Enterprise Architecture as an Instrument of Strategic Control

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Abstract: Enterprises compete in high dynamic and fast changing markets. Reacting quickly and flexibly to market changes is a crucial competitive advantage for an enterprise. Therefore premises of strategic planning and achievement of strategic goals have to be controlled permanently and in a systematic way. Strategic control which is part of strategic management monitors premises of the corporate strategy and the environment of the enterprise in order to evaluate whether the strategic positioning is still appropriate or whether the strategy has to be adopted due to changes in constraints. This paper shows how the enterprise architecture of an enterprise can be used as an instrument of strategic control. Strategic control is characterized by a high demand on information. Hence one needs to know where needed information is to gather. Enterprise architecture which is enriched by results and information of strategic management process is a helpful instrument in delivering information respectively the source of gathering information used in strategic control. In particular for each enterprise architecture layer a proposal is given how strategic control can be supported.

1 Introduction

Enterprise Architecture (EA) is used in enterprises in many different ways [ARW08]. Regardless of concrete use the goal of EA is to create an IT environment which is focused on the corporate strategy [Mi08]. Hence it is mandatory that the strategic positioning of an enterprise is reflected in the EA in order to be of any value to the enterprise [Bo10]. The goals of an EA and in particular the goals of business information systems have to match with the overall strategic goals of the whole enterprise. Therefore it is essential to design and if necessary to redesign the EA within the strategic management process [Go06]. Thus information about the process of strategic analysis and choice are implicit contained in the EA. This information, in turn, can be used in strategic control.

Premises which are defined within the process of strategic planning are the fundament of a corporate strategy [BS95]. The strategic positioning of an enterprise is established on
those premises. Therefore it is of strategic importance to first document these premises carefully and second to monitor them permanently. Should there be changes in premises, strategy might be adopted respectively modified. SAAT ET AL. state, that external forces such as changes in premises are “beyond the scope of EA models” [SAG09, p. 4]. Nevertheless the EA provides hints, where those changes in premises are noticed first in daily business. Another task of strategic control (see chapter 2.1) is to measure the degree of target achievement, i.e. to control whether the strategic goals of an enterprise are achieved and the intended strategy is implemented successfully. In order to measure the degree of target achievement one needs to know which processes respectively which business application systems or business units were responsible for achieving certain goals. Also in that case EA, where processes and application systems are mapped in a model, is able to provide valuable information.

The research question is: How can EA support the strategic control of an enterprise? This paper introduces a research framework for answering this question. A proposal is submitted, how information from strategic management process which is needed within strategic control can be included into EA respectively into an EA model.

The remainder of this paper is structured as follows: In chapter 2 conceptual fundamentals are given. The understanding of the terms strategic control and enterprise architecture is stated and related work is given. In chapters 3 - 5 the proposals for supporting strategic management in general and strategic control in particular are stated for each model layer of an EA. Chapter 6 concludes with a short summary and an outlook on further research needs.

2 Conceptual Fundamentals

This chapter provides an overview of conceptual fundamentals which are basic for understanding the topic and of research work which is related to that topic. The terms strategic control and enterprise architecture are explained. Based on this understanding related approaches are stated.

2.1 Understanding of Strategic Control

Strategic Control in Strategic Management Process

Most of the authors in the fields of strategic management and corporate governance consider strategic control to be part of strategic management [Fr10, p. 171-176; PR94, p. 16; Ha06; SS00, p. 157]. HAHN characterizes control as an obligatory addition of any planning processes [Ha06]. Strategic control therefore contains the control of strategic planning respectively strategic maps. Strategic control does not start at the end of the planning and implementation process but at the very beginning of the strategic management process. As soon as assumptions within the strategic planning process are made, those so-called premises have to be overseen [SS87]. “Strategic control is concerned with tracking a strategy as it is being implemented, detecting problems or changes in its underlying premises, and making necessary adjustments.” [PR94, p. 381].
Hence strategic control has to be forward-looking since the end result of a strategic process is “still several years off” [PR94, p.381] and realized parallel to planning and implementation processes [Ha06]. Figure 1 clarifies this meaning of strategic control.

