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IMPLEMENTING PRODUCT PLATFORMS: A CASE STUDY

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1. Introduction

Creating product platforms in the literature is often described from a technical perspective. Procedures for creating architectures for product assortments and indices and algorithms for modularising products are numerous, but the implementation of a platform project is rarely mentioned. From our experiences in Danish industry we have learned that creating the technical solutions is only part of solving the problem. Indeed many platform projects start out as excellent technical solutions but fail in the long run due to poor implementation.
Many platform projects start out as cleanup projects, where an already existing product assortment is replaced by a more well-balanced product family. The cause of the mess in the existing assortment is often a lack of coordination between individual designer efforts, and therefore mess is likely to reappear gradually after a cleanup if no designated effort has been taken to ensure this coordination.
This paper describes a case, where the full process of creating and introducing a product platform has been performed, and aims to generalise the used approach.

2. Background

Most literature on product platforms emphasise the ability to coordinate the development of multiple new products and in this way describes the platform as a strategic tool for expanding the product assortment in a controlled and systematic way [Simpson 2004]. This is often done by introducing a modular system of carefully planned and defined independent subassemblies, which can be used in multiple product variants (see [Erixon 1998]). The purpose of this modular system is well-described in the literature: Increased customisation, reduced development time and costs, reduced manufacturing costs, reduced manufacturing investments, reduced systemic complexity, lower risk and improved service [Robertson et al. 1998].
Modularisation can be done from several perspectives, and in the literature the market or product perspective is often emphasised [e.g. Muffatto 1999]. Knowing exactly which product variants are needed will partly define a modular structure based on commonalities and differences between product variants [Fiil-Nielsen et al. 2005], but many companies will also benefit from using a manufacturing perspective [Kusiak 2002]. In the manufacturing perspective the modular structure is based on the capabilities and properties of the manufacturing facilities, and the final assortment of product variants is determined afterwards based on assessed economical impact and risks.
In our experience modularisation of a product assortment can therefore be done in a number of ways, but in order to gain the most benefits it is necessary to align the architectures of the different life systems (e.g. product development, production, assembly and service) as described by Andreasen et al. [Andreasen et al. 2004]. Aligning architectures is the process of creating synergies and eliminating inconsistencies (bad dispositions [Andreasen et al. 2004]), which have great impact on the quality and costs of the entire product assortment.

Therefore we define a platform as an alignment of architectures, with the purpose of gaining some or all of the benefits listed earlier.
As described in the introduction creating technical solutions does however not solve the mentioned problems alone. A cleanup of the existing product assortment is only temporary and will have to be repeated within a few years, if product development remains unchanged. Modularisation of the product assortment is likely to be a base for changing the way product development is performed [Andreasen et al. 2001], it is however not described in the literature nor obvious how the change in product development relates to technical models of a new modularised product assortment.
To learn this the following case study has been performed.

3. Setting up the case study

The case study was performed in the Danish company LEGO Group in November 2004 until June 2005. LEGO is a leading international toy producer, and the main part of their products (i.e. the LEGO bricks) is plastic moulded in highly automated manufacturing facilities.
The project described in this paper had already been initiated several times before, but had failed because of a lack of results and poor implementation in the organisation. Because of this the case provided an obvious opportunity for studying how platforms could be successfully be implemented.
The case study was performed as action research (i.e. the researchers themselves took part in the project).

4. Platform creation at LEGO

Like most companies LEGO Group is feeling the impact of the intensifying global competition, and this has unfortunately coincided with a general decline in the toy business. The situation has forced LEGO to reconsider everything from the selection of suppliers and distributors to the internal product development procedures. The company has begun a massive cleanup of the entire organization and product assortment. Among the initiatives a project for rationalising the assortment of wheel hubs and tyres have been started, the *Wheels* project, described in this paper, is special however because the focus has not only been on cleaning up past errors, but also on filling out gaps, improving the general quality, and aligning the assortment of wheels with the manufacturing equipment. In order to successfully balance this, a product platform has been implemented.

