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EFFICIENT PLATFORM UTILISATION WITH CONFIGURABLE PRODUCTS - ENABLING FACTORS ILLUSTRATED

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Abstract

This paper describes issues that contribute for return on platform investment in a company. Our results are based on ethnographical research method, developmental research and observations done in interviews in many companies.

Some cases are presented to highlight critical areas of the platform knowledge e.g. configuration knowledge and requirements engineering. Decision-making in several situations is presented to illustrate the complexity created by dependencies.

To effectively make business with platforms sets high demands on processes and competencies in the company. The creation and maintenance of platform requires knowledge to be learned, captured, shared and further developed. Thus the importance of knowledge representation and usage of different product structuring methods and models are emphasised. Succeeding in platform engineering calls for critical mass of people in communities of practise.

The most important conclusion is that effective utilisation and description of knowledge as a valuable, manageable asset for platforms is yet to be discovered. This implies further integration of financial aspects and processes used for assessing the benefits of platforms.

Keywords: Platform Knowledge representation, Community of Practice, Critical mass of competencies

1 Introduction

Currently platforms appear to be very attractive way of creating new products. It is possible to produce mass products, one of a kind products and everything in between from platforms. The creation of configurable products from platforms increases the challenge for any company. In the following chapters we articulate the requirements for implementing mass customisation by developing and delivering platform based configurable products.

Victor & Boynton [1] and Pine [2] have described mass customisation by defining four different paradigms for a company. Craft, mass production, and process enhancement were already familiar to many but the mass customisation was an interesting and novel approach. Based on these basic paradigms Tiihonen et al. [3] have positioned mass production, one-of-a-kind production and configuration on two axis; cost of product on Y-axis and fit to customer needs on x-axis. In figure 1 paradigm are positioned based on number of deliveries and fit to customer needs.

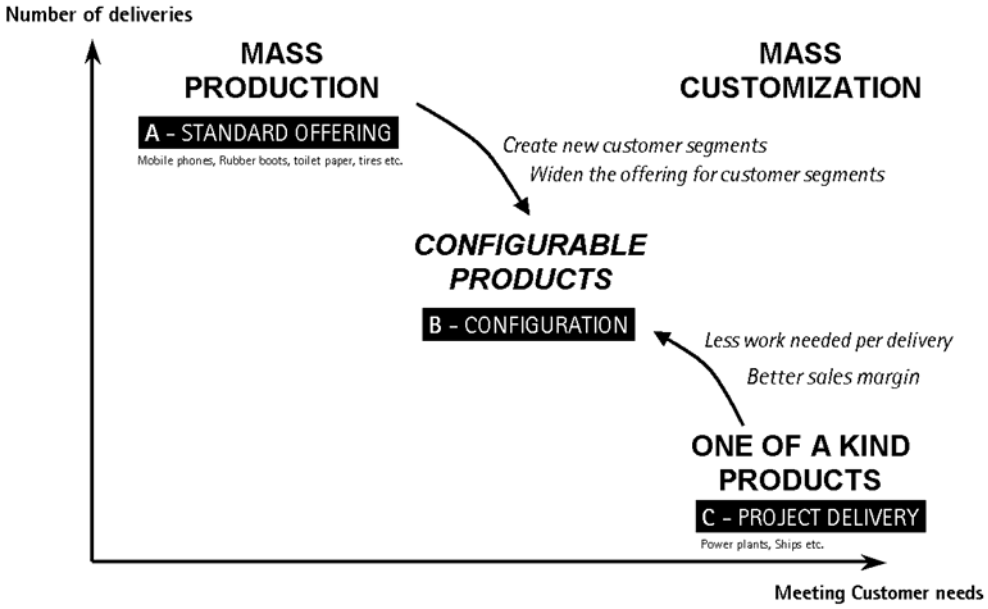

Figure 1. Configuration as a subset of mass customization. The different paradigms are labeled with A for mass products, B for configurable products and C for one-of-a-kind products.

Configurable products have more volumes than one of a kind product and meet customer needs better than mass products. The drivers for several companies are also illustrated next to the arrows. New customer segments and widening the offering for existing segments are the main drivers for mass production companies. Better sales margins and less work needed per delivery attract companies with one of a kind product.

Platforms are treated as a *technical system enabling efficient creation, manufacturing, delivery and maintenance of variant products,* i.e. configurations. The reuse of design, economies of scale and flexible adaptation to meet customer needs are the key elements to platform mode of operations. The focus in this paper is to address how to harvest the benefits from platforms.

