2009

Exploring inter-organizational alignment with e3alignment – An Aviation Case

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22nd Bled eConference
eEnablement:
Facilitating an Open, Effective and Representative eSociety
June 14 - 17, 2009; Bled, Slovenia

Exploring inter-organizational alignment with *e³alignment* – An Aviation Case

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Abstract

In this paper we present the e³alignment framework and approach, which we use to explore a wide range of inter-organizational alignment issues concerning the interaction between organizations in a value web, as seen from multiple perspectives, and with the aid of modeling techniques. The e³alignment approach focuses on interaction between actors, since "interaction" is one of the key success factors for a sustainable value web. Our ultimate goal is to create a sustainable value web, where various organizations cooperate to successfully meet a consumer need. To support our claims we conducted an industrial strength case study at the Dutch aviation sector.

Keywords: Alignment, Business-IT, Aviation

1 Introduction

An overview of over 150 articles concerned with business-IT alignment, concluded that the *process of alignment* is underrepresented in current research (Chan and Reich, 2007). We see the first step in this alignment process as an *early requirements engineering phase* (Yu, 1997), in which the *business context* is analyzed to elicit business requirements which ultimately are met by information systems.

To this end, we introduce *e³alignment*. With *e³alignment* we provide a method to explore a wide range of *inter-organizational* alignment issues concerning the *interaction* between organizations in a value web, as seen from *multiple perspectives*, and with the aid of *modeling techniques*. In a value web, a set of organizations collaborates (i.e. interacts) to jointly satisfy a complex customer need (Tapscott et al., 2000). To create alignment, or coherence, between these multiple organizations, the *e³alignment* approach focuses on aligning the *interactions* between organizations, since one of the key success factors of a value web, and thus for the organizations in the value web, is proper alignment of the *interactions* between the organizations (Yu, 1997; Gordijn & Akkermans, 2001). By aligning the interactions between organizations, *e³alignment* ultimately creates a sustainable value web.

Since various types of interaction exist and to separate concerns, *e³alignment* takes *four* different perspectives on interaction. Separating concerns by taking multiple perspectives is well known in both the field of requirements engineering and business-IT alignment (see eg. Nuseibeh et al. (1994), Henderson en Venkantraman (1993)). In *e³alignment* the following perspectives are taken on interaction: 1) a *strategic perspective*, to understand the strategic influence of organizations on other organizations; 2) a *value perspective*, to understand things of economic value being exchanged between organizations in a value web; 3) a *process perspective*, to understand the order and activities behind the interactions; 4) an *IS perspective*, to understand the IT/IS enabling information exchanges between organizations.

By focusing on interactions, *e³alignment* takes an *external* view on alignment, also referred to as *inter-organizational alignment* (Derzsi and Gordijn, 2006). In contrast, an *internal* view on alignment, or *intra-organizational* alignment, focuses on the alignment within a single organization (Derzsi and Gordijn, 2006), which has been the interest of many traditional alignment frameworks (eg. Henderson and Venkantraman (1993)). Inter-organizational alignment has two forms (Derzsi and Gordijn, 2006): (1) alignment *within* one of the aforementioned perspectives on interaction, which is concerned with aligning interactions *between actors* as seen from a single perspective; (2) alignment *between* two or more perspectives, which is concerned with aligning *multiple* perspectives of the value web at hand, for instance between the value and IS perspective.

Furthermore, with the *e³alignment* approach we reason that *conceptual modeling techniques* should be used in three iterative steps - (1) alignment problem identification, (2) alignment solution design, and (3) impact analysis - to actually execute the process of alignment. Utilizing modeling techniques enables us to create shared understanding among stakeholders (Borst et al., 1997), allows for traceability of changes over the perspectives (Nuseibeh et al., 1994), and closely resembles the way of working in information system design. To support the claims made with *e³alignment* we conducted a number of industrial strength case studies, from which the Dutch aviation sector, in which processes need to be redesigned and support from various information systems is needed, will be presented.

The paper is structured as follows: First, the case study conducted is presented. Second, *e³alignment* will be discussed. Hereafter, the actual steps for alignment will be presented, in which simultaneously the case study is discussed in more detail. The paper ends with future research directions and conclusions.

2 Research Approach

As Chan and Reich (2007) showed when comparing over 150 alignment models, many alignment frameworks exist. However, Chan and Reich also pointed out a number of shortcomings: (I) The *process* of business-IT alignment is underrepresented in current research; (II) Although many viewpoints are taken on the organization to be aligned, the *in-depth* relationship between these viewpoints is often neglected. Furthermore, most of these frameworks focus on alignment *within* an organization (eg. the strategic alignment model of Henderson and Venkantraman (1993)), and do not focus on alignment *between* various organizations. Other alignment models, emerging from the field of computer science, such as Archimate (2009) and TOGAF (2009) heavily focus on IT and business *processes*, thereby neglecting the *financial* (i.e. value) and *strategic* implications of business-IT alignment. Furthermore, these approaches are rather *comprehensive*, making them unsuitable for the early exploration phase.