![Figure 1: Strategic Control in strategic management process]

**Types of Strategic Control**

STEINMANN and SCHREYÖGG distinguish between three types of strategic control: premise control, implementation control and strategic surveillance [SS87]. “Premise control is designed to check systematically and continuously whether the premises on which the strategy is based are still valid.” [PR94, p. 382]. Thus premise control is focused on noticing changes in premises as early as possible in order to allow an early shift in strategy if necessary. Implementation control checks milestones during strategy implementation in order to recognize deviations from the chosen strategic course [SS87]. Strategic surveillance finally is defined by STEINMANN and SCHREYÖGG as an unfocused control. The environment of an enterprise and the enterprise’s resources are to be monitored for information which could be threats but also opportunities for the enterprise’s continuity.

**Problems of Strategic Control**

One thing all types of strategic control have in common is a high demand on information. The kind of desired information is known whereas the source of information gathering is partly unknown or undefined within an enterprise. Once it is known who or what (e.g. a business application system) is responsible for collecting the desired information and where they occur first, the enterprise’s management can respond quickly to threats or opportunities. A quick respond to market movement is an important strategic competitive advantage. Besides for instance predefined milestones in the strategic implementation process it is hardly possible to determine ahead at which time which information has to be gathered [SS00, p. 248f]. Nevertheless the strategic course has to be monitored in a structured manner. The EA of a company can make a valuable contribution to this. Before making proposals for that, the understanding of enterprise architecture in this paper is given.

**2.2 Understanding of Enterprise Architecture**

A common definition for EA is not given in the business information systems community so far. In this paper the understanding of architecture as “the fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution” [IEEE00]
follows the definition by the IEEE. Hence EA is understood as the fundamental organization of an enterprise.

An EA can only be established successfully in an enterprise if it is considered being a means to an end. “Architecture is a means, and should not become a goal itself” [Op09, p. 45]. OP’T LAND ET AL. state EA amongst others as a mean “within strategic Business/IT-Planning” and “to align strategic objectives and IT” [Op09, p. 40]. Every intended use should create value to an enterprise. The benefit of an EA will be the greater the stronger EA is positioned in accordance to goals and objectives of an enterprise.

An EA model maps the components of an enterprise, relationships within an enterprise and to the environment into a model. There are various approaches for EA modelling. Most frameworks for EA modelling disperse the core artefacts of EA to five layers in order to reduce complexity [WF07]: Business architecture, Process architecture, Integration architecture, Software architecture and Technology architecture. The methodological foundation of this approach is the Semantic Object Model (SOM) by FERSTL and SINZ [FS95; FS06], which is an object- and business process-oriented methodology for modelling business systems. In the SOM EA the core artefacts identified by WINTER and FISCHER [WF07] are comprised in three model layers: (1) enterprise plan, (2) business process model and (3) resource model (see figure 2).

Figure 2: SOM enterprise architecture [FS06, p. 349]

Business objects at the business process model layer have to fulfil goals and objectives which are deduced from the enterprise plan layer. Furthermore the SOM methodology provides a concept for explicitly linking business application systems to business process models [FS06]. Hence information from strategic management process can be considered continuously from enterprise plan to business application systems.

Strategies respectively strategic goals are initially specified at the first layer of the SOM EA. Premises of a corporate strategy are not modelled at all in any EA model so far.

12
2.3 Related Work

The design of an EA should be a task of the enterprise’s strategic management. ROSS ET AL. even claim, that enterprise architecture should be a strategy itself [RWR06]. Most researchers position the design of EA in the strategic planning process [Op09, p. 40; RA09; Go06]. In accordance to that BOUCHARAS ET AL. identify in a broad literature review as benefits of EA “better strategic planning” and “Decision Making” [Bo10]. Thus EA is considered to be of value in the strategic planning process. SMOLANDER ET AL. suggest the metaphor that architecture represents decisions [SRP08]. Following this metaphor EA represents management’s decisions, esp. strategic planning decisions. A benefit of EA in strategic control in contrast is barely mentioned. An extensive literature review of publications in journals of the AIS Senior Scholars’ Basket of journals brought no hits searching for articles linking EA and strategic control. There have been some research works, especially within the TEAR-workshops, concerning the benefits of EA. The main focus of articles reviewed by BOUCHARAS ET AL. in the paper „The Contribution of Enterprise Architecture to the Achievement of Organizational Goals“ lies on empirical studies analysing the benefit of EA in practice [Bo10]. However strategic control cannot be identified as a context, for which EA is of value. Possibly it is because, to the best of my knowledge, the potential benefit of EA to strategic control has not been analysed so far.