1.1 Key drivers in platform based configurable products

The companies are seeking competitive edge for improved sales margin and increase in sales. The efficient *utilisation of platforms* can bring the bill of materials down considerably due to economies of scale thus increasing the sales margin. The *efficiency of delivering* variant that meets customer needs is reflected to sales margin, too. The work effort and resources spent for delivering unique configuration increases the cost per delivery.

The configurable products increase sales volumes by enabling new customer segments to emerge and brings more variety to current offering in existing markets thus increasing market share.

1.2 Key concepts in managing platform

Andreansen and Riitahuhta [4] have defined commonality, variety and complexity to be the factors to be balanced when managing platforms. The architecture is the key element enabling platform structuring thus giving visibility to balancing task.

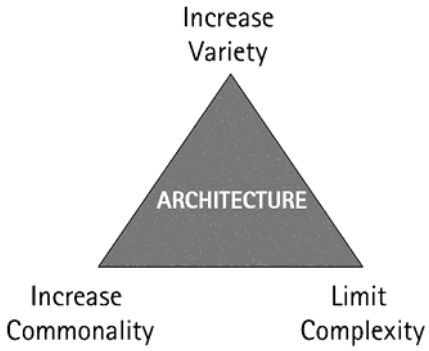

Figure 2. Optimisation dimensions in platform based product development.

To increase variety the company needs to identify properties for architecture flexibility i.e. dimensions or properties where variation exists in customer needs. The commonality stands for efficient reuse in several life phases. Usually the straightforward interpretation is component reuse enabling larger batch sizes in manufacturing and economies of scale. The variants' using common parts tends to increase the complexity of the product development and manufacturing. The commonly used tactic is to encapsulate design into sensible modules from design and production point of view.

2 Methods

2.1 Ethnography

We use ethnographical research method [5]. *"In an ethnography, the researcher looks at an entire group-more specifically, a group that shares a common culture -in depth. The researcher studies the group in its natural setting for a lengthy period of time, often several months or even years. The focus ... is on the everyday behaviors of the people in the group, with an intent to identify cultural norms, beliefs, social structures, and other cultural patterns."*

Key concepts presented in this paper are derived from everyday vocabulary of the community that creates, implements and maintains platforms. However, the problem is that different people in the same community use the same terms in different meaning causing confusion and misunderstandings. The terminology used is presented as a concept map based on the discussions in the community. See figure 3.

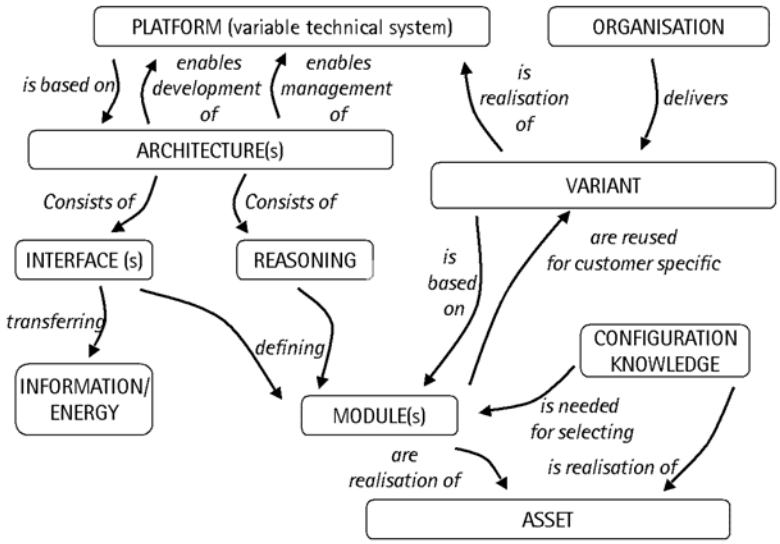

Figure 3. The concept map of terminology used in this paper. The notation is read e.g. "Architecture *enables development of* platform"

2.2 Developmental Research – activity-theoretical approach

Prof. Engeström has presented a model for Developmental research of work to analyze human activity in a work community. The model has six factors; object, subject, mediating artefact, rules, community and work split. The *subject* is the person or the group in the work place. The person or the group has targets that are the *objects* the activity is applied. The *mediating artefacts* are tools that are needed to create the *object.* These are computers, calculators, screwdrivers, documents etc. In information intensive work mental models, frameworks, architectures or any other thinking aids can be seen as *mediating artefacts* [6]. The rules in the community effect which mediating artefacts are used and how they are used. The community *work roles* have an effect, too. The division of work indicates which mediating artefacts are applicable for each role. The *community* and its assumptions, values beliefs etc. have an effect on the other factors.

