INTERNATIONAL CONFERENCE ON ENGINEERING DESIGN, ICED'07
28 - 31 AUGUST 2007, CITÉ DES SCIENCES ET DE L'INDUSTRIE, PARIS, FRANCE

PLATFORM DECISIONS SUPPORTED BY GAMING

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ABSTRACT

Platform is an ambiguous multidisciplinary concept. The philosophy behind it is easy to communicate and makes intuitively sense. However, the ease in communication does overshadow the high complexity when the concept is implemented. The practical industrial platform implementation challenge can be described as being a configuration problem with a high number of variables. These variables are different in nature; they have contradictory influence on the total performance, and, their importance change over time. Consequently, the specific platform decisions become highly complex and the consequences of these decisions can cause a high strategic risk. This paper describes and discusses the complexity of the platform decisions. We argue that new methods have to be introduced in order to create a comprehensive picture of the consequences of the platform decisions. One of the promising new methods is the application of on-line games in order to provide training for decision makers and in order to generate overview over the implications of platform decisions. However, games have to be placed in a context with other methods and we argue that a mixture of games, workshops, and simulations can provide improved support to the platform decision making.

Keywords: Platform development, platform decisions, platform utilization

1 INTRODUCTION

The elements of working with platforms are not new. In his reflections upon the setup at Ford Motor Company, Henry Ford made a description of the careful delineation of subsystems inside an automobile, and he examined new component technologies both inside and outside the company to improve comfort, ease of use, and durability [1]. This reflects a general systems approach of how to develop product and production systems. Herbert Simon [2] defines complexity as the main problem of handling systems: "Roughly, by a complex system I mean one made up of a large number of parts that interacts in a non-simple way. In such systems the whole is more than the sum of the parts, not in an ultimate, metaphysical sense but in the important pragmatic sense that, given the properties of the parts and the laws of their interaction, it is not a trivial mater to infer the properties of the whole". The complexity problem when working with platforms is to infer the cause effect relationships and thereby the intended overall performance of the platforms.

The most widely used formal definition of product platform is the one provided by Meyer and Lehnerd [3]: "product platform is a set of subsystems and interfaces that form a common structure from which a stream of derivatives products can be efficiently developed and produced." This definition has been extended to provide a focus on shared assets. Robertson and Ulrich [4], for instance, define product platform as a collection of shared assets (such as components, processes, knowledge, and people and relationships) that are shared by a set of products. In these definitions platforms are inherently defined as product platforms. However, it is obvious that the product platform relates to much more than the product in a narrow sense. The product platforms determine the setup of the supply chain [5] and impact the organizational efficiency through its relation to the knowledge structure and thereby the organizational coordination structure [6].

The cross organizational nature of platforms implies that both overall and specific decisions become complex (as discussed above). As Robertson and Ulrich [4] articulates, "good platform decisions requires making complex trade-offs in different business areas. Top management should play a strong

role in the platform process for three reasons: (1) platform decisions are among the most important a company makes, (2) platform decisions may cut across several product lines or divisional boundaries, and (3) platform decisions frequently require the resolution of cross-functional conflicts".

As organizations do not yet have enough insight into the phenomena of platforms these decisions tends to be difficult to fit into the traditional decision structure of the individual company. In this paper we will take outset in our empirical observations of platform decision processes and discuss the application of alternative methods to support the platform decision making.

2 PLATFORM DEVELOPMENT PROCESS

The platform development process includes two different aspects, 1) The process of defining, implementing, and communicating platforms, and, 2) The process of applying the platform when developing new products. Though the two aspects are different in nature it is important to view and manage them in an integrated perspective. However, initially we will discuss the research methodology in order to make use of our empirical research findings while discussing the two aspects.

2.1 Research methodology

Yet, there are no studies available that reveals statistical significant cause-effect relationships regarding platforms. We interpret this as a result of three factors:

- The complexity of the cross-organizational platform effort
- The differences between companies and industries which means there are hardly no standard solutions
- The maturity of the research within the field

As a consequence of this we have chosen to conduct our empirical studies as case-studies. Due to the complexity issue we have furthermore chosen to setup major parts of the empirical research as an action research approach. This has meant six years of continuous weekly involvement with two Danish companies: LEGO Group and Bang & Olufsen. Also, more than 20 companies have been involved in the study in various degrees.