To deal with the aforementioned problems, we propose *e^3alignment* (see Section 4). The *e^3alignment* framework and approach is developed with the aid of various case studies (see also Pijpers, et al. 2008; Pijpers, et al. 2009). During our research the primarily use of the case studies is to develop and test the *e^3alignment*. We have used the case studies to aid with *formalizing qualitative theories* concerning conceptual constructs, which is mainly applied during the research on the relationships between the perspectives. The secondary use of the case study was to *demonstrate* how *e^3alignment* can be utilized, as done is this paper. The final use of the case studies is to test the external validity of the approach by apply *e^3alignment* in various settings (eg. electricity industry, mobile telecom industry, and the aviation industry – as presented in this paper).

3 Case Study: Dutch Aviation

The Dutch aviation industry is one of the important pillars of the Dutch economy. It is responsible for an annual turnover of €20 billion and offers employment to over 80,000 people. In the Dutch aviation's value web a large number of organizations are present, we however focus on three key organizations:

1) *Amsterdam Airport Schiphol* (AAS), the owner of the physical airport located at Amsterdam the Netherlands;

2) *Royal-Dutch KLM*, the main airliner at Schiphol airport and responsible for transporting passengers;

3) *Air Traffic Control the Netherlands* (ATC), responsible for air traffic management (ATM), which is concerned with guiding planes in Dutch airspace.

For this case study we focus on a specific aspect of the Dutch aviation: the transfer of passengers from one airplane to another airplane. Schiphol airport is a "hub"-airport, meaning that Amsterdam is commonly not the end destination. Instead passengers switch airplanes at Schiphol to reach their final destination. The activity concerned with connecting incoming airplanes with outgoing airplanes is referred to as the "turnaround" process. All three organizations perform specific steps within the total turnaround process. Throughout the paper we will use examples from the case study to illustrate various concepts and to demonstrate the *e³alignment* approach.

4 e³alignment framework

To understand the philosophy behind *e³alignment* we present the framework in Figure 1. The model shows the key features of *e³alignment*:

1) *e³alignment* is concerned with creating alignment between organizations operating in a value web by focusing on the *interaction* between these organizations. In Figure 1, interaction is represented by the horizontal lines;
2) *e³alignment* takes *four* different perspectives on interaction between organizations: a *strategic*, *value*, *process*, and *IS* perspective. Each horizontal line in Figure 1 represents the interactions for that perspective;
3) To understand and analyze each of the four perspectives on interaction, per perspective a *conceptual modeling technique* is utilized, as stated in the brackets per horizontal line in Figure 1;
4) Since we take multiple perspectives on interaction, *e³alignment* creates alignment between organization *within* a single perspective (the horizontal arrows) and alignment *between* perspectives (the vertical arrows).

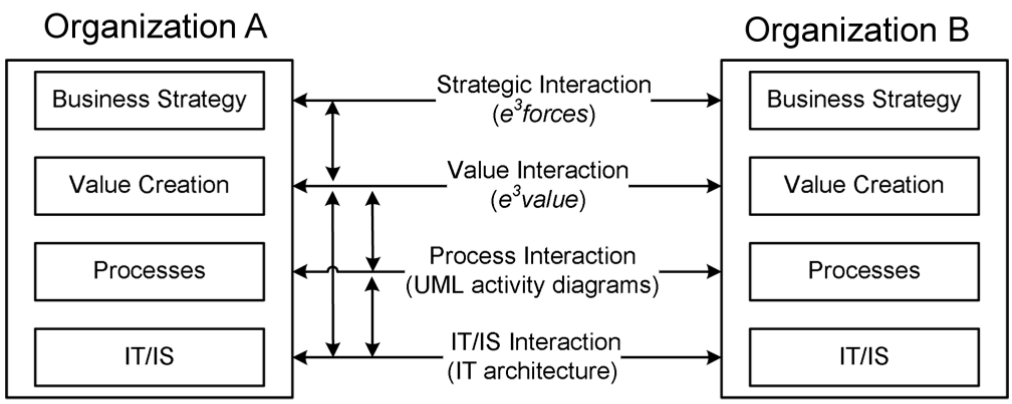

Figure 1: The *e³alignment* Framework

Interaction between Actors in Networks

The *e³alignment* framework takes a network, or inter-organizational, view on alignment, since nowadays organizations operate in *value webs*, or networked value constellations. In value webs multiple organizations collaborate to jointly meet customer needs (Tapscott et al., 2000). One of key elements of networks is the *interaction* between actors, which is the key focus of *e³alignment*. The *e³alignment* approach focuses on interactions since "*interaction*" is one of the key success factors of a sustainable value web (Yu, 1997; Gordijn & Akkermans, 2001). There is interaction between two actors when one actor somehow *influences* the other (the horizontal lines in Figure 1). In the case at hand examples of interactions among actors are the exchange of flight information, coordination of turnaround (sub-)processes and payments for services delivered.