The framework is applied at transition phase and at platform utilisation phase to articulate requirements for efficient platform utilisation. The transition phase with historical view is needed because the challenge and objectives for mass production company is very different from company delivering one-of-a-kind products. See figure 1.

2.3 Industrial cases

Some of the conclusions are drawn based on the research done in "Konsta project – Design for Configuration" that was carried as a part of "Improving product development efficiency in manufacturing industries" during 1996-1999. There were several small and medium size Finnish companies involved with an investment type of products mainly to business –to business markets. The best practices were studied by interviewing ten different companies in manufacturing industries. In addition the research on configuration and product configurators by Mr. Tiihonen and Mr. Soininen was utilised. The ethnography and developmental research is ongoing in a multinational telecommunication company with both consumer and investment type of products starting from fall 1999.

3 Factors for efficient platform utilization

3.1 The scope and approach to the analysis

The main focus in the analysis is to illustrate processes and competencies needed both in efficient transition and in effective platform utilisation. In reality it is very difficult to isolate a particulate change and to define when it starts and ends. For the analysis sake the borderline is where the platform starts to benefit the company. In real life cases the change continues although first results are already tangible. See figure 5.

The approach has two areas; the capability to plan and run transition and the capability to utilise the platform. There are several enabling factors facilitating the transition phase. For example the lack of change management and inability to plan change project results in schedule slippages thus postponing the break-even point. The break-even point is one indication for the company about the success of the transition; the longer the time to break-even is the worse return on investment in short term.

The capability to utilise platform as other area has enabling factors like company learning curve, the maturity of platform engineering process etc. The main interest is to find out where the effort is used per variant delivered bearing in mind that the one important driver in platform utilisation is work effort used per delivery.

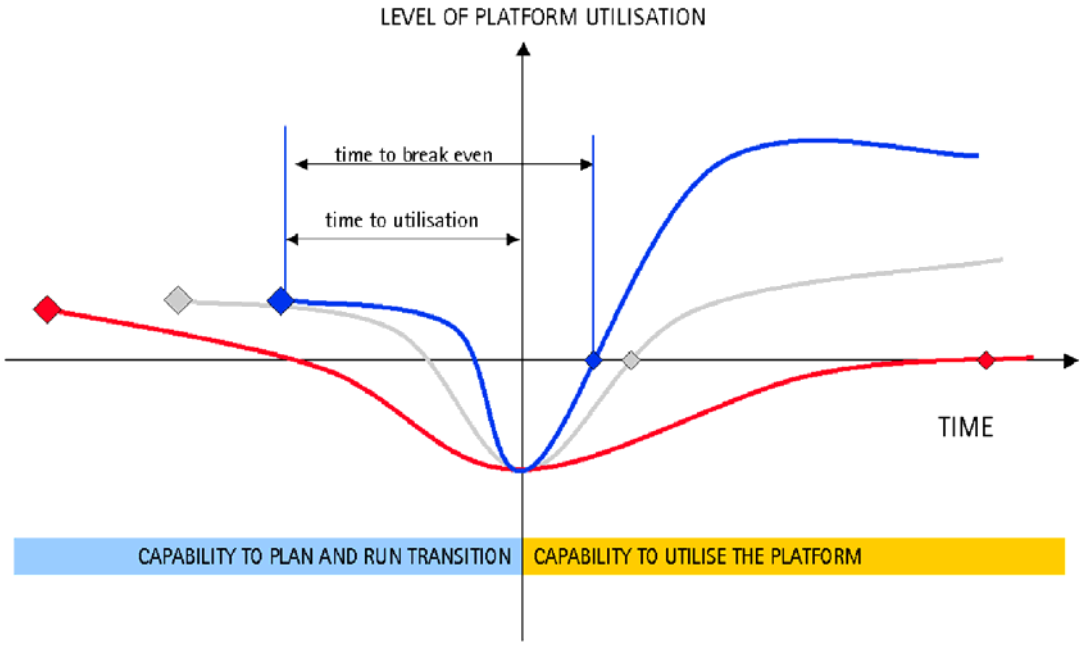

Figure 5. The scope and approach to the analysis. The starting date of the transition is indicated with the milestone on the left side. The break-even point is similarly indicated on the right.