The most intensive case study has been conducted at LEGO Group. This study has been setup as an action research project aiming at both observing, documenting and impacting the platform related work at LEGO Group. For four years (2002 to 2006) we have spend between two and three days each week at the company. While associated with LEGO Group we have set up network relationships with more than 20 other companies focusing on different aspects of working with platforms.

Strategy	*Form of research question*	*Requires control over behavioural events?*	*Focuses on contemporary events?*
Experiment	How, why	Yes	Yes
Survey	Who, what, where, how many, how much	No	Yes
Archival analysis	Who, what, where, how many, how much	No	Yes/No
History	How, why	No	No
Case study	How, why	No	Yes

Figure 1 Five research methods as defined by Yin [7]

Yin defines five different overall research strategies. According to Yin case study is an advantageous strategy when 'how' and 'why' questions are being asked about a contemporary set of events, over which the investigator has little or no control [7]. In our case we have combined the case study with historical analyses, archival analysis, and experiments. The long term relationship with the case

company has made it possible to make experiments in an action research manner. Our definition of action research is informed by Gummersson [8], who defines action research as “the combination of research and management consultancy that involves interventions into processes of decision making, implementation, and change”.

The case study approach has some limitations in the theory building process. Yin promotes the importance of always stating the specific theory base and propositions before undertaking any case interactions [7]. In our case this has only been possible to a limited degree. The current maturity of the platform theories means that companies have very different ideas about platforms in their specific context. Instead we have been inspired by the eight-step process for building theory from case studies as proposed by Eisenhardt [9]. Eisenhardt emphasizes the need for a high degree of flexibility in the process where early theory constructs are only tentative and not guaranteed a place in the resultant theory. In our case the early theory constructs have been the cases documented in the literature. These constructs have been applied and tested against the empirical setup in the main case company.

Change, implementation, and dynamics are three important features of working with platforms. Our unique access to the case company has given us an opportunity to take an active part in this change and implementation. Working within an organization requires an ability to work with dynamic complexity, not only because of detail complexity but also because of multiple cause-effects events over time [10]. Gummesson applies the metaphor of an iceberg; i.e., 90% of the iceberg is under the surface [8]. The research thus requires access to and recognition of the complex realities and a focus on the totality of the system. In a similar way Westbrook states that "the grounded, iterative interventionist nature of action research ensures closeness to the full range of variables in settings where those variables may not emerge at once" [11]

All in all more than 50 case studies have been conducted during the four year period. These case studies vary in scope and size. The theory constructs derived from the studies support various theoretical and practical fields. However, in this paper we will predominantly focus on issues regarding the important platform decisions.

2.2 Defining, implementing and communicating platforms

The process of defining, implementing and communicating platforms is familiar with the traditional technology planning or technology management process. When applying the concept of platforms the concept of modularity inevitably follows, and this is one of the most powerful differences when comparing with traditional technology management theories.

The definition of a platform (as discussed above) seems to fit how most companies use the platform term [4]. However, the broadness varies. Some companies use a narrow definition focusing mainly on product structures and technology. Other companies apply the broad definition by including processes (supply chain) and knowledge structures. The product structure tends to be the most visible part of the platform and many companies have formalized this part by applying product configurators [12].

Though the platform definitions in different companies are similar the actual representation of the platforms from company to company are quite different. Therefore, we have proposed a platform template to capture the similarities between different specific platform interpretations and to support and inspire platform development and continuous improvement of platforms by facilitating learning across industries. The following factors are identified as potential elements of a platform template [13]:

- The platform is based on one or more architectures
- It forms a meaningful part of a product or a process
- It includes relevant knowledge at the architectural level
- It serves as a basis for long-term development work
- It serves as a basis for short- and medium-term continuous improvement
- It is based on a partly modular structure (by adopting modular architectures)
- It specifies internal and external interfaces
- It is specific about where to gain effects

One particular reason for the differences in interpretation between companies is the differences between industries. In some industries the platforms or part of the platforms are shared. This is in particular the case within the computer industry and the auto industry [14]. When parts of the platforms are shared to decisions regarding platform development tend to become more complex.

