Product Familiy Business Analysis And Definition

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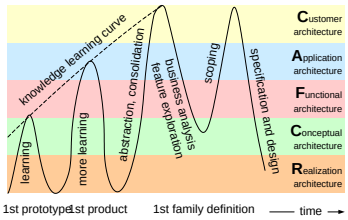

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Abstract

The creation and evolution of a product family is based on a business analysis. Such a business analyis is used for the definition of the family: Which products are members of the family, what distribution of features, which performance range?
This article is to be used in the "Family Engineering Handbook", a collective effort of Philips Research employees to consolidate their experiences in family engineering.

version: 2.1 status: preliminary draft September 5, 2020

1 Introduction

The creation and evolution of a product family is based on a business analysis. Such a business analysis is used for the definition of the family: which products are member of the family, what distribution of features, which performance range.

Several methods can be used to make the step from business analysis to product family definition, see for instance Figure 1.

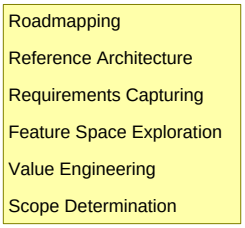

Figure 1: Methods for Family Analysis

2 Roadmapping

About once per year it is recommended to work for a number of weeks on roadmaps. These roadmaps serve as a shared vision of the next 5 years, see [3]. Roadmapping is done at the level of a product portfolio or product family. The value of roadmapping is that it brings understanding over 5 views: market, product, technology, process and people. This understanding has the time perspective as the main dimension.

The roadmaps provide a time and product portfolio context for the definition of a product family. A number of the activities in roadmapping and product family definition are quite similar; both require an market analysis, a good understanding of commercial opportunities and insight in the technology.

Roadmapping is focused on insight, understanding and shared vision, without any commitment. The definition of a product family results in a more specific detailed output, which is at least partially committal. In other words. Roadmapping is transforming a strategy into tactics, while Product Family definition transforms the tactics into operational activities.

3 Reference Architecture

A reference architecture covers 5 viewpoints on a product family, see figure 2. The business, application and functional architectures are the main subjects of interest during the business analysis and family definition process.

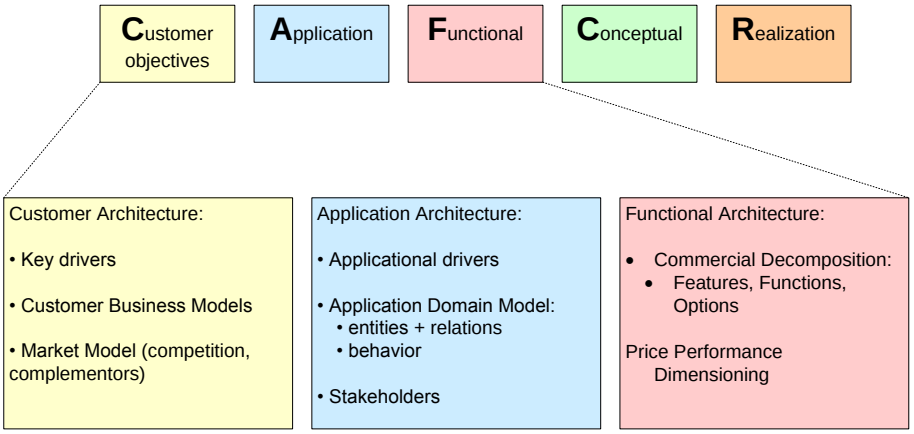

Figure 2: Product Family Reference Architecture, zooming in on the views determined by the business analysis and family definition process

3.1 Business Architecture

The business architecture models the world of the customer. Again a number of complementary views are required.

The key drivers of the customer are identified, see [2]. A limited, but specific set of key drivers is a powerful guide in the entire creation process.

The business model of the customer is determined, see typical questions addressed by a business model in Figure 3

Who appreciates what?

Who pays when for what?

Who takes decisions?

Figure 3: Questions addresses in the business model

The business of the customer is served by many different suppliers. Some of these suppliers are competing with your own business, while others are complementary. This information is compiled into a market model.