The three different profiles are illustrating the effect of the different change speeds; the slowest transition takes about twice as much time to utilisation vs. the fastest one. The deepnes of the curve represents the resources used in developing platform. On the right side of the y-axis the slope of the curve represents the speed of learning and ability to benefit from platform.

3.2 A successful transition to platform based configurable products

According to ideal approach the processes, competencies, IT-systems are in place and ready for efficient utilisation in the end of the transition phase. The people are well aware of the new objectives and they are able to act accordingly. The organisational structure supports efficient development, delivery and maintenance of platform based configurable product.

The challengies for different companies can be addressed by reflecting the historical mode of operation to transition needed on key process areas. These areas are synthesis of results from ethnography and developmental research. The identified key processess, the maturity of the process and company´s capability of using the processes, enables the transition success and the level of utilisation. The challengies are gathered in to the tables 1 and 2.

Table 1. The key challengies for companies transforming from mass production to configurable products.

PROCESS AREA	FROM MASS PRODUCTION TO CONFIGURABLE PRODUCT
MARKETING	How to sell configurable products efficiently? How to define price of each configuration?
ROADMAPPING	How to plan the discontinuities of technologies? Which technologies to use in the future?
REQUIREMENT ENGINEERING	What is the distribution of requirements across variation dimensions? What variation to bring in to the platform? When module x is not available anymore?
SYSTEMS STRUCTURING/ ARCHITECTING	What to have in common across configurations? What to have in common between mass and configurable products? How to model constrains and interdependencies between modules? How to incorporate the flexibility in to the platform?
PLANNING	Which modules to implement meeting which requirements? How to synchronise the schedule of subsystems?
MANUFACTURING/ DESIGN FOR REUSE	Where to get the list or recipe for each configuration? Is this module to be reused in other configuration
SUPPLY & SOURCING / DESIGN BY REUSE	How to utilise existing solutions? How to anticipate sales volumes of needed modules?
INTEGRATION	How to arrange material handling in production?
VERIFICATION& VALIDATION	What tests are needed to verify each configuration? Who defines and executes the tests for each configuration?
DELIVERY	What assistance and support is needed by the customer?
AFTER SALES	How do we keep track what was delivered and interchangeable?
ADMINISTRATION/ MANAGEMENT	In which segments to utilise configurable products?

The mass production company will face challengies in managing all the product documentation with each configuration. This is obvius in manufacturing, for example. The recipe for manufacturing and assembling mass product remains the same for long periods. With configurable products each recipe, assembly can be unique and the instructions are needed to be productive. The ability in sales to configure the product meeting customer needs is a major step to overcome during transition towards configurable products.

Table 2. The key challengies for companies with the transition from one-of-a-kind product to configurable product.

PROCESS AREA	FROM ONE-OF-KIND-PRODUCT TO CONFIGURABLE PRODUCT
MARKETING	Which configurations are available? How well does the configuration meet customer requirements? What are the customer segments and will they evolve?
ROADMAPPING	How the variation is enabled in the future in each customer segment? How the variation dimensions will evolve and where are the discontinuities?
REQUIREMENT ENGINEERING	What are the dimensions for variation the platform must enable? What variation to rule out of the platform?
SYSTEMS STRUCTURING/ ARCHITECTING	What elements to have in common across configurations? How to incorporate the flexibility in to the platform? How to model constrains and interdependencies between modules?
PLANNING	Which modules to implement meeting which requirements? How to synchronise the schedule of subsystems?
MANUFACTURING/ DESIGN FOR REUSE	Where to get the list or recipe for each configuration? Are there other customers for this module?
SUPPLY & SOURCING / DESIGN BY REUSE	How to anticipate sales volumes of needed modules? How to utilise existing solutions?
INTEGRATION	Where to get the instructions how to assemble each configuration? How much 'fine tuning/ bug fixing' is needed to have functional configuration?
VERIFICATION& VALIDATION	What tests are needed to verify each configuration? Who defines and executes the tests for each configuration?
DELIVERY	How to create and deliver documentation related with each configuration?
AFTER SALES	How do we keep track what was delivered and interchangeable?
ADMINISTRATION/ MANAGEMENT	In which segments to utilise configurable products?