Multiple Perspectives

Interaction is a *generic* construct and has been dealt with in both business literature and IT literature (see eg. Tapscott et al. (2000) and Wieringa et al. (2008)). Since various conceptualizations of interaction exist, we separate concerns by taking different perspectives on interaction. Each perspective analyzes a different type of interaction between organizations. Separating concerns is well known in the field of business-IT alignment (see eg. Henderson en Venkantraman (1993)), and brings the benefit of reducing (large) complex issues in more comprehensible issues. To separate the wide range of interactions, four different types of interaction are considered in *e^3alignment* between actors in a network:

1) The *business strategy* perspective, which considers how organizations influence the *strategic position* of an organization. This perspective explores how organizations influence each other on the long term. For example, think of the strategic influence of the KLM and AirFrance merger on Schiphol, since KLM became an even more dominant player (eg. bigger market share).
2) The *value creation* perspective, which considers how value is created by the *value web* in which the organization operates. This perspective explores what objects of *economic value* are exchanged (i.e. interaction) by the actors in the value web. Consider for instance, the exchange between ATC, offering air traffic management, and KLM, which pays for this service.
3) The *processes* perspective, which considers the cross-organizational *coordination processes* supporting the value creation. This perspective explores the actual *physical* transfer of objects (i.e. interaction) and takes "*time*" into consideration, such that the activities behind the interactions and sequence of interactions can be considered. Think of the order of activities and physical exchanges needed for a successful turnaround process.
4) The *IS* perspective, which considers *information systems* and technologies used to interact with the environment to *exchange information*. This perspective enables us to explore which part of the objects exchanged (eg. information) is facilitated by information technology. For example, information systems facilitate the exchange of flight information between the organizations in the Dutch aviation.

Although four perspectives are considered relevant for inter-organizational alignment, field experience has shown that stakeholders are more concerned with specific perspectives rather than with all four. For example, in the presented case study stakeholders are mainly concerned with the value, process and IS perspective. Their interest was not with strategic implications. To this end, from now on we no longer consider the strategic perspective. For a case where the strategic perspective is considered see Pijpers et al. (2008).

Conceptual Modeling

To be able to execute the process of business-IT alignment, *e^3alignment* departs from traditional alignment frameworks (eg. Henderson and Venkantraman (1993)) by actually introducing *techniques* and *steps* to create alignment. *e^3alignment* considers for each type of interaction a specific *conceptual modeling technique*. Utilizing conceptual modeling techniques brings the benefits of (1) creating *shared understanding* more easily among stakeholders over the value web at hand (Borst et al., 1997), (2) easily *tracing consequences* of design choices over the perspectives (Nuseibeh et al., 1994), and (3) closely resemble the way-of-working in information system design, subsequently the models developed provide a *suitable starting point* for further design of the information systems needed to enable the value web.

5 Modeling Techniques

5.1 Process Perspective: UML Activity

For the business process perspective UML 2.0 activity diagrams are used (see UML (2008)). UML activity diagrams are among others also used by Wieringa et al., (2008) to model the interaction between actors in value webs. The activity diagram notion is relatively simple and uses few symbols. *Ovals* represent activities, *rectangles* represent objects (data, goods or money), and *arrows* represent object flows. *Control flow* can be structured using solid bars to represent parallel splits and parallel joins, diamonds to represent choices, a *bullet* to point at the start of the process, and a "*lamp*" (crossed circle) represents the end of a flow. A *parallel split* indicates that parallel processes start. The activity diagram is structured in such that the actions of a single actor are listed in a single column. The name of actor is placed on top of the column. A column is also referred to as "*swim lane*".

Due to space limitations, Figure 2 presents a *simplified* process model for the case at hand. The model shows the three key actors: KLM, AAS, ATC. Per swim lane/actor a number of activities and their order are shown. Furthermore, the vertical lines represent exchanges of information between the actors. The model is discussed in more detail in Section 6.2.