One of the big players within the computer industry – Intel – delivers the microprocessor that is an important part of the PC. But a microprocessor can do little or nothing useful by itself. It's a component of a broader platform or system. Intel explain their challenge this way: "Intel is in the business of providing the engine for the PC…That engine is doubling in capacity every 18 to 24 months…What we really want is to ensure that the rest of the platform goes with it. This means that, if the engine gets better, the tires get better, the chassis gets better, the roads gets better, you get better gas mileage…The platform around the engine limits the engine. So we want the platform – which is everything that's around the microprocessor – to be keeping pace and improving and scaling, such that the microprocessor can deliver its potential" [15].

Our primary case company – LEGO Group – some years ago had only a small variety of LEGO bricks that snap together to form a structure. Now they produce a large array of different bricks. On top of this has been added the DUPLO® bricks aiming at smaller kids and the TECHNIC® range which includes the ability to make mechanical assemblies, including gears and motors. More recently LEGO Group has introduced the MINDSTORMS® range which includes a computer, infra-red transmitter and receiver, software and sensors as well as the motors and bricks of the earlier products. Users can now make relatively sophisticated robots with sensors that can receive set of instructions through robot programming language [16].

LEGO Group is operating in a more vertical integrated mode than Intel. In short the value chain includes the following elements: raw materials – molding – decorating – assembly - packing – distributing. Until a few years ago the LEGO Group also developed and produced equipment. Today, nearly all of this is outsourced to specialized suppliers and decisions regarding development of the platforms have to be coordinated with external partners.

Back in 2001 LEGO Group felt an urgent need to reshape how they were working with platforms. They had eventually come to a situation where the platform term was used in many different meanings and there seamed to be a large number of platforms. There were platforms for the building systems (DUPLO®, TECHNIC®, SYSTEM®, etc.), platforms for electronic technologies, platforms for different types of moulds, platforms for various kind decoration equipment, platforms for many types of materials, platforms for the packaging equipment, and platforms for the packing solutions. The following process led to a more consistent understanding and definition. This process was supported by the simple graphics depicted in figure 2.

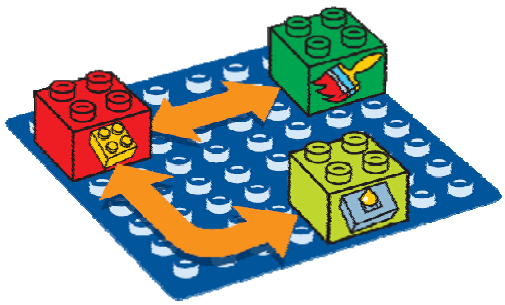

Figure 2 The illustrative figure used to communicate the platform understanding at LEGO

In short LEGO Group decided that what was original viewed as platforms now should be viewed as architecture [14, 16]. The new platforms then emerged as a number of aligned architectures. Figure 2 illustrates a simple platform with a building system as the key element which is aligned with a mould architecture and a decoration architecture. As a consequence the number of platforms was reduced to

equal the number of building systems. The most important platforms are the DUPLO® platform, the SYSTEM® platform, and the TECHNIC® platform (see http://www.lego.com for further details).

The platform development process consists of two different tasks. One task is to update the current architectures according to perceived requirements from the market and another task is to make sure that the updated architectures in the platform are sufficient aligned and that the alignments of existing architectures are continuously improved. The following three examples can illustrate the nature of these tasks:

- Increasingly the market department wanted special bricks to differentiate the products. These special bricks were typically produced in smaller numbers and consequently the existing mould architectures were considered too costly. A new mould architecture was developed – an architecture which was very different from the existing. The new mould architecture included an industrial produced mould frame and a flexible setup to produce the core element of the mould. Since the process was radically different from the existing mould production process a whole new process had to be developed. The new mould architecture had some limitations in terms of geometrical possibilities of the bricks. These limitations had to be communicated efficiently to the designers. All of these adjustment activities characterize the content of the alignment process.
- The dominant decoration technique is the pad-printing process. This process is a low cost technique when the batch size is high. However, the technique is rather inflexible when the batch size is low. Therefore it is frequently considered whether new digital decoration techniques are available. Yet, the alternatives have not proven cost competitive. Mainly because the existing setup is efficiently aligned with the existing supply chain process and the designer. A change will initiate a cascade like row of changes in the whole setup.
- In 2003 it was decided to redesign the DUPLO characters. Marketing were requesting a more organic and appealing design. The redesign required a thorough alignment with mould, decoration, and assembly architectures. It had to be considered whether parts of the original product elements and the supply chain setup could be re-used. In figure 3 the resulting design of the DUPLO character is illustrated. All product parts were redesigned but significant parts of the supply chain were re-used.