As a result of analysing these challengies there are quite many similar challengies regardless the history of the company. The customer intimacy of company with one-of-a-kind products is a major advantage if utilised wisely. The company has specific requirements of each customer but if the approach remains still to fullfil every requirement there is hardly no room for commonality.

Regardless of the direction of the transition the reuse of modules increases interactions and interdependencies between modules in all life phases: in roadmapping, in product development, in manufacturing and in after sales. Thus the pressure is also in managing the lifecycles of architecture, interfaces, module properties and behaviour, the development schedules and the contents of the development projects. This indicates further improvements in multiproject management, platform engineering and requirement engineering, for example.

The role of change management is not addressed in this approach. The transition process needs to be well managed with clear long-term and short-term objectives with measurable targets. The re-engineering or transformation of company requires multiple projects to be run concurrently. The changes need to be taking place not only in technical structure of the platform but also as changes in underlying assumptions of the new operational mode and each person needs to change their behaviour accordingly. Without such renewal the change might regress somewhere in between of the old mode and the new mode resulting in poor economic results.

3.3 Enabling factors in platform utilisation

The phase after transition tests whether the company is actually able to harvest the benefits of platforms and configurable products. The key driver is to minimize work effort done per each configuration. The focus is to find out where the overall work effort and resources are spent and the amount of the resources. The right balance in the company depends on the phase they are on the transition. If the platform is under development and nothing can be delivered the resources should be used accordingly. If the platform is mature and competitive the resources should be spent on delivering as many configurations as possible. (See figure 5.)

To get overall view of resource usage the partition is based on the key process areas identified earlier. The approach is to find out issues inhibiting the company fully utilising platform as the difference between full potential and actual level. We take the lack of efficiency in the marketing as an example. The task of marketing personnel is to define together with the customer solutions meeting the needs. The configuration task is usually iterative by nature and the marketing parsonnel needs to have the configuration knowledge at hand. In this case there is no information available of a particular configuration so there is need to have it from R&D personnel. Depending on the size and the complexity of the configuration the study can take several days or weeks. The worst case is, regardless of the study results, when the customer doesn't sign the contract and buys the solution from competitor. Then the R&D effort is quite useless and increases the overhead cost of the company.

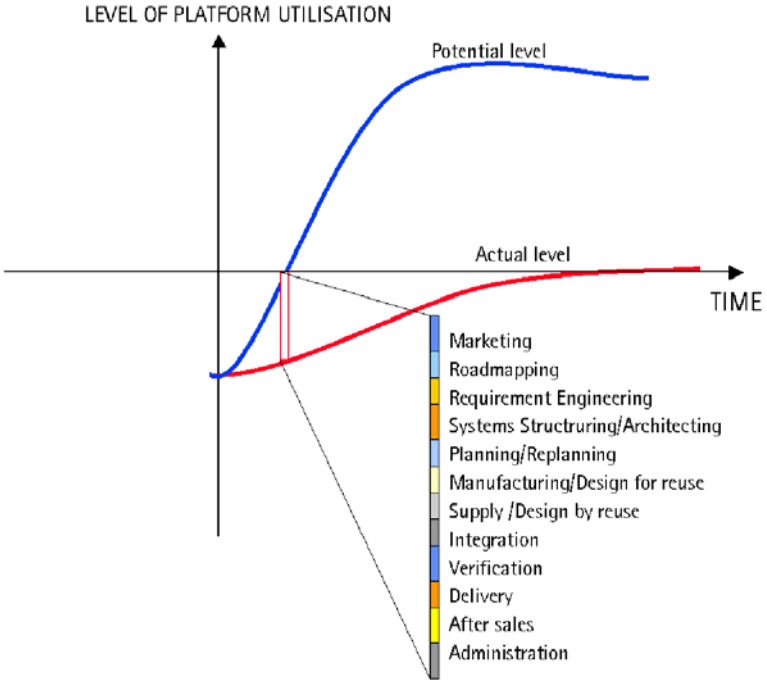

Figure 6. The difference of full potential and actual benefit from platform.

The areas where work effort and resources are wasted are visualised in figure 6. Based on the research studies [e.g.7] the maturity of processes and capability of personnel to benefit from processes have a significant contribution to the overall efficiency. The maturity levels can be defined using questions like "do the process descriptions exist", "are people aware of process description", "do people use the same terminology as in process description", "do people use the process in their daily work", "is the process connected with other processes" and "do people develope processes further supporting their tasks". To get more insight into the context the questions presented in tables 1 and 2 are used. The results are in figure 7.