3 Supporting Strategic Control by the Enterprise Plan

In this chapter a proposal is introduced how information generated and used in strategic management process (in the following called ‘strategic information’) can be integrated in EA models and in turn can be used in strategic control. The following focuses on the enterprise plan layer of the EA model (see fig. 2). The proposals for supporting strategic control by other layers of the EA are given in chapters 4 and 5.

Studies show that premises, the underlying assumptions of every strategy, are not documented well [BP03]. But documentation is required in order to check the premises within strategic control whether they are still valid or changes have occurred. Furthermore goals of business information systems should coincide with the strategic positioning of an enterprise. Therefore premises as well as strategic goals should be documented in the enterprise plan layer.

The enterprise plan of the SOM methodology takes an outside perspective onto the business system [FS06]. In the system of objectives and goals, which is the behavioural view of the enterprise plan, the planned strategies, goals and objectives as well as constraints are modelled. FERSTL and SINZ do not provide a metamodel for the design objects of the enterprise plan layer, since the modelling of the SOM methodology focuses on the second and third layer of the SOM EA. But in order to document information needed in strategic control in a structured manner a formal description of

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premises and strategic goals is needed. Therefore following classification is introduced which leads to the metamodel in figure 3. The relationship between strategies, strategic goals, measured values and actions bases on the concept of the Balanced Scorecard by KAPLAN and NORTON [KN97] which is a management tool for translating strategy into action.

Premises are assumptions on which a strategy is based on (see chapter 2.1). A premise can be basis of several strategies and a strategy usually bases on more than one premise. A premise is a specific constraint. There exist further constraints, e.g. regulation on taxation or accounting. Those constraints are out of focus here because they affect all competitors in the same way and are not assumptions of strategic positioning. Premises can be further differentiated into critical and non-critical premises or internal and external premises. This can be modelled either as another meta object or as attributes. A strategy aims one or more strategic goals. Conversely a strategic goal can be assigned to several strategies. A strategic goal is a specific goal. Besides strategic goals there are also operational goals, for example. Since in this paper information used in strategic management is considered, other than strategic goals are out of focus. A goal can be split into sub goals. Goals respectively their achievement are restricted by constraints. For every goal at least one measured value has to be defined which measures the degree of goal achievement. A measured value belongs to exactly one goal. A target value is given to each measured value as an attribute of this meta object. In order to operationalize a strategy for every goal at least one action is defined. An action in turn can contribute to achieve several goals.

![Figure 3: Metamodel for the considered part of the enterprise plan layer](image)

This metamodel is the basis for supporting strategic control by EA, since strategic information is initially attached to the top layer of the EA model. Further layers are modelled under consideration of this strategic information.

Next an example for illustration purposes is introduced. e-Car plc. is a company that deals with electric cars. The company entered the German automobile market recently. Table 1 shows an excerpt from strategies and underlying premises which were defined by the management of e-Car plc. This example is a modification and extension of the example given in [LWF10].
<table>
<thead>
<tr>
<th>Premise</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A new product can only be launched on the market at a moderate price level</td>
<td>Cost leadership</td>
</tr>
<tr>
<td>Growing demand for electric cars</td>
<td>Growth strategy</td>
</tr>
<tr>
<td>Government aid for electric cars remains until 2014</td>
<td>Cost leadership</td>
</tr>
</tbody>
</table>

Table 1: Example premises and strategies

Figure 4 shows the relationship between strategic goals, actions, measured values and target values as an extension of the metamodel defined above: A top-level strategic goal is to “be a reliable partner”. In consideration of the strategies (see tab. 1) a subgoal is e.g. “pay on time”. The achievement of this goal is evaluated by the measured value “date of payment”. Target value for goal achievement is “one day before the contractual date of payment”. In order to achieve this goal the action “diligent billing management” should be implemented.