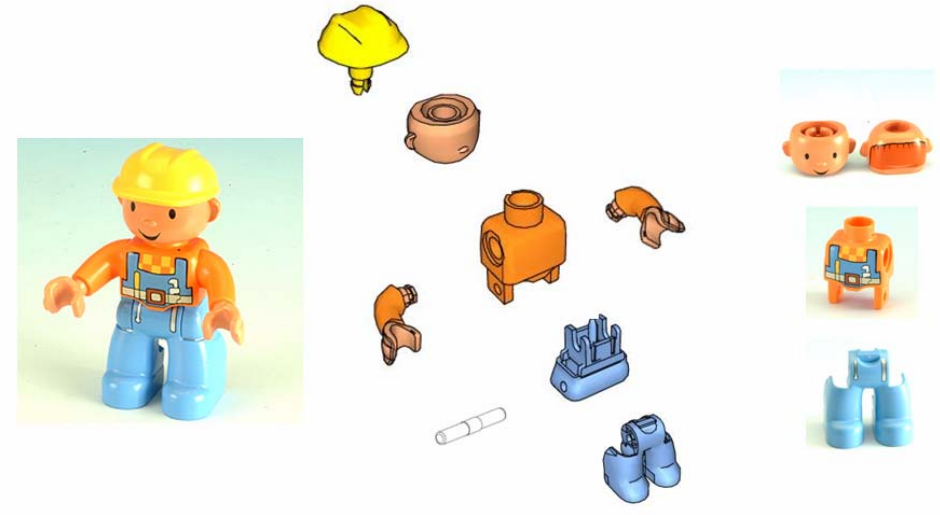

Figure 3 The DUPLO character and the product structure

The three examples illustrate the challenges of aligning architectures. It is clear that the judgment of the efficiency and effectiveness of the quality of the alignment is not a binary either-or question. It is a complex cross-organizational and inter-organizational problem where it is difficult to get the full overview of the consequences. We will return to this problem in the following sections.

2.3 Applying the platform when developing new products

The existence of a platform as discussed above does not guarantee that this platform is applied efficiently when new products are developed.

The process of applying the platform is a process familiar to the traditional product development process. However, there are some important differences due to the different aims. As the platform development process aims at developing some kind of meta-product the methods associated hereto are more abstract. Since the research and industrial interest in platform design has intensified in the recent years the full understanding of the process has not yet been satisfyingly revealed. The design literature contributes with different views. Ulrich & Eppinger [17] frame the process as a part of "system level design", Pahl & Beitz [18] frame it as being a part of "embodiment design", and Ullman [19] speaks about a "configuration design task".

The difficulties of applying a platform relate primarily to the ways the platform and the architectures that constitute the platform are communicated. Ulrich & Eppinger illustrate this with a combined geometric layout and functional clustering of a Hewlett-Packard DeskJet printer [17]. This leads to a very generic product architecture that facilitates re-use of specific solutions across the whole Hewlett-Packard DeskJet printer range. Furthermore, it significantly shortens the time to develop new variants. On the top it facilitates the discussion of the potential updates of the product architecture and the platform.

At the LEGO group the product architectures are communicated visually in the so-called "Element Park". In the Element Park all existing LEGO bricks are mounted at big posters and the designers can literally walk through the park and see what is currently available. The bricks are organized within the different product architectures (DUPLO®, TECHNIC®, SYSTEM®, etc.), and, furthermore, they are classified according to their functionality (e.g., standard brick, special bricks, functional bricks, vehicle bricks, characters, animals, etc.). If a designer wants to use for example a hinge he or she can easily get an overview of what is available. There is a high degree of re-use of functional bricks across the different product lines, e.g., Harry Potter®, Starwars®, Batman®, Bob the Builder®, and LEGO Groups own product brands. Each brick is also marked with color codes that symbols whether the process architectures are updated and running, and whether the raw materials are available.

The Element Park and the product architectures are "owned" by a dedicated organizational unit. These product architects advise the designers and initiate renewal and clean up of the current product architectures.

The critical questions when applying a platform in a product development process relate mostly to communication, existence of portfolios, and timing issues.

Communication has been discussed above. The cases of Hewlett-Packard and LEGO Group illustrates that good platform communication is a highly company specific problem. It has to match the current challenges in the particular industry and it has to match to the organizational structure of the company. Having these two requirements in combination means that the platform communication challenge has to be considered individually from company to company.