Example Set top boxes are supplied to different kinds of customers, varying from consumers to content providers. In case of the content providers different business models are practiced, ranging from pay-per-view to entirely paid by the advertisers.

The set top box is only a small part of the value chain. Many complementers are active in this entire chain, which starts at the content generation and ends at

the television screen of the consumer. Philips is quite active in all complementing products at the consumer side, such as television and video storage, while it is active in parts of the value chain proceeding the set top box.

The competition exists from comparable set top box manufacturers, but also new devices such as game computers (Playstation 2) enter this market.

3.2 Application Architecture

The application architecture models the way the user works or enjoys your products in a broader context.

The key drivers of the business architecture are transformed into application drivers, which describe what the user needs to fulfill the key drivers of the business. These application drivers provide insight. The direct relation with the key drivers and the functional requirements provide traceability and a means to focus the requirement process.

Application domain models support the other processes by providing a shared reference. A model describing the entities and their relations "sets the stage"; it defines the relevant entities such as persons, tools, deliverables, consumables et cetera. A dynamic view on the application is given in the behavior model. Both models at this level should focus on the main issues, detailed definitions endanger the overview and understanding.

Figure 2 explicitly mentions stakeholders as part of the application architecture. Of course stakeholders will show up as an entity. The (human) stakeholders play such an dominant role in the application that it is useful to make a separate overview of the stakeholders and their roles.

Example: An X-ray diagnostic system requires predefined diagnostic procedures to be used easily. These procedures are based on rather specific domain knowledge, such as demographic data, pathology and anatomical data. The essentials of the way of working should be described in the application drivers.

The application model would describe all relevant entities, such as patient, patient table, monitors, UI devices, tube, detector, ECG monitor, film, examination room, technician, nurse, patient et cetera including their relationship.

Note that understanding is the aim of this exercise, not completeness. Those entities and relations should be shown which are relevant for the shared (by commercial and technical people) understanding of the application.

The behavior model would describe the dynamics of the application. It could for instance describe the patient flow, and the information flow.

The application stakeholder view focuses on the human players, which are in this case: referring physician, receptionist, radiologist, patient, technician, nurse, technical support staff of the hospital, et cetera.

3.3 Functional Architecture

The functional architecture is the commercial view on the system, describing the commercial flexibility of the products. The functional architecture is the basis of the sales catalog.

The commercial decomposition defines in terms of functions, features and options the capabilities of the products and their structure from commercial point of view. The product manager decides which items to package in sellable products.

The price performance ranges are also defined in the functional architecture.

4 ”YoYo-View” over time

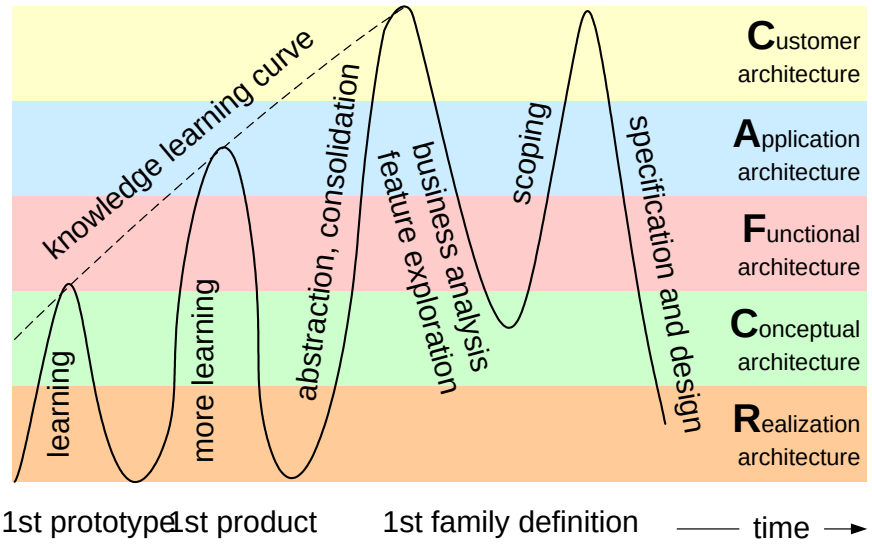

Figure