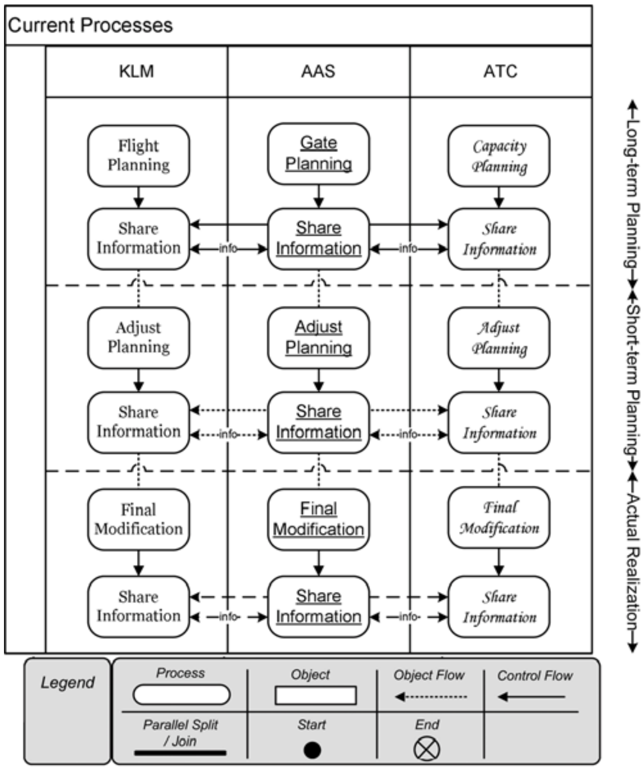

Figure 2: Process Perspective: Problems

5.2 IS Perspective: Architectures

In terms of languages there is the UML (UML, 2008) as an industry standard. In addition, design approaches such as TOGAF (TOGAF, 2008) are becoming increasingly popular. The aforementioned approaches are however rather comprehensive and therefore time consuming to apply during the exploration phase of business-IT alignment. Therefore, we aim at a notation which is easy and tractable. Specifically, we are interested in identifying three specific aspects: 1) which (sub)-information systems or data stores are required, 2) how do the information systems interact with their environment, i.e. what information is exchanged between actors, and 3) what key technologies are needed to facilitate the information exchanges.

These three aspects show the big picture of how information systems technically realize the value web under investigation. Furthermore, based on our field experience, if one of these three aspects of the IS architecture changes, chances are high that the value creation and processes will also change. So, for the value web under investigation we model the *actors* and *information systems* utilized with *squares* and *rounded squares*. Subsequently, we model, via *simple arrows*, which information is exchanged between the actors in the value web. For these actors we also model which (sub)-information systems and data stores they require to *interact* with the other actors in the value web. *Technologies* needed to enable the IS are also included (textual), since the selected components reflect important technology choices.

Figure 4 shows the current (high level) architecture for the Dutch aviation. Three main systems are active “FERDA” at KLM, “AAA” at ATC and “CISS” at AAS.

In relationship to the turnaround process, all three information systems exchange (some) relevant data for the turnaround process with each other. However, the model also shows that there is communication between the actors without use of any information systems (the dashed lines).

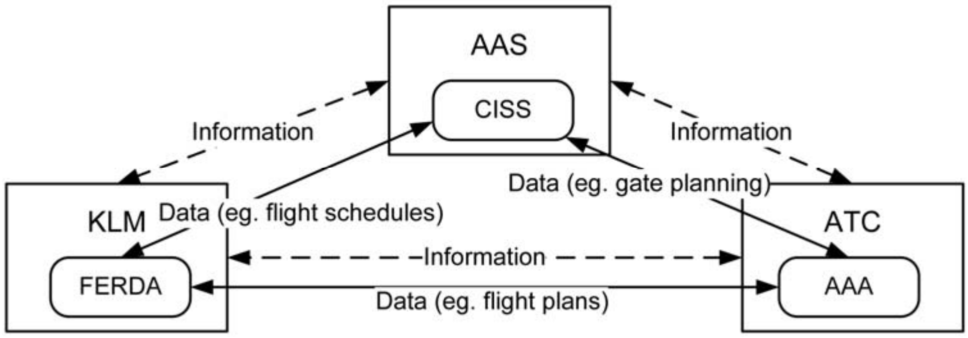

Figure 4: Information System *Perspective*

5.3 Value Perspective: *e^3value*

To model the value perspective of a multi-organizational setting, we use the *e^3value* modeling technique (see Gordijn and Akkermans (2001)). The *e^3value* approach provides modeling constructs for representing organizations in a value web, exchanging things of economic value with each other. We provide an *e^3value* model for the Dutch aviation sector to explain the various constructs (see Figure 3).

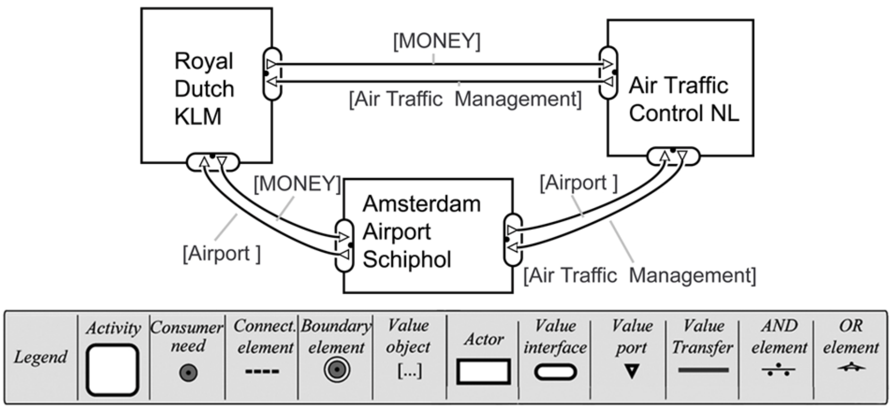

Figure 3: Value Perspective – Dutch Aviation

- *Actors* (often enterprises or final customers) are perceived by their environment as economically independent entities, meaning that actors can take economic decisions on their own.
- *Value objects* are services, goods, money, or information, which are of economic value for at least one of the actors. Value objects are exchanged by actors.

