Reciprocal dynamic effectiveness for industrialized house builders

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ABSTRACT

To achieve competitive advantage, companies have different capabilities that supports a reciprocal and dynamic effectiveness way of operating. This research aim to extend theory about business models and get deeper understanding on how industrialized house building coordination takes place and the dynamic aspects of the coordination. It was conducted as case study, using two deliberately different industrialized house building companies. The results indicates processes links to reciprocal dynamic effectiveness are complex, because all four dimensions in the model must be considered. The theoretical contribution lies in the definition of reciprocal and dynamic effectiveness needed to maintain a viable business model.

Keywords: Reciprocal, Dynamic effectiveness, Industrialized house building

Purpose

A general (traditional) house building construction company uses an Engineer-to-Order (ETO) production strategy (e.g., Gosling and Naim, 2009). Work is organised in projects, houses are built with high levels of customization aimed for the whole market and project based relationships dominates based on contractual mechanisms to control the fragmented supply chains. In contrast to traditional house building, Industrialized House Building (IHB) in Sweden can, in line with (Lessing et al., 2015), be characterized as specialized. An IHB company aims to organise their operations around total deliveries structured into platforms using high degrees of standardization of materials, processes, and predictable supply chains, offering houses in selected niche markets. To achieve competitive advantage an IHB company therefore requires capabilities and investments in the
development of platforms and for shaping an organization capable of managing the pre-engineered solutions in building projects and for long-term development (Lessing and Brege, 2015). An IHB company is similar to a traditional ETO house building construction company in the sense that coordination between market and operations (Konijnendijk, 1994) and project management to be successful in bidding for and completing projects within budget (Davies and Brady, 2000). Based on these core capabilities and on the IHB specialization, an IHB company needs extended capabilities to protect and capitalize their specific investments into platforms and organisations. This extended coordination mechanism is the reciprocal capability to exploit the defined platform as specific building projects in niche segments and to explore and develop that platform based on continuity and repetitive use between building projects, i.e., the capability of parallel short-term exploitation and long-term exploration.

The purpose of this article is to understand how this IHB coordination takes place and the dynamic aspects of the coordination. A business model concept is utilized as the analytic tool to describe and analyze how IHB companies manage the coordination. The view of Brege et al. (2014) that business models explain the logic of companies and how they operate is adopted in this article. The purpose is operationalized into a research question:

(1) How can the reciprocal dynamic effectiveness to manage operations, market, exploitation and exploration be described for an IHB company?

This study is a case study limited to investigate how two IHB companies respond to specific business triggers to describe the dynamic effectiveness.

Frame of reference
The business model concept of Brege et al. (2014) contains three major elements (Figure 1): offering, market position and operational platform. Coordination of the particular production resources, customer, actor and supplier base in the value chain(s) represents the connection between a selected market position to the operational platform. This alignment is called the dynamic effectiveness and describes in an IHB situation, how the company operates the value chain in two dimensions – operational (resource based) vs. market (strategic) against the exploitation (in unique building projects) vs. the exploration (between building projects and in a long-term perspective).

Internal and external coordination
The theoretical perspectives of strategy and organization (e.g., Teece and Pisano, 1994), operations strategy in manufacturing (e.g., Hallgren et al., 2011) and production system evaluation in construction (e.g., Johnsson, 2013) implies that competitive advantage is achieved by exploring new possibilities and exploiting what is already known by utilizing internal and external firm specific capabilities. These perspectives adopt a contingency perspective recognizing, that production system design must be tailored to different market segments with specific requirements (Johnsson and Rudberg, 2014). Important for IHB firms is also a system integration ability to employ the specific platform to control and coordinate the supply chain in specific housing projects and at the same time create a predictable and stable supply chain in the long run (Jansson et al., 2014 and Lessing and Brege, 2015). Exploiting a platform is to directly compete with other actors why market knowledge and responsiveness in tendering are important capabilities (Johnsson, 2013). Exploring a platform necessitates product development capabilities and the ability for continuous improvements to control work processes (Meiling et al., 2014).