4.1 Prior platform experiences

LEGO has already had its first experiences with platforms. Several platforms have been introduced in the manufacturing organization primarily focusing on moulding equipment. The primary achievement of these platforms has been the reduction of costs for low-volume bricks, which has made it possible for LEGO to keep expanding the brick assortment. Prior to the Wheels project LEGO has however not had any experiences with successful platforms initiated in the product development organization, the main reason for this being partly the already highly standardised interfaces and flexibility of the bricks themselves and partly the failure of a number of platform-like initiatives. As a consequence existing platforms at LEGO have mostly been tools for rationalisation and have not included in-depth analyses of future requirements or alignment of architectures across department boundaries.

4.2 Situation before the Wheels project

Throughout the last couple of decades LEGO has introduced around 100 different wheel hubs and tyres (not including colour variants). Each element has been introduced with a special purpose in mind, but naturally many of these elements now experience no or very low production volumes and many moulds are given the current circumstances not likely to be exhausted within the coming decade. Scrapping moulds before they are exhausted, running low volume production series, and keeping large amounts of unused moulds in stock (See Figure 1) are naturally not very profitable, and therefore it has been decided to decrease the number of wheel hubs and tyres.

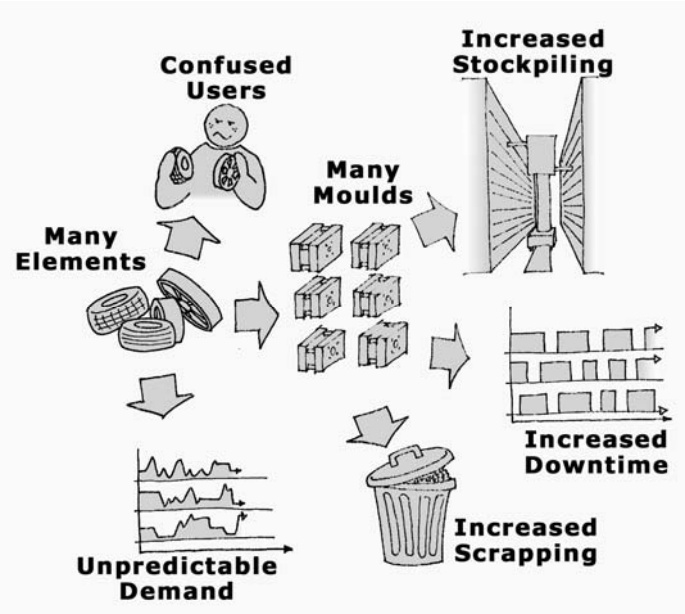

Figure 1. The consequences of having too many elements

It is not the first time such a project has been tried at LEGO. New complete assortments of wheels have been introduced several times in recent years, but all of these have failed to stop the massive introduction of even more wheel elements.

4.3 Aims of the Wheels project

To prevent another swelling of the wheel assortment in the future, the assortment must not only be reduced but also be carefully balanced to meet the necessary requirements of most future LEGO products. From the very beginning of the project is was therefore obvious that new elements would have to be introduced even though the main problem with the old situation was that too many new elements were introduced.

The long term aim of the Wheels project was to reduce the number of new elements generated and thereby better utilise existing moulds and increase manufacturing efficiency. In the proposed future situation designers would primarily use already existing wheel hubs and tyres in the LEGO models.

Because of the need to introduce new elements, the Wheels project would initially require funding, but due to the economical situation at LEGO this funding should be kept at a minimum. The short term goal of the wheels project would therefore have to meet a breakeven situation fast.

One of the two main challenges would be to make the designers accept the new situation by meeting their various needs and requirements for wheels. The other main challenge would be to show managers that the extra investments in new moulds for filling out gaps and replacing bad elements would be financed by later savings in form of fewer investments for new elements, less maintenance of existing element assortment, and rationalising of the manufacturing equipment.