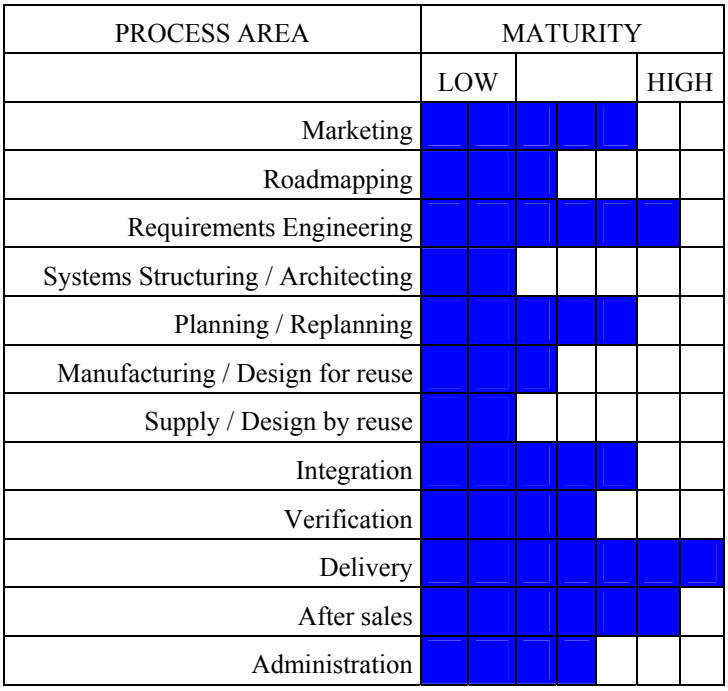

Figure 7. The maturity of operational processes in an organisation. In this fictional example we are able to analyse that the company has very good maturity in delivery area and the bottlenecks are mainly in architecting process and design by reuse process. This company is not able to utilise design reuse in the full potential because the design by reuse is not planned and managed well enough.

4 Key conclusions

The key findings are synthesis of difficulties found from different processes, lack of competencies and shortcomings of tools and IT-systems used for supporting variety of tasks needed in efficient platform operational mode.

4.1 Knowledge creation, sharing and utilisation

Quite often the problems in different processes were traced back to knowledge related issues. The role of configuration knowledge seems to play important part in these problems or actually the lack of it. Currently the tools are not supporting different actors and tasks in various lifephases of the sales-delivery process. The information needs to be available for marketing for the iterative sales process to make sure the configuration is available, manufacturable and meeting the customer needs. There is plenty room for improvement because the knowledge exists in the heads of the R&D engineers. We have had similar findings in research done earlier [7]. It is obvious that the company's capability to create, share and utilise knowledge is success factor in business now and in the future. This conclusion is supported by studies done by Wenger et al. indicating that knowledge can be treated as a capital to be created and applied [8].

4.2 Human error in communication

The community's ability to unambiguously describe the technical system they are creating was found also as an important basis for structuring and managing the platform. To have common terminology, agreed way of structuring the techical system leverages the contribution of each individual. For example the ease of agreeing work split in R&D is quite straightforward when both parties are referring to the same artefact understanding the properties and behaviour of the module similarly. Thus investing more effort in the communication by the means proposed in previous chapter could radically decrease the "human error" like misinterpretation.

4.3 Competencies for efficient platform creation, utilisation and maintenance

Based on the study some vital competencies were identified. The competencies and the amount needed are illustrated in figure 8. The idea of separating current level and target level is to provide visibility to the challenge in the area of competences. The number of critical mass is proportianal to the size of the company; if the whole R&D is of 30 persons there is no need for them all to be experts in maintaining configuration knowledge. Then again, if the R&D organisation consists of 15 000 people the critical mass is much more.