Figure 4: Modelling of strategic goals at enterprise plan layer

4 Supporting Strategic Control by Business Process Models

At business process model layer solution procedures for realizing the enterprise plan are specified [PS10]. That means that the implementation of the corporate strategy is modelled. Hence the defined actions in the enterprise plan have to be reflected in the business process model. Premises and strategic goals defined in the enterprise plan should be mapped to certain business objects in order to clarify which business object is responsible for putting defined actions into practice and for delivering which strategic
information. Before this mapping is explained in detail a short introduction into the modelling method of the SOM methodology is given.

In the SOM methodology there exist two views of a business process model. “The interaction schema is the view on structure” whereas the “task-event schema is the view on behavior” [FS06]. Strategic goals and constraints are only modelled in the structural view. In the interaction schema business objects and business transactions which transmit goods, services or messages between these business objects are modelled. A short example illustrates the modelling method. The negotiation between a company and a customer consists of an initiating transaction (i), a contracting transaction (c) and an enforcing transaction (e). Fig. 5 shows the structure of this business process.

![Figure 5: Interaction schema](image)

### 4.1 Modelling of strategic goals

In strategic control the achievement of strategic (interim) goals is monitored. Furthermore it is checked which actions put into practice successfully and which actions missed their targets. Hence strategic goals and their sub goals have to be mapped to business objects. These business objects are then responsible for translating these goals and for implementing assigned actions.

In the SOM methodology every business object has to fulfil goals and objectives which are given by a management object. Goals and objectives in general and strategic goals in particular are modelled as follows. A management object (e.g. “Management” in fig. 6) sets goals and objectives of an operational object (e.g. “Production” in fig. 6). This goal relation is modelled as “g”-transaction. The operational object in return informs the management object about the degree of goal achievement [FS06].

Example e-Car plc.: The two top-level goals “Be a reliable partner” and “Profit maximization” are mapped to the business object “Management” (see fig. 6). The subgoals are assigned adequately by this management object to the operational objects “Production“ and “Sales”. For example, the subgoal “Pay on time” has to be fulfilled by the business object “Production”.
Every action can be mapped to a transaction of the business process model [Me96, p. 153]. The result of an action is a service which is performed either by the sender or by the receiver of a transaction.

Example e-Car plc.:

<table>
<thead>
<tr>
<th>Action</th>
<th>Service</th>
<th>Transaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality aspects are part of contracts with delivers</td>
<td>Working out adequate contracts</td>
<td>c: PO pre-products</td>
</tr>
<tr>
<td>Diligent billing management</td>
<td>Registration of invoices immediately and check by a second person</td>
<td>c: invoice</td>
</tr>
</tbody>
</table>

Table 2: Actions and transactions

The action “Quality aspects are part of contracts with delivers” (goal: Good quality) has to be implemented by working out adequate contracts, which is prerequisite for the transaction “PO pre-products”. The business sub object “Procurement” sends this transaction. The action “Diligent billing management” (goal: Pay on time) is applied through registration of invoices immediately and checking by a second person whenever the transaction “invoice” reaches the business sub object “Production finance” (see tab. 2 and fig. 7). For the sake of clarity, modelling of measured values and target values in the business process model are omitted.

For modelling objectives and therefore for mapping them form enterprise plan layer to business process model layer rules are defined, e.g.:

- A modelled goal in the business process model has to correspond to a goal defined in the enterprise plan respectively has to be assigned to a goal as a sub goal. (Secures continuous goal-orientation and consistency)
- A strategic goal and corresponding actions have to be linked in the same business object respectively in a controlled business object. (Secures that a business object is able to achieve the strategic goal)
Modelling strategic goals and assigned actions in this detailed way ensures that business processes are aligned to corporate strategy.

4.2 Modelling of Premises

Another important task of strategic control is to monitor the premises of strategies. The question raises how and where those premises are to be monitored and who is responsible for that. SCHREYÖGG and STEINMANN suggest the business unit which is factual competent to monitor premises. [SS00, p. 249]. Thus premises are attached to business objects in the business process model following the rules:

- Which business object notices a change of a premise first?
- In which transaction between business objects can a changing premise be noticed first?