- *Value ports* are used by actors to provide or request value objects to or from other actors.
- *Value interfaces*, owned by actors, group value ports and show economic reciprocity. Either all ports in a value interface each precisely exchange one value object or none at all.
- *Value transfers* are used to connect two value ports with each other. It represents one or more potential trades of value objects.

6 Inter-organizational Alignment

6.1 Alignment within a perspective

The first type of inter-organizational alignment is concerned with the alignment between organizations as seen from a *single* perspective (Derzsi and Gordijn, 2006) (the horizontal arrows in Figure 1). The various types of interaction between actors in a value web need to be properly aligned, since otherwise the network won't be able to function properly, thereby influencing the success of the organization (Yu, 1997; Derzsi & Gordijn, 2006).

A clear example of inter-organizational alignment *within* a perspective is the alignment of the processes between KLM, AAS and ATC within the process perspective. Each organization executes certain processes to aid with the turnaround of airplanes. Obviously, these processes should occur in the correct order (i.e. they should be aligned over time).

6.2 Alignment between perspectives

Inter-organizational alignment *between* perspectives is concerned with the alignment between *two* or *more* perspectives on a value web (the vertical arrows in Figure 1). In the case at hand, we only consider the value, process and IS perspective. Subsequently, we must create alignment between these perspectives. However, to be able to do so, we need to understand the relationship between interactions as seen from these perspectives. Note that the relationship between the IS and process perspective is not discussed, due to space limitations

Value and IS Perspective.

Two relationships between the value and IS perspective can be distinguished: "*structure of interactions*" and "*technologies*".

With the "*structure of interactions"* we mean the lay-out, or composition of actors and their interactions. Field experience and case studies have shown that when the structure of the value web changes the IS structure follows a similar pattern and vice versa (Pijpers et al., 2008). For example in the case at hand, after a number of steps in the e^3*alignment* approach there is the design choice to centralize all information regarding the turnaround processes at a single information system or to distribute the information peer-to-peer (i.e. decentralized). Furthermore, this information is of economic value. So if the information is centralized at one actor, so are the objects of value (i.e. the information). If the information is distributed peer-to-peer, so will be the objects of value. Thus the value structure follows a similar pattern to the IS structure. Note that adjusting the value structure to the IS structure is a clear example of *inter-organizational* alignment between perspectives.

Technologies used in the IS perspective partially determine the actors and value exchanges in the value web, since new technologies often result in new objects (which might be valuable) and new processes. For instance in the case study at hand, new communication technologies resulted in faster and more accurate communication with ground personnel, thereby increasing productivity and thus the value creation. This indicates that new technologies lead to different ways of value creation, meaning that the changes to the IS perspective lead to changes in the value perspective.

Relationship between Value and Processes

The relationship between the value perspective and process perspective is best described as *conceptual* vs. *physical*. In a value model *conceptual* exchanges of value are modeled. In a process the *physical* delivery and execution of these exchanges are modeled. So the same actors are present in both models (Wieringa et al., 2008), since a new actor would imply additional value exchanges and thus additional processes. Furthermore, the conceptual exchanges in the value model are somehow represented in the process model (Wieringa et al., 2008). How depends on the nature of the value exchange. Money and goods can be directly found in the process model as exchanges. Services, due to their intangible nature, are however seen as a set of activities, sometimes also including exchanges (Wieringa et al., 2008). For example, in the case at hand ATC guides KLM's airplanes during approach and take-off at Schiphol. In the process perspective this would be shown as internal activities and exchanges of information with KLM, since this is how it occurs in the physical world. From a value perspective however, ATC provides the service of air traffic management, for which KLM has to pay (see Figure 2).

7 e^3*alignment*: Alignment Steps

So far, we have discussed the concepts behind e^3*alignment*. Now we introduce how to actually use e^3*alignment* to create *inter-organizational alignment* in value webs.

Exploration Phase

It is important to know that e^3*alignment* focuses on the exploration phase of business-IT alignment only. The purpose of an exploration phase is to find and analyze *solution directions* regarding alignment problems for the value web at hand. Usually, the found solution directions are still at a fairly high level, yet they already focus on a more detailed alignment analysis process, which follows *after* the exploration phase and is beyond the scope of e^3*alignment*. Deciding about such solution directions in the early exploration phase brings the risk of being locked in, meaning that you get stuck to a certain solution path, whilst superior paths may exist (Fagerberg et al., 2004). Such may happen often, since the exploration phase is characterized by an inherent fundamental uncertainty

(Schumpeter, 1934). To avoid being locked in, a wide range of options should be considered in the exploration phase of business-IT alignment, as we intend to achieve within *e*^{3}*alignment*.

Three Basic Steps

The steps in *e*^{3}*alignment* are based on the engineering cycle developed by Wieringa et al. (2005). Three main steps are considered in the alignment process of *e*^{3}*alignment*:

1) *Alignment Problem Investigation*, in which the exact nature of the problem is explored;
2) *Alignment Solution Design*, in which various solutions for the problem are considered and explored.
3) *Solution Validation*, in which the impact of the solution is explored. The validation of a solution may lead to new or refined problems.