The existence of portfolios of products (and supply chains) raises a problem of visualizing across the different product programs. Re-use of a component from another product program might be motivated by the possibilities for economy of scale in production. This is often complicated further by the fact that the re-use might happen within a time span of several years. The logic of re-use is that the single component often gets more costly. Most financial systems are not able to capture the benefits from such kinds of re-use.

Timing is crucial. Often additional resources have to be added when component with re-use potentials are developed. This also includes longer time to develop. Development teams are often left in a dilemma between developing their own solution or waiting for the solution from a decoupled platform team. In addition the old saying applies "The devil is in the details" – the reason why a particular

solution fails often lies in the details. This points back to the overall problem of dividing the total development resources between platform development and product development.

3 PLATFORM EFFECTS

The main benefits gained from platform thinking can be classified within the following areas: reduced development and manufacturing costs, reduced development time, reduced systemic complexity, better learning across projects, and improved ability to upgrade products [20]. Some authors argue that both product performance and the majority of effects on the whole supply chain can be determined when the product architecture is designed [12]. For instance, it has been shown that the degree of supplier-buyer relationships can impact the degree of modularization during the product architecture design [21].

From a managerial viewpoint the effects are generally considered as potential effects. Applied successfully, platform philosophies and modularization provide a potential strong basis for achieving major competitive benefits along the whole supply chain [22]. However, realization of the benefits requires extensive coordination among different functional bodies of a company, often leading to the difficulty of balancing commonality with distinctiveness of products.

Product platform has tremendous implications for a company's product portfolio management, in which sets of technologies and products are evaluated in relation to each other. How platform architecture is planned and configured, in terms of the technology composition contained in the subsystems and respective interfaces linking these subsystems, has significant impact on trade-offs between the degree of standardization and customization of product families and respective end products.

Therefore, the platform decisions are among the most important ones a company makes as such decisions may cut across several product lines or divisional boundaries, frequently requiring the resolution of cross-functional conflict and making complex trade-offs in different business areas [4].

The experienced problems in platform development processes are in particular related to two areas:

- Platform decisions are intertwined and often dynamically dependent
- It is not obvious how and when the benefits of applying a platform approach can be realized

The characteristics of the platform development processes and the problems in realizing and visualizing the benefits from applying a platform approach both points to the complexity as the main obstacle – and to the decision making as the revolving point. If this decision making regarding platforms could be better facilitated in terms of establishing a more comprehensive overview a lot of the complexity could be reduced.

The traditional methods of creating overview over complex phenomena often fail. Partly because the platforms context is so different from company to company and partly because of dynamics. Therefore, we have continuously developed new methods to structure the platform development process. The recent development in on-line computer games has initiated an effort to use the games to test how complex decisions do impact the strategic performance of companies. Our initial experiences are positive. In the following section we will discuss these experiences.

4 GAMES AND DECISION MAKING

Learning and decision making are two closely interrelated concepts. Though the concept of learning in organizations is far from new we are still in a situation where most organizations suffer from learning disabilities. Learning in organizations is truly difficult. To learn in organizations we need to create the right culture for learning, we need to have sufficient time, and we need approaches to facilitate learning. Our culture for learning is highly determined by our experiences in school. By the time all children are 10 they know what it takes to get ahead in school and please the teacher – a lesson they carry forward through their careers of "pleasing bosses and failing to improve the system that serves customers" [22]. To challenge this cultural heritage we need to create a setup where "what is" and

"what we use to do" can be questioned and "what could be" and "why don't we" can be encouraged and facilitated.

Our general approach to learning is the traditional class room teaching. However, this is only a valid method for teaching novices. To make professionals learn we need to introduce interactive methods that support experimentation and reflection [24, 25]. In professional settings learning always takes place in relation to a specific environment. We don't use environment in the ecological sense but in the sense of the sum of all forces that affect an organizations actions. When we learn we get a better understanding of this environment, we can improve our ability to adapt to the environment, or we can change the environment. It is our experience that the means in the learning process can be conceptualized into three categories: Workshops, Simulations, and Games. The three means have different characteristics that when applied in the specific environment stimulates the various elements of the learning process. In figure 4 the means and the environment is illustrated in a simple conceptual model