For modelling premises the notation of modelling context of business systems is adopted. WAGNER and FERSTL define the context of business objects and transactions as “influencing factors of their environment which are not already modelled in transactions“ [WF09, p. 4]. Hence context is understood as specific constraints of entrepreneurial activities. Since premises are also understood as constraints the use of this notation is justified.
Example e-Car plc.: The premise “Growing demand for electric cars” is characterised by a high number of requests and orders. These transactions reach the business object “Sales” (see fig. 8). The premise “A new product can only be launched at a moderate price level” is overseen by the same business object through analysing the realized sales numbers and prices. In the decomposition of the business object “Sales” premises can be attached to the business sub objects „Sales administration“ and “Sales management” (see fig. 9). The premise “Government aid remains until 2014” has to be overseen by the management of e-Car plc.

For modelling premises and therefore for mapping them from enterprise plan layer to business process model layer rules are defined, e.g.:
Premises which are not modelled in the business process model layer are to be monitored by the management (e.g. business object “Management” in figure 8).

A premise can also be attached to more than one business object.

Once it is known which business objects have to monitor which premises the business objects are then responsible for the way they monitor premises. Business application systems can support this monitoring (see chapter 5). A procedure for dealing with changed premises has to be defined by corporate governance, which is out of focus here.

5 Supporting Strategic Control by Business Application Systems

Software development projects, thus also development projects of business application systems supporting business processes, fail frequently because of lacking goal synchronization between software development project goals and goals of the whole enterprise [BM11]. Therefore it is necessary to take strategic goals during specification of the business application system into account.

The third layer of the SOM EA (see fig. 2) comprises the resource model. It “describes the actors for carrying out the business tasks of the business system” [PS10, p. 59]. Those resources are needed for execution of business processes. Besides the specification of business application systems also the organization of personnel is specified. The latter is not considered in the following since this is a classical field of organization theory. Nevertheless considering the strategic positioning of an enterprise is also very important in personnel decisions. The better the first and second layer of the SOM EA is modelled and the more information about strategic positioning is included, the stronger business application systems will be aligned to strategic goals, which is an important contribution to Business-IT-Alignment.

In a business process model goals are attached to single business objects. One or more business objects are linked to one business application system. I.e. the linked business application system supports the execution of the business processes. For more information how derivation is done in detail see [FS06]. Therefore it is explicitly specified that a business application system has to support the goals respectively the actions which are attached to the business objects linked to this application system. If the measured value of these goals can be measured automatically then checking the degree of goal achievement is easy. E.g. if the payment process is IT-supported then it can be automatically checked, whether the outstanding accounts of the business object „Production finance“ are paid one day before the date agreed on in the contracts (see fig. 7). The same is true for the desired information in strategic premise control. Premises are also attached to business objects and therefore - if changes in premises can be determined automatically - also to one or more business application systems. An example would be the number of queries respectively conclusions of contract which are directed to the business object “Sales administration” via a web shop (see fig. 9).
6 Summary and Outlook

Detailed information about the parts of an enterprise and their relationship to each other are included in the EA. Enriched by information from strategic management process the EA can be a valuable instrument of strategic control. The paper on hand introduces a proposal how information respectively the source of gathering information needed in strategic control like changes in premises or responsibility for achieving strategic goals can be taken from the EA. The other way round putting information from strategic management process into all layers of an EA model ensures that business process models and business application systems are going along with the strategic positioning of an enterprise.

An essential prerequisite for EA being an instrument of strategic control can be deduced from that: The EA has to be developed within the strategic management process and has to be adopted when changes in strategy are made.

Further need for research is necessary in defining this involvement in the process of strategic management. Furthermore tool support in modelling strategic information at all layers of the SOM enterprise architecture is needed. Tool-supported modelling of EA especially documenting premises and strategic goals in an enterprise architecture tool is mandatorily required for understanding a strategic positioning of an enterprise in order to follow this positioning in further modelling of the EA.

References