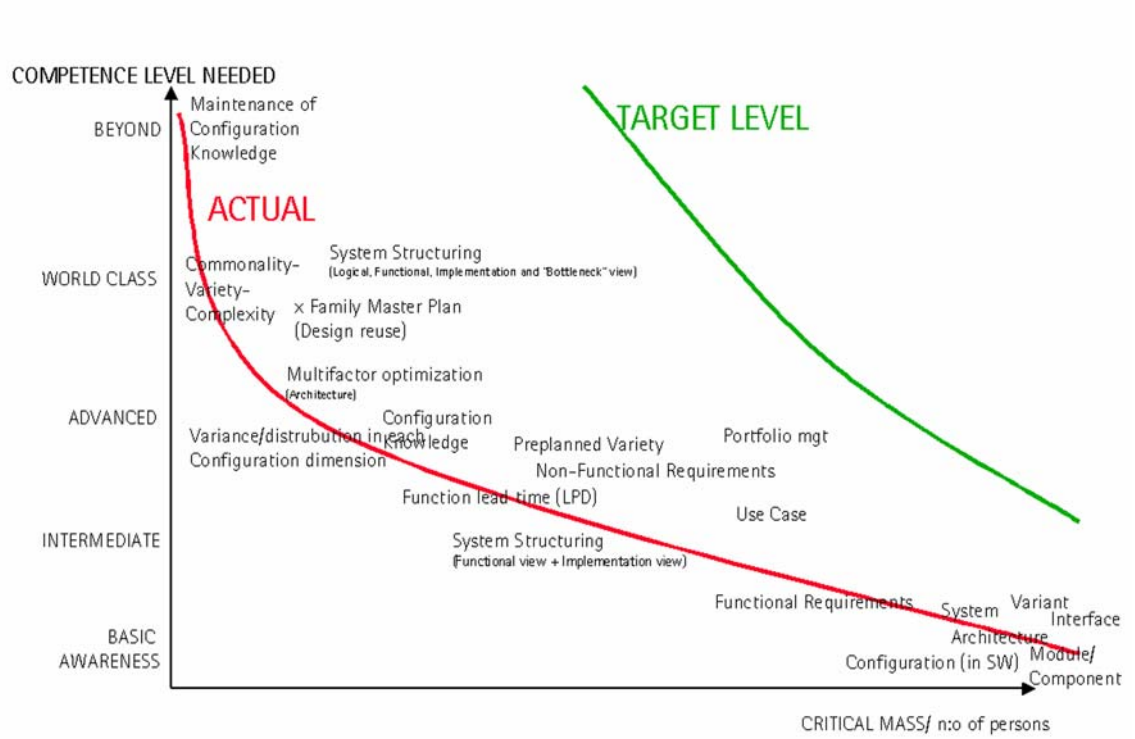

Figure 8. The critical mass of competencies needed enabling efficient transition and utilisation of platforms.

In configuration there is need to capture the rules and constraints into some tool. The capturing is laboursome in itself but the challenge is how to manage such knowledge. Depending how intelligent and suitable notation is used the maintenance effort is also affected. With some approaches the company is forced to start over again from time to time. Therefore the competence for maintaining configuration knowledge was identified as an important issue.

The art of balancing commonality, variety and reducing complexity can be seen more like a process by nature. The need still exists because it is identified as key issue in managing platforms. This aspect is only the top of the iceberg embedding the rest of optimisation dimensions to be considered simultaneously. Thus the multifactor optimisation is also major skill needed.

The ability to design the architecture as flexible, containing optimal technical solutions dictates the business benefit from platforms. The system structuring with viewpoint for different stakeholders is the essence for the company. The platform and the architecture can be evaluated against the needs along the lifecycle and then the successful resolution calls for ability to lifecycle and disposition management.

The word system, architecture, interface, module etc. were very common in the studied communities. However the meaning differs slightly between different communities causing misunderstandings and some extra work when making sure the participants were describing the same artefact. There is a clear need to have common agreement on the usage of some basic concepts.

5 Discussion

The research methods used in this study reflect the social reality of the communities under study and we are cautious not to draw too generic conclusions. On the other hand the earlier research results support the conclusions in this paper. We also want to point out that the processes and competencies presented as findings are only enabling factors for higher efficiency. This is to highlight the presence of other factors not visualised in this paper such as the strategic fit of the platform versus the preferred value chains and business models. If the platform in itself does not enable desired business models the world-class processes or the competencies do not give any comfort to the investors.

During the research a clear need was identified for practical ways to assess the business impact or value of using platforms. Such a device would give deeper understanding and more facts for the management level decisions. To our understanding the total cost of platform ownership can be a surprisingly high and this aspect should be taken into the decision making process. Some further research is also needed to integrate financial aspects to evaluate and manage the value of intangible asset, the knowledge capital.

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