4.4 Wheels platform acceptance

No new strategy of focusing on or limiting to certain sizes or kinds of wheels had been proposed from management; therefore the primary requirement for the Wheels platform was to offer wheels in all sizes and for all purposes. We were able to categorise the existing wheels into a set of fixed sizes (i.e. diameters and widths) and fixed kinds (e.g. truck tyres and race car tyres). These categorisations and the number of different sizes and kinds where revised with different teams of experienced designers. During the revision process it was decided to offer an assortment of separate wheel caps for the designers, these wheel caps would enable customisation of the wheels and separate the styling aspects

of the wheel into one separate element. The remaining wheel could therefore be focused on functional purpose only. This fact greatly increased the acceptance of the Wheels platform in the design organisation. The caps would not be predefined and would fit nicely into a well-known category in the manufacturing facilities: It would be low-volume and high price (designers have a fixed budget when designing LEGO models).
The result of the revisions was a matrix of wheels (some new and some already existing) made up of between a third and half of the original number of wheel elements (see Figure 2).

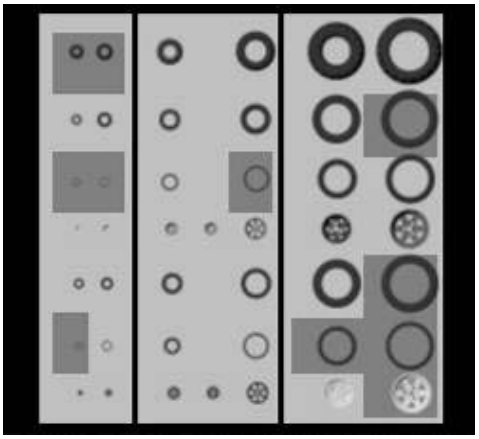

Figure 2. The Wheels matrix of elements

4.5 Creating platform alignment towards manufacturing

Reducing the number of wheel elements would naturally increase the efficiency of the manufacturing tasks. Fewer changes between moulds would reduce waste time, and increased utilisation of the moulds would hopefully increase the level of expertise in using and maintaining the moulds.

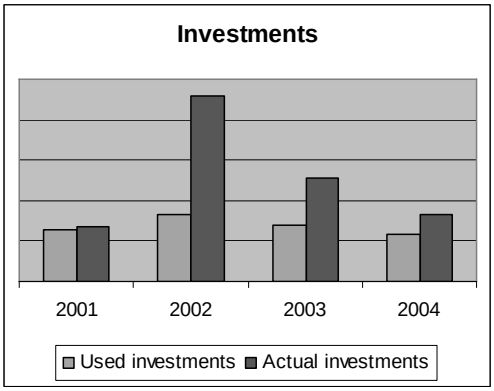

Figure 3. The actual and used investments in wheel elements

Additionally the standardisation of wheel hub diameter would greatly reduce the number of auxiliary equipment and a new kind of modular mould would in the long run save costs. The optimisation of individual elements to save material use and decrease mould cycle time could also lower costs, but mostly however these additional savings were small and could not justify the extra investments alone. As a result many existing wheel elements are used in a transition period until their moulds are exhausted. Only when investments are unavoidable, will these additional changes to the elements take place.

The main achievement and economical driver in the project was always the planned expanded reuse of selected elements and limitation to future designers, which would make introduction of new wheel elements relatively rare. Sketched graphs (Figure 3) showed that the sum of investments in new moulds for wheel elements on average amounted to twice the sum of the used investments. This meant that LEGO each year invested in moulds which could produce twice the needed amount of wheels, and the natural and observed consequences of this was an increasing stock of unexhausted moulds and a unrealistic low price on wheel elements (i.e. each element should actually repay a bigger part of the investments, because each mould produce less elements than it is capable of).
The fact that the actual investments in 2004 had been below average was mainly due to a policy of postponing the investments in replacement moulds and a reluctance to let designers introduce any new wheels because of the upcoming revision of the entire wheel element assortment and because of the economical situation. It was however evident that this policy could not be continued in 2005 and 2006. By dramatically limiting the number of new elements, the Wheels platform would ensure that moulds would be fully utilised and therefore that the actual investments would be reduced to the level of the used investments. In reality this was an alignment of the product assortment towards the manufacturing equipment.