7.1 Step 0: Motivation for Alignment

We need to determine which one of perspectives, considered in the *e*^{3}*alignment* approach, to start with before actually analyzing one of them. For this reason, we need to understand the main driving force behind the alignment analysis process. In various case studies, we have found two dominant motivations: process innovation and product innovation.

Product Innovation

The first motivation for alignment is "*product innovation*", which starts with a technological invention. An invention is the first occurrence of an idea for a new product or service (Fagerberg et al., 2004), which nowadays is often information technology driven. *Commercialization* of inventions results in "*product innovation*" (Schumpeter, 1934). To commercialize the invention, the invention must not only be technically realized, the commercialization of the product must be realistic (i.e. a proper business plan) (Gordijn and Akkermans, 2001). Would this be the motive for alignment, then the first step would be to explore how the new product creates value (i.e. is commercialized) within the value perspective (Gordijn and Akkermans, 2001).

Process Innovation

According to classic business-IT alignment frameworks, organizations should strive for alignment to improve their performance (Chan and Reich, 2007). Such organizational improvement is often referred to as organizational "*process innovation*" (Rogers, 1995). *Process innovation*, in the broadest sense, can be seen as innovation on the *business side* of the organization, ranging from process redesign to changing the entire business structure (Schumpeter, 1934). Would such be the motivation for alignment, then the first step would be to explore the *process perspective* to identify alignment issues within the process perspective. For the case at hand the motivation is organizational *process innovation*, since the ultimate goal is to improve the turnaround process. Subsequently, we start with exploring the process perspective.

7.2 First Iteration

Step 1: Identify Problems

Following the engineering cycle of Wieringa et al. (Wieringa et al., 2005), the first step is *problem identification*. Since the motivation for alignment is process innovation, we start with identifying problems within the process perspective first. A condensed UML activity diagram for the Dutch aviation is shown in Figure 2. Three actors are modeled: AAS, KLM, and ATC. Furthermore, three timeframes are indicated: long-term planning, short-term planning and actual realization. In all three stages the actors perform various processes to complete the stages. As a result of these processes, information is exchanged between the actors. Due to space limitations the specific processes are not shown.

We start with analyzing the process perspective by analyzing the interactions, and related processes, between the various actors. Two main problems are identified:

1) The various actors use *different terminologies* for the states of the airplanes. For instance the time of arrival for an airplane has different *notations* and *valuations* (meaning the key and value of the variable "arrival time" various per actor). In the process model (Figure 2) this is highlighted by using different fonts in the swim-lanes/actors.
2) There are limited, or too late, exchanges of information between the three key actors. Consequently, the actors have problems making correct logistics plans and executing their processes since their own planning dependents on information of the other actors. This is represented by using dashed arrows in the short-term planning and actual realization stage, instead of solid arrows as with the long-term planning stage (in which complete and in time information is shared among the actors).

Step 2: Design Solutions

The following solutions for the above stated alignment problems were found by the stakeholders.

Milestone Approach

The first problem identified was that each organization uses its own terminology for the turnaround process. The solution is a common terminology of the various stages of the turnaround process (eg. landing, in-gate, departure, etc), called the "*Milestone*" approach. Furthermore, the Milestone solution includes that the valuation for each stage of the plane is the same across all actors. For each moment the valuation of one of the actors is leading. In the, again due to space limitations, simplified process model (Figure 5) this is visualized by showing one type of font in all three swim-lanes/actors.

Single Point of Information

To solve the problem of limited information sharing, the solution is found in centralizing the information to *one* actor. Meaning, one actor is going to gather/receive all information concerning the various planning activities (which are the stages of a plane from the Milestone approach). Furthermore, this actor will distribute the, now shared and up-to-date, information among the other actors. In the process model (Figure 5) this is visualized by a specific order of information sharing (eg. all via AAS). Furthermore, all lines are now solid, indicating that there is complete and in time information shared between actors.

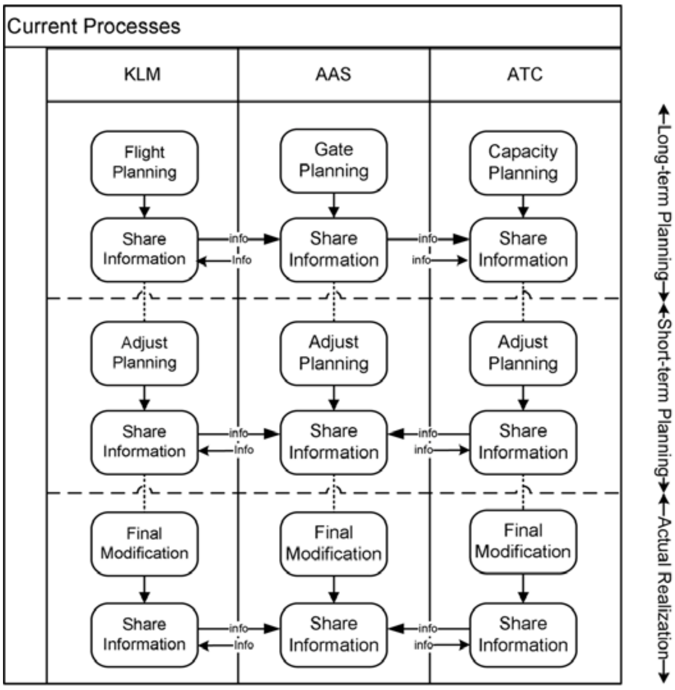

Figure 5: Process Perspective: Solution.