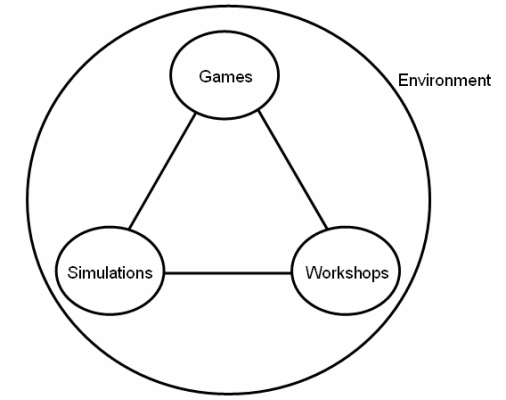

Figure 4 A conceptual model of the learning practice including the means in the learning process and the specific environment where learning takes place

In the following we will elaborate on each of the three means in the conceptual model and hereafter we will describe their interplay in the learning process.

Workshops
Generally the workshop is defined as: "*An educational seminar or series of meetings emphasizing interaction and exchange of information among a usually small number of participants*". The workshop element is the social engagement element. In this sense, workshops are required in any learning process. Simple problems can normally be handled by a workshop alone. This is for example the case when a few people gather to solve or to communicate an experienced problem. As problems become more complex the power of social workshops alone decrease. When the number of variables increases the capacity of the human brain to handle new information reaches a limit, and in this case people often choose one of two strategies: do what they have done before or negotiate a compromise which may not be optimal. Both strategies are conservative in terms of learning and they might also fail seriously in regard to the problems that we are facing. Regarding the first strategy the French have a proverb, "*L'histoire se répète*", and it might hold some truth regarding political development. In professional organizational settings however, doing what we use to do might be threatening to the life of the organization. The reason while it is often chosen as a strategy is that it is within the comfort zone of the decision makers. Regarding the second strategy - to seek a compromise - this might be a good solution if we know all the options. However, there is a high risk that the compromise becomes a political decision rather than an informed decision. A R&D manager at Bang & Olufsen once put it this way,"Compromise is the ugly cousin of synthesis"

Simulations
A simulation generally refers to mathematical simulation. The encyclopedia describes simulation in the following way: "A *simulation* is an imitation of some real thing, state of affairs, or process. The act

of simulating something generally entails representing certain key characteristics or behaviors of a selected physical or abstract system. Simulation is used in many contexts, including the modeling of natural systems or human systems in order to gain insight into their functioning. Other contexts include simulation of technology for performance optimization, safety engineering, testing, training and education. Simulation can be used to show the eventual real effects of alternative conditions and courses of action. Key issues in simulation include acquisition of valid source information about the referent, selection of key characteristics and behaviors, the use of simplifying approximations and assumptions within the simulation, and fidelity and validity of the simulation outcomes". In our prior work with university students and with private companies we have used simulation and have experienced problems in giving the participants a truly hands-on experience [26]. Simulation tends in most applications to be a specialist tool that is often applied in an asynchronous way. The implication of this is that the interaction element becomes weaker.

Games

In "Got Game", a book published in 2004 by Harvard Business School Press, John Beck and Mitchell Wade [27] argue that gaming provides excellent training for professionals in business. Gamers, they write, are skilled at multi-tasking, good at making decisions and evaluate risks, flexible in face of change and inclined to treat setbacks as chances to try again. The chancing role of gaming was also an issue for a special report in The Economist [28, 29]. Under the provoking title "Breeding Evil?" gaming is discussed from the perspective of age and new habits for new generations. In this light gaming is viewed in line with rock and roll. Like rock and roll in the 1950s games have been accepted by the young and largely rejected by the old. Once the young are old, and the old are dead, games will be regarded as just another medium and the debate will have moved on.

The new insight into how games can be used in professional setting has triggered a range of efforts to develop games for this particular purpose. We take part in an EU funded project PRIME [30]. The main objective of the PRIME project is to give business professionals a learning environment where they can experiment with new ideas and learn how to handle the entire life cycle of products and processes for all stakeholders of the organization. PRIME proposes to achieve this by enhancing current work environments with a new paradigm based on serious gaming. This will provide the means for learning by experience within a virtual environment that is safe and foments risk taking without detrimental impact on the business.

The platform development process has been chosen as one of three exploratory case studies to support the PRIME project [30]. These exploratory case studies have been used to set the initial user requirement for the game development process and will be used in the initial as well as the final test of the game. In the selection process it has been important to define a test environment that are highly challenging to the participating organization.