4.6 Creating commitment to the Wheels platform

The biggest threat to the Wheels platform was a lack of commitment. If the designers continued to introduce new wheels there would be no beneficial outcome of the platform.
By achieving the short term goal of the project (i.e. to meet a breakeven situation fast) a commitment from management could be achieved. This goal was obtained by reducing investments by rebuilding existing moulds, postponing individual investments until needed, and accepting some bad elements for a transition period. Furthermore a number of economical scenarios were created. The economical scenarios assumed different evolvements in the market; some assumed an unchanged demand on the different wheel elements, while others were based on the latest predictions of the marketing department. Finally management gave it's commitment to the project.

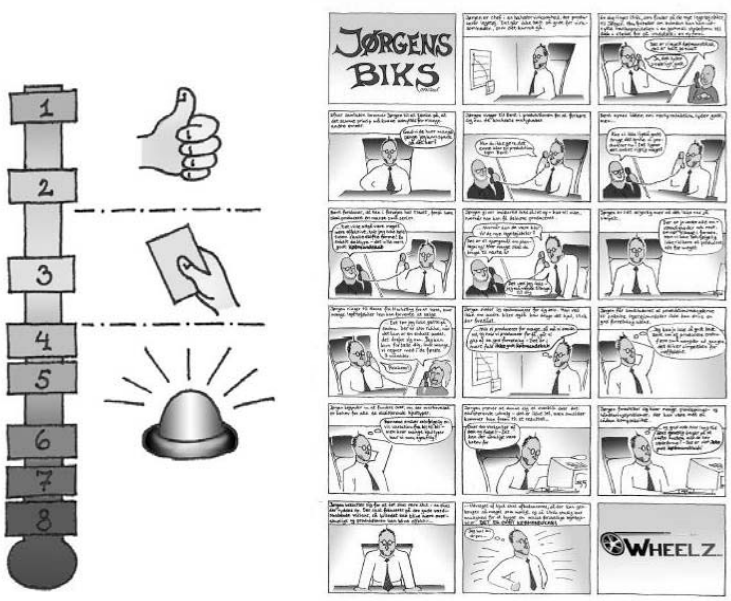

Figure 4. Communication tools for the Wheels platform. The exact wording is confidential

To enforce this commitment from management new procedures for using wheels in LEGO models were implemented. These procedures made it possible to monitor the designers' use of unwanted

wheels in new models. The use of any non-platform element would not be impossible, but sound argumentation would be required to do so. A barometer (See Figure 4) showing the effects of different designer actions and the likely reactions from management was introduced to explain the design rules of the platform.
To further explain the new platform and create a general approval of the new system a number of presentations were made for the designers, and among other initiatives a short story (also Figure 4 – exact wording is confidential, therefore it has been downsized) was created. The short story explained the reasoning behind the new platform.

4.7 Current situation

At the moment the Wheels platform is being implemented and the first new elements are produced. These elements will first appear in new products in the second half of 2006. Due to the relative size of the wheel element assortment compared to the entire brick assortment at LEGO, the economical impact of the Wheels platform will not affect the overall economical situation; however the project shows that investments can be reduced dramatically if design rules are accepted in larger parts of the element assortment. The platform has been accepted and is approved of in general, and this has caused a number of similar projects to be initialised throughout the company.

5. Generalising the case

The activities in the Wheels case can be divided into two main streams (Figure 5.): One, which has the purpose of creating the technical architecture (e.g. the matrix of wheel elements) and aligning this architecture with the architecture of other life phases (e.g. the manufacturing equipment); And another, which has the purpose of creating procedures for using and maintaining the systems (e.g. the barometer in section 4.6.) and getting the acceptance, commitment and approval of both technical systems and procedures.