In line with Teece and Pisano (1994), Davies and Brady (2000) identified that companies need to attain and develop an absorptive capacity - or dynamic capabilities -
to create flexibility for internal and external actions to a changing technological and market environment. In production strategy research, the link between how the external market requirements should be aligned with the ability of the production system is often termed the process choice (e.g., Olhager and Rudberg, 2002). Internal operations capabilities to conform to a contingent process choice are well researched in the operations strategy, operations management and production systems literature, e.g., Hallgren et al. (2011).

The business model construct and dynamic effectiveness

The dynamic capabilities and process choice concepts are herein linked together by the use of the business model perspective. The rationale for using the three-element model (Figure 1) of Brege et al. (2014) in this work is its explicit differentiation between strategic (market) effectiveness and operational efficiency.

![Figure 1 – The business model construct and the dynamic effectiveness](image)

The **offering** is perhaps the most important part of the business model because it ends up in a ‘value proposition’ directed toward customers.

The **Market Position (MP)** can be described by the position the company has chosen in the marketplace; the choice of particular customers and actors, the choice of type of cooperation (e.g., main or sub-contractor), the choice of supply chain integration (e.g., long-term integration or project contracts).

The **Operational Platform (OP)** consists of the company’s resources integrated with external resources from supplier and partners that produce and deliver the offering. The core is the production platform that contains the particular production resources, know-how, partners and the (value chain) management of these assets.

In Figure 1, the dynamic effectiveness can be seen as how fit is achieved between the MP and OP in the business model. The dynamic aspects of the coordination mechanism represent abilities to constantly adjust internal operations to respond to a changing market environment (Teece and Pisano, 1994) so that: manufacturing outputs meet customer expectations (Hallgren et al., 2011); the architecture of capabilities for facilitating learning across process are constantly improved (Söderlund and Tell, 2009); the dynamic evolution of business models is secured (Höök et al., 2015).

The framework for analysis in Figure 2 has been synthesized from the different theoretical frameworks.
MPER is the capability for long-term exploration of the chosen niche market; MPET is the capability for bidding for and completing projects (exploitation); OPER is the capability to explore and tailor-design the operational platform in a long-term perspective; OPET is the capability to exploit the pre-engineered components and methods limited to the specialized production system in separate building projects. Three analysis steps illustrate how Figure 2 is utilized:

1. Shifts in the business environment trigger changes either in the MP or in the OP dimension,
2. A reciprocal and dynamic effectiveness is attained if all MPER-OPER-OPET-MPET capabilities are jointly employed, i.e., if the firm takes active actions, as a response to the environmental business trigger, to change both the Market Position (MP) and Operational Platform (OP) and if these actions incorporate considerations for exploitation (ET) and exploration (ER),
3. An active action is considered to reflect the dynamic (and reciprocal) flexibility needed for a company to develop itself to a changing market environment. Reactive actions to a changing market trigger is considered as the “static” actions just to exploit or explore the business model.

Methods, case selection and research design
Case study research as such, allows the exploration and understanding of complex issues. In addition, the strength of the method (Yin, 2013) is that the examination of data can be conducted within the context of its use. In this article, a case study is selected as a theory-extension strategy since it answers well to “how” and “why” questions. Yin (2013) and Eisenhardt (1989) argue that, to build or extend theory one must have in-depth understanding of the concerned phenomena not only to define the data but also to provide a foundation to explain the complexities of real-life situations. A case study was considered particularly suitable in this situation to get an understanding of how and if correlations exists between operations, market, exploitation and exploration to identify capabilities and the dynamics of the capabilities that connect OP and MP (Figure 1), i.e., to exemplify what dynamic effectiveness is.

Following this methodological view, a qualitative explorative approach was chosen and a case study was used to gain rich information about how two Swedish IHB companies, with separated production systems according to Gibb and Isack (2003), mobilized capabilities according to the business model constructs of Brege et al. (2014). The IHB type companies are consciously differentiated, to do theory extension as well as get more generalizable results. Case company A is classified as modular building and case company B as volumetric pre-assembly.

Screening and selection of case companies was based on previous knowledge and personal connections that some of the authors have with the companies. This personal connection gives authors the possibilities to gain a more in-depth understanding, as well
as an opportunity to gain better information from the interviews. To avoid biases, precautions were taken as discussed later.