Our long-term relationship with LEGO Group has provided us an opportunity to base the test cases on real data and real products. Furthermore, the game can be tested with the real decision makers. The focus will be on the launch process of new products. Each year approximately 20 new products are launched. These products count for more than 50% of the sales. However, the products rarely sell according to the initial budgets. Some will sell 4 times the budgeted plan and some product will sell significantly lower according to the budgets. The launch process can be seen in three simplified steps Concept Development, Detailed Product Development, and Manufacturing and Delivery (see figure 5).

Figure 5 Simplified model of the product launch process at LEGO Group.

The concept development phase leads to approval of the whole portfolio of products to be launched the following year. After the approval the project teams are formed and the detailed product development process starts and leads to the manufacturing and delivery of the products.

When operating in a highly competitive environment as the traditional toy market there are obviously several challenges related to this launch process. However, we have chosen to focus two overall challenges:

- The first challenge concerns the approval of the concepts. During the concept development phase the concept often change due to new inputs regarding competitors and technological possibilities. Only in the last weeks before approval the concepts converge into what is finally presented. During this process the participants from different market segment are extremely focused on their own concepts. In reality this means that the concepts in the portfolio that are not aligned. Seen from the perspective of the individual concept this leads to pure concepts without compromises. Seen from the perspective of the whole organization this can easily lead to sub-optimizations. This challenge is interpreted as the degree of platform application across the whole portfolio.
- The second challenge concerns the manufacturing setup. As the last part of a chain the manufacturing unit is bound to adapt and to be flexible due to changes in the market. This is facilitated by establishing flexible manufacturing platforms both within the company and in collaboration with suppliers. The efficiency of these manufacturing platforms is highly dependent on the specific product portfolio. When problems of delivery or quality occur later in the process it is always easy in retrospect to point to the initiating problems regarding the chosen product portfolio.

Both challenges are highly related to the decision on the specific product portfolio and the decisions regarding platform development. The evaluation of the consequences requires a substantial cross-organizational effort. There is a lot of knowledge about the effects spread across the organization but it is often tacit or there are unclear cause-effect relationships. If the consequences of a specific choice of product portfolio can be revealed it is normally possibly to change elements of the portfolio without weakening the ideas put forward from marketing. But since the consequences are not easily revealed and the number of variables is high it is not at all clear where to intervene.

Given the character of the challenges we anticipate that they are suitable for a combined workshop, game, simulation approach.

The initial test on the workshop, simulation, game setup has been limited to one product line, Bob the Builder® within the DUPLO® platform. Among our initial observations are:

- The number of variables is too big to overviewed and handled by a workshop.
- There is a high risk of the solution being either a compromise (that we really don't know the consequences of) or a solution based on what we have done before (that we really don't know the consequences of either).
- The complexity is too high to be handled by simulations. The effort to build a comprehensive model that can cover the complexity is huge and the risk of not succeeding is high. However, critical elements can be simulated and detailed parts of the solution or refinements can be supported by simulations.
- Games can only give superficial indications of a solution. However, they can support in testing the robustness of a chosen solution.

The conclusion is that each of the workshop, game, and simulation elements can support the effort if configured and synchronized properly. In the specific case we have decided to apply the approach at the beginning of the detailed design phase (see figure 5). The reason for this is that this provides us a kind of "time-out". The concepts have been finish and we know the critical differentiating factors of each concept. However, these concepts can be realized in a number of different ways. The workshops can provide us with a rich picture of the situation and give suggestions to different ways of interpreting risks. By simulations we are able estimate how different solution might impact the capacity of our manufacturing setup. And by games we will be able to test the potential solutions.

Through the workshops we are able to consider changes in the process and take in inspirations from other companies. In the particular case it is relevant to consider the experiences from the Japanese car manufacture Toyota. They apply a similar "time-out" period at the end of their concept development phase. They have named this phase Kozukeikaku or just 4K [31].

5 CONCLUSIONS

In the paper we have proposed a division of the platform development process in two interconnected processes. The main challenges in platform development are to overcome the complexity of many cross-organizational impacts and to make decisions with the right timing. In order to overcome these challenges we have proposed a mixture of games, simulations, and workshops. Though the available games are still at a moderate ambition level they have proved to deliver an important contribution in order to generate an overview of the complex cause-effect relationships.

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