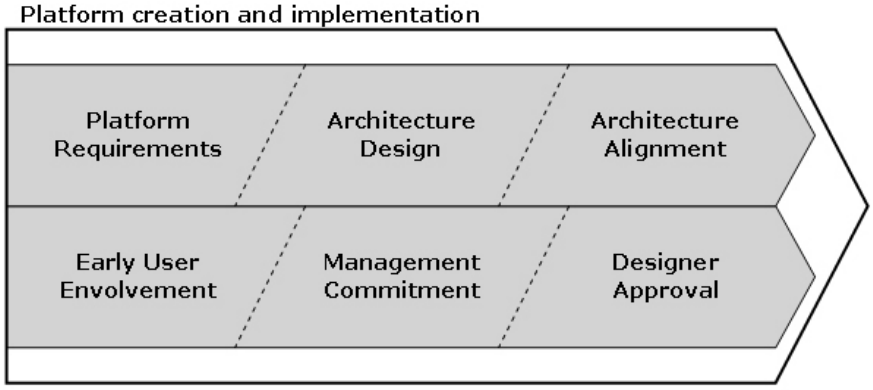

Figure 5. The two streams of platform creation and implementation

5.1 Stream 1: Creating and aligning architectures

Product architecture creation is described in detail in the literature and several different approaches fit into this framework. The process of aligning architectures is however not as thoroughly described.
Aligning products and manufacturing equipment is traditionally done through DFMA, but this case shows that alignment can be taken to a higher level, where the quantity and nature (e.g. low-volume/high price) of modules and products can be aligned with the manufacturing equipment. Creating alignment on this level often leads to even better outcomes than on the single-product level and offer new opportunities for companies, which have already gone through DFMA and Lean projects.

5.2 Stream 2: Implementing the platform

Restrictions for designers in the form of design rules and guidelines is likely to meet opposition in any organisation, but these design rules and guidelines are an essential management tool to lead product development in a certain direction and to coordinate the efforts of individual designers.
A key aspect of introducing design rules and guidelines in platforms is the separation of value-adding elements and non-value-adding elements. Like in the case with the wheel caps, value-adding properties (e.g. styling) can often be separated and this should be exploited in the manufacturing equipment. Design rules should emphasise the need for freedom and creativity in value-adding elements and properties, whereas they should emphasise reuse and standardisation in non-value-adding elements and properties.
Involving designers in the definition of value-adding and non-value-adding elements helps to determine the requirements of the product architecture, but it also helps to create acceptance of the whole platform project. Creating acceptance or even approval is important in a platform project, because the effects of the platform will be greatly diminished if the behaviour of designers remains unchanged. Therefore a major concern of any cleanup or rationalisation project is to ensure a behavioural change so that past errors do not repeat themselves. Behavioural change can be facilitated by procedural change, but these procedures could be short-lived if they are not approved of and enforced.
This case study does not offer any general applicable tools for creating platform approval and commitment in an organisation. It does however show that a combination of getting management commitment to enforce the procedures and decisions of the project together with designer involvement and communication of findings and results on a broad scale can do the trick.

6. Further Research

Creating commitment from management was a critical step in the process as described in the above. For management to commit to a project various documents describing the business case, risks, and other effects of the project normally needs to be presented. The literature on platform projects describes many kinds of benefits and effects, but do all of these effects always apply and what are their magnitude? This knowledge would be required to create a business case. Case studies and other research in this area would therefore be valuable in gaining further insight into and developing tools for the implementation of platforms.
Another interesting area of research would be analyses of design rules and how these relate to company strategy. As described earlier design rules offer a way for management to direct product development in a certain direction, and this means that company strategy should somehow be integrated into a product platform. Research aiming to clarify when and how this should be done is needed.

7. Conclusions

The core findings of this paper are within the area of platform implementation. Companies wanting to gain the benefits of platforms must not only create the necessary technical architectures, but also ensure a permanent change in behaviour, so that past errors do not reoccur. In this paper two key challenges have been described, namely gaining acceptance as well as commitment in the organisation by involving designers and presenting results of the project. The acceptance and possibly approval from the organisation in general and the commitment from management to enforce decisions made in the platform project will increase the chances of a permanent change in behaviour.
It is our hope that these findings and future research within this area will diminish the number of otherwise excellent platform projects, which fail because of poor implementation.

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