The data analysis was performed using the analytical framework in Figure 2. The procedure for interpreting the qualitative data follows (e.g., Miles and Huberman, 1994): reading and re-reading the data, data reduction and categorization (coding). The coding was made independently by two authors and final coding for capability interpretation was made by all authors jointly. Coding of active activities and capabilities followed a five stage scheme:

1) A (critical) environmental business trigger at the company level is identified for company A and for company B,
2) Actions taken in the two dimensions of MP and OP (Figure 1) as a response to the trigger were identified. The actions were grouped into the four groups in Figure 2: MPER, OPER, MPET and OPET
3) Identification that an action is active or reactive follows the scheme of Höök et al. (2015). Definition of an active action is when the OP organization or the MP organization deliberately is making a decision as a consequence of the trigger,
4) Only active actions are considered to influence a reciprocal and dynamic effectiveness, and
5) Dynamic effectiveness capabilities follow Chandler’s (1990) and Teece and Pisano’s (1994) definitions as organizing structures, roles, experience, skills and managerial processes required to carry out a particular activity, i.e. the way things are done.

Data was primarily acquired from interviews but also supplemented with secondary data regarding the two case companies. Interviews were conducted with one project developer in company A and a marketing manager in company B (both representing the MP dimension of the business model) and one production manager (representing the OP dimension) at each case company. The rationale for this choice follows the purpose of the article to describe and evaluate the dynamic effectiveness. The interviewees chosen were persons with large insight in the respective companies marketing and production operations to get the views framing a dynamic effectiveness. The procedure was to conduct interviews in pairs as suggested by Lundahl and Skärvad (2016). The benefit with two researchers conducting interviews is that while one is doing the interview the other can observe, make notes and do follow-up questions. Furthermore, to minimize bias, the one primly in charge for conducting the interview was the person with least personal contact with the company. Overall, the interview session lasted approximately one hour. Two of the interview sessions where conducted face-to-face in the interviewee’s own contextual environment, and two were conducted as video conferences. The interview data was recorded and written down to ensure quality and data backup.

The interview guide, with approximately 20 questions, was based on the frame of reference. The questions include management of the operational platform, the market position and how the two were interconnected during the environmental trigger studied. To enable the interviewees to present their own narrative, all areas of inquiry started with openly formulated questions and continued with more detailed questions.

Case company descriptions
Case company A is a medium size construction contractor, producing multi-storey buildings. The company has separated its production platform into an off-site production system for prefabrication of volumetric elements and an on-site production system for the final building construction. The prefabrication extend of the off-site production system includes electricity, pipes, tiles, wall paints, wardrobes, bathroom and kitchen interior.
Production is one of the major bottlenecks within the company’s business processes so the continuous improvement process to strengthen the efficiency of the production is well established exposed by e.g. a lean organization and an attempted “takted” flow through the value chain from the suppliers to the customers.

- **Offering:** Multi-storey buildings with timber frame and high customization towards the requirements
- **Market position:** Main- or sub-contractor
- **Operational platform:** Off-site production system for prefabrication of volumetric elements and an on-site production system for the final building construction, a substantial part of resources is allocated in the off-site production system, investments made in the automation of the production lines, LEAN award winning and known as a strong performer within that field

The environmental trigger studied at case company A has been a recently increased demand for the company’s products that resulted in a management decision to speed up the production takt and further on caused activities within the operations to solve the faster takt. The reduction of drying times for tiles and painting in the case company A’s off-site production system has been one of the focus areas and has been realized within a product development project and finally with a creation of a new company with management from both the case company A and it’s supplier for composite floor. The new company’s business model is to deliver complete bathroom pods (including electricity, pipes, tiles, wall paints and interior) to case company A. **Studied trigger: is a joint venture with a specialized supplier into a subsidiary company to produce complete bathroom pods suited for their production flow.**

Case company B, it’s a medium-sized family-owned volumetric preassembly company with close to 300 employees, with sales of around SEK 370 million per year the company offer construction and real estate company’s prefabricated bathroom pods for hotels, nursing homes and residential properties. The company aims to be lean and effective, yet offer their clients to specify unique requirements regarding pod shape, floor material, ceiling material, glazed-tiles and bathroom accessories.