Step 3: Analyzing Impact

The third step of the e^3*alignment* approach is to analyze the impact of the solutions designed. For the case at hand, modifications are suggested within the process perspective. The questions are: (1) whether there is proper alignment *within* the process perspective, and (2) whether there is proper alignment *between* the process and other perspectives.

In other words, we need to analyze the impact of the proposed solutions. First, we consider alignment *between* perspectives. Since modifications have been made to the process perspective there is very likely incorrect inter-organizational alignment between perspectives (this is verified in the next step). In other words, the process perspective is no longer aligned with the value and IS perspective. In the next Section we focus on this form of misalignment. Second, we consider alignment *within* a perspective; in this case the process perspective. Although additional alignment issues were found within the process perspective (eg. the order of some specific inter-organizational activities), we do not elaborate on this due to space limitations.

7.3 Next Iteration

Step 1: Problem Identification

In the previous step, two problems were identified: (1) the process and value perspective are no longer aligned, and (2) the process and IS perspective are no longer aligned.

Step 2: Design Solutions

The stakeholders found the following solutions for the above stated alignment problems.

Align Process and Value Perspective

The *e*[3]*value* model presented in Figure 3 is generic, meaning that we need to zoom in to actually see the value creation in the turnaround process. Due to space limitations we do not present this value model. We do however provide the modified "zoomed-in" value model for the turnaround process (see Figure 6). The model shows that all value objects (i.e. planning information) are centralized at AAS. Furthermore, AAS uses this information to create milestones, which are distributed to KLM and ATC.

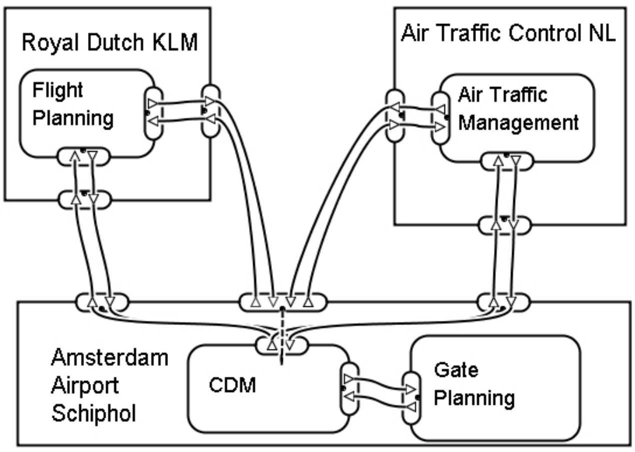

Figure 6: Value Perspective: Redesign.

Align Process and IS perspective

Figure 7 shows the aligned high level IS architecture. In comparison to the IS architecture in Figure 4, the structure of information exchanges has transformed: all information exchanges are done via CISS at AAS. CISS receives data from KLM and ATC, either directly from employees or via FERDA at KLM and AAA at ATC. Subsequently, all data is centralized at CISS and CISS transforms the data into "Milestones". CISS also distributes the "Milestones" to the information systems of the other actors.

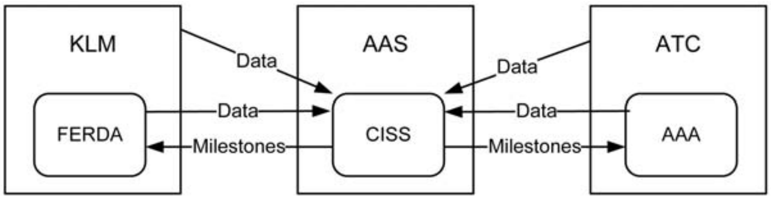

Figure 7: IS Perspective: Solution.

Step 3: to be continued…

The next step is to analyze the inter-organizational alignment *within* the value, process and IS perspective, and the inter-organizational alignment *between* these three perspectives. However, we have run out of space. If we would have continued we would have found that there are more inter-organizational alignment issues. For instance, within the IS perspective there is the problem of integrating the Milestone-information into the existing systems at ATC and KLM. Furthermore, using the Milestone approach also requires additional modifications to internal processes and interactions between all three actors in the process perspective. And as stated, if the IS and process perspective are modified, then the value perspective also needs to be adjusted.

8 Lessons Learned

Modeling Techniques

Our claim was that we could *explore problems, find solutions* and *understand the impact* of these solutions by utilizing modeling techniques. We believe that the case study conducted supports our claim. The techniques aided us in eliciting which actors were relevant and what type of interactions was relevant for that perspective. Furthermore, since the relationships between the modeling techniques are known, it is easy to *trace changes* over the model, which is one of the claimed benefits of using modeling techniques.

