully disagree Interaction only if some hardware problems occur. In other cases we are better of by our own.	Fully disagree Interaction is mostly restricted to problems. Sometimes we get help, sometimes we are simply told that there is no simple solution.

Table 2. Summary of the case study results (current stage)

Construct	Indicator	Engineering	Job Planning
Alignment	The IT employees are very competent. [19]	Disagree The competence overall is low. But the consultant and the service provider personnel helped them to improve.	Agree Competence is above average but still not high.
	The IT unit is very responsive regarding needs of the business unit. [22]	Disagree Cooperativeness has improved. It is rated between low and average. But they are still not too proactive.	Indifferent Cooperativeness is average. If we have questions we often get answers in time.
	The IT employees are knowledgeable about the business activities. [25]	Disagree Very low. Just some peripheral needs such as the print service is somehow understood. Our core business still not.	Agree During the project to restructure the BOM IT has learned a lot. Understanding in this area is quite high now.
	There are regular meetings between the IT and the business unit to discuss potential process improvements [25]	Agree There are regular weekly meetings.	Agree There are regular weekly meetings, but beside that we also ask them in case of problems or usage support.

The comparison between table 1 and table 2 shows an improvement in terms of alignment indicators. Nevertheless, the assessments are still not very positive. The assessments in parts reflect the time lag between initiating a change and its full effectiveness. The time between the assessments of table 1 and 2 is six months. After the first assessment several measures were initiated to improve. Among those is the introduction of a consultant to improve the competence of the IT department by bringing-in know-how and by training existing personnel on the job, Further regular meeting were set up to support communication and the working on a common business problem, thereby transferring knowledge about business activities, constraints, and goals into the IT department. This obviously needs time. Although some progress can be seen, there is still a long way to go.

On the part of the IT department, behavior changed from a purely reactive organization viewing itself as a subordinate utility provider towards an organization that, from time to time, can give valuable hints to business departments. It is accepted that more business know-how is needed within the IT organization and more proactive management. But it is also acknowledged that changing people and changing the ways of operation is not an one-time event but needs permanent effort.

5. Conclusion and further research

This paper focuses on a topic that is surprisingly rarely explored in literature: The dependence between alignment and business-IT complementarities. Referring to the question "how complementarities can be achieved" discussed in section 2, we found evidence that IT business alignment enables business-IT complementarities, thus contributing to literature.

Methodologically, we used a longitudinal single case study of an operations process in a company of the aerospace industry with focus on alignment and business-IT complementarities. The case study setting allowed us to observe the development of alignment levels, the complementary development of business practices and information systems over time. Furthermore, the case provides relevant insights into a concrete situation at the operational level of a business process which is also very rare in literature.

This paper contributes to literature in suggesting a connection between the parallel development of work practices and information systems on one hand and alignment between business and IT at an operational level (functional integration) on the other. Alignment at an operational level enables the business-IT complementarities as reported in the case. After creating regular meetings between the IT department and the business departments, relationships improved and knowledge gets transferred. After that, solutions encompassing technical systems and business procedures were developed simultaneously. The parallel change of work practices and information systems enabled by alignment leads to reduced cycle times in the business process investigated.

The most important aspect regarding operational alignment was the understanding of business needs by the IT staff and the interaction between the business departments and IT which is also in line with literature. Furthermore it was shown that top management support was important as a catalyst.

The managerial implications are to foster interrelationships between IT and business departments to enable complementarities between the business and IT department in favor of the company. Top management should be aware of this relationship and focus on smoother communication between the departments.

Using a case study we are not able to statistically generalize our findings but at least indicate that there is a connection in our case which should be replicated in further studies for closer investigation. The case study data will serve as a basis for further research. Extending the case study to include further performance aspects such as quality and further departments will allow us to research alignment, complementarities, and performance at a business process level of analysis on a broader basis.

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