- **Offering:** The volumetric pre-assembly, as a product, is aimed to be used broadly in the almost every market segment from single-family houses to multi-storey buildings and buildings. Furthermore, the bathroom pods can be customized according to customers’ needs, in terms of pod shape, floor material, ceiling material, glazed-tiles and accessories. As a consequence, the quality and price therefore differ widely.
- **Market position:** Company B takes a role as a volumetric pre-assembly supplier, delivering only volumetric pre-assemblies to either main- or sub-contractor, making them almost a component supplier taking no active role in the building process.
- **Operational Platform:** A substantial part of resources is allocated in the production facilities especially including the assets and investments made in the automation of the production line making the production line the determining factor for the rest of the operations (e.g., marketing, design etc.)

The environmental trigger studied at case company B has been almost the same as in case company A. With an increased demand in company’s products, resulting in insufficiency in resources i.e., lack of manpower, shortcoming of production facility space and production capacity, triggered company B management to take actions to overcome these obstacles to ensure continuum in company development. As a consequence, search for production facilities and manpower gave company B an
opportunity to take over ownership and acquired a company with all its resources, that is one of the world’s leading suppliers of sandwich panels products.

**Studied trigger:** is the recently acquired production facility with the aim to strengthen the company position based on their unique bathroom pods produced in small series.

**Results and analysis**

The coded answers on how the environmental trigger imposed actions in the OP and active actions to interconnect with the MP dimension, and vice versa, are summarized in Figure 3. The two pie charts (Case A and B) show the relative number of active actions, assessed by both the OP and MP representative, in the dimensions of MPER etc. For example, as one (of several actions in many dimensions) response to the creation of the new company that will deliver complete bathroom pods to case company A, the MP manager replied.

- *We will do an information sheet [...] for marketing purposes. After a couple of years of sales, the customers will feel more secure with the product. We will get (production) flow gains*

This is interpreted as an active action taken in the MPER dimension, i.e., to protect and create long-term exploration of the chosen market.

A reciprocal and dynamic effectiveness capability, according to Figure 2, would show up as an evenly distributed pie-chart displaying active actions jointly taken in all four dimensions (about a quarter each of the total). Quantitatively company A displays a reciprocal and dynamic effectiveness as a response to the trigger, with a slight over-focus on exploration of the operational platform. However, company B responds to the trigger differently. There is clearly an imbalance in the four dimensions and active activities in the MPET dimension (market exploitation) is totally lacking. The trigger in company B was clearly addressed almost exclusively in the OP dimension, i.e., a production oriented response to the trigger displaying less capability for a dynamic effectiveness.

![Pie charts for Case A and B](image)

*Figure 3 – Classification of active actions taken in as a response to the business trigger. An even distribution indicates a reciprocal dynamic effectiveness.*

It must be remembered that Company A is classified, according to Gibb and Isack (2003), as a modular building company and company B as a volumetric preassembly company. The pie charts almost certainly reflect these different production system designs (and also the different business models). Case company A should not be compared to case company B.

Dynamic capabilities forming the four dimensions of MPER-OPER-OPET-MPET are assessed based on the whole data-set in figure 3.
**Capability for MPER – exploration of the market platform**

**Production manager company A**
- Some of the customers are skeptical about the new product. The future goal is that the customer, to a higher degree, can customize the bathroom pods themselves. The inner ceiling of the bathroom pod is lower, but then there is no need for any visible ventilation and customers can get spotlights.

**Sales manager company B**
- The goal [.. with the new production facility] is to get more products into the market place that also can be more associated to each other in order to create a broader portfolio so that the whole company becomes more independent. We can then link different concepts, e.g. wall elements with bathroom pods, which can be built into a complete volumetric module.

Summary: A capability for MPER, seems strongly related to improve the market position in a long-term. Both companies have a vision of what the future holds and are striving toward that vision. Therefore, MPER can be labeled as the capability to secure and extend the market position over time, by filling customer’s needs.

**Capability for OPER – exploration of the operational platform**

**Production manager company A**
- All company functions were involved in the development [.. of the new company]
- The ownership was chosen to release resources [.. form the case company A] for the development of the bathroom pod. It could be hard to get a loan from the bank for product development, instead was ownership chosen to get development funds until the new company was up and running.

**Production manager company B**
- We have borrowed personnel between the new company and ours. We have personnel from the new company here to learn. They will produce same type of bathroom pods [at the acquired production facility] as we do here. We have already produced complete hotel rooms there.

Summary: Common nominators for an OPER capability appears to be long-term planning and development of employees in order to secure production over-time through product development. Both companies emphasize the importance of continuous improvement through expanding the product portfolio. Consequently, OPER can be labeled as the capability for long-term development and utilization of resources.

**Capability for OPET – exploitation of the operational platform**

**Production manager company A**
- We have taken into consideration everyone’s point of view in the whole trip [.. of developing the new company], we all have visualized problems, worked to find common solutions, discussed, been a partner to other parts of the company. All the departments [.. in the company] have been involved. The [.. old] bathroom floor concept has been around for ten years and we are developing this concept further.

**Sales manager company B**
- They [.. the acquired company] can affect and interact with our suppliers. For some new product groups, we have already made agreements usable for the group [.. the extended business group] so all of our business units [.. production facilities] can make use of the agreements and pricing.

Summary: Both companies emphasize the use of existing resources, assets, partners and know-how: Company A used the existing bathroom floor concept to build a whole
new product; Company B used the power of group agreements and pricing to enhance its product. Hence, OPET can be labeled as the capability to use of existing resources to engage the operational platform in building projects.

**Capability for MPET – exploitation of the market platform**

Product developer company A

- *We have not transferred bathroom pod development costs in to the prices, the bathroom pod is more expensive at first. The company takes the product development cost themselves which I think is long-term thinking*

Company B, did not have any response that could be classified as a MPET.

Summary: Company A puts focus on keeping the market position by not interfering the business by transferring product developing cost into the product. They instead expects that it will pay back in the long run. Hence, MPET can be seen as market position strengthening through product development to exploit the OP in specific projects.

**Conclusions and discussion**

The purpose of this article is to explain, how the reciprocal dynamic effectiveness with its dimensions operations vs. market and exploration vs. exploitation can be described in IHB settings. A business model concept (Brege et al. 2014) was utilized as the analytic tool to describe and analyze how IHB companies react on environmental triggers and how they operate. As a result dynamic capabilities were identified within the four dimensions of MPER-OPER-OPET-MPET. Capability for MPER – exploration of the market platform are in line with the positive effects Das and Teng (2000) saw when the operations are aligned to the market position in long-term networks (alliances) with customers or/and suppliers. To sustain a maintaining capability of learning, the ability for continuous improvements to control work processes (Meiling et al., 2014), capability for OPER – exploration of the operational platform is therefore important. Capability for OPET – exploitation of the operational platform can be seen as “controlled or self-owned manufacturing resource” which includes the ability to manage and engage the particular production resources (platform resources, network and partners) in a particular project (Johnsson and Rudberg, 2014). Capability for MPET – exploitation of the market platform is strongly connected to the concept of order winners and qualifiers that Hallgren et al. (2011) presented on how the dynamics of manufacturing capabilities are built and employed for ETO type companies.

Not surprisingly as seen, the processes link to reciprocal dynamic effectiveness are complex, because all four dimensions MPER-OPER-OPET-MPET must be considered. However, we cannot rule out that this model is too simple and there are more complex issues that affect the company’s ability to be reciprocal and is dynamic effectiveness. The generalizability of the results is limited, because just two separate events have been studied without any deeper investigations about how the findings of single event allow conclusions about the case companies’ general appearance or how performance is affected by being reciprocal dynamic effective. Hence, further research must be done, to examine the role positioning in supply chain affects the dynamic effectiveness in IHB companies. Next step could be to study the interactions between these four dimensions, as the primarily result indicates diagonal interactions between MPET- OPER and MPER-OPET, and horizontal interactions with MPER – OPER and MPET – OPET.
References