Four Perspectives on Interaction

Our second claim was that we need to consider *four types* of interactions. First of all, by considering four perspectives we believe that the areas where alignment issues can occur and where solutions need to be found are covered. For instance, in the case at hand we found alignment issues in the process perspective. The solution of modifying processes however led to incorrect support from the IS. Therefore the IS had to be adjusted, becoming part of the solution. Thus creating inter-organizational alignment is not possible by only focusing on a single perspective.

9 Related work

A focus on inter-organizational alignment via multiple perspectives is also proposed by Huemer et al (2008). However, in comparison to *e^{3}alignment*, only the value ("management"), process ("administration") and IS ("IT") perspective are considered, strategic implications are not considered. Furthermore, a top down approach, starting with the value perspective, is taken into account, while in e3alignment each perspective can be the starting point for inter-organizational alignment. Another related early phase requirements approach focusing on multiple organizations is TROPOS (Castro et al. 2002). However, TROPOS focuses on software development and less on the business-IT alignment. Furthermore, TROPOS mainly takes "actor goals" into account and for instance does not consider value creation.

10 Conclusions

With *e^{3}alignment* we intend to explore a wide range of *inter-organizational alignment* issues concerning the *interaction* between organizations in a value web, as seen from *multiple perspectives*, and with the aid of *modeling techniques*. Our case study has demonstrated that we are able to rapidly, yet still correctly, explore the alignment issues at hand, both *within* single perspectives as *between* perspectives. Furthermore, we were able to explore a wide range of solution directions and understand their impact on the interactions between the organizations in the value web. However, *e^{3}alignment* needs to be tested in more settings to validate all its claims. In addition, additional research is needed on the relationships between the four perspectives.

11 Acknowledgements

We would like to thank everyone spoken to from Amsterdam Airport Schiphol, Royal-Dutch KLM, and Air-Traffic Control the Netherlands for their help.

References

Borst, W. N., Akkermans, J. M., and Top, J. L. (1997). Engineering ontologies. International Journal of Human-Computer Studies, 46:365–406.

Castro, J., Kolp, M., Mylopoulos, J., "Towards Requirements-Driven Software Development Methodology: The Tropos Project," Information Systems, June 2002

Chan, Y. E. and Reich, B. H. (2007). It alignment: what have we learned? Journal of Information Technology, (22):297–315.

Derzsi, Z. and Gordijn, J. (2006). A framework for business-it alignment in networked value constellations. In Proceedings of the workshops of CAiSE'06), pages 219–226, Namur, B. Namur University Press.

Fagerberg, J., Mowery, D., and Nelson, R. (2004). Handbook of Innovations, chapter Innovation: a Guide to the Literature. Oxford University Press, Oxford.

Gordijn, J. and Akkermans, H. (2001). e3value: Design and evaluation of e-business models. IEEE Intelligent Systems, 16(4):11–17.

Henderson, J. and Venkantraman, N. (1993). Strategic alignment, leveraging information technology for transforming organizations. IBM systems journal, (1).

Huemer, C., Liegl, P., Schuster, R., Werthner, H. and Zapletal, M. (2008) “Interorganizational systems: From business values over business processes to deployment,” in Proceedings of the 2nd International IEEE Conference on Digital Ecosystems and Technologies.

Nuseibeh, B., Kramer, J., and Finkelstein, A. (1994). A framework for expressing relationships between multiple views in requirements specification. IEEE Transactions on Software Engineering, 20(10):760–773.

Pijpers, V., Gordijn, J., and Akkermans, H. (2008). Business strategy-it alignment in a multi-actor setting a mobile e-service case. In Proceedings of the 11th International Conference on Electronic Commerce.

Pijpers, V., *e^{3}alignment*: Exploring Inter-Organizational Alignment in Value Webs. In Proceedings of the 3rd Research Challenges in Information Science (RCIS’09).

Rogers, E. (1995). Diffusion of Innovation 4th ed. The Free Press, New York.

Schumpeter, J. (1934). The Theory of Economic Development. Harvard University Press, Cambridge, Mass.

Tapscott, D., Ticoll, D., and Lowy, A. (2000). Digital Capital - Harnessing the Power of Business Webs. Harvard Business School Press, Boston, MA.

TOGAF (2009). www.opengroup.org/togaf/.

UML 2.0 (2008). www.uml.org.

Wieringa, R., Maiden, N., Mead, N., and Rolland, C. (2005). Requirements engineering paper classification and evaluation criteria: a proposal and a discussion. Requirements Engineering, 11(1).

Wieringa, R., Pijpers, V., Bodenstaff, L., and Gordijn, J. (2008). Value-driven coordination process design using physical delivery models. In Conceptual Modeling - ER 2008, volume 5231/2008.

Yu, E. (1997). Towards modeling and reasoning support for early-phase requirements engineering. In Proceedings of the 3rd IEEE Int. Symp. on Requirements Engineering (RE’97), pages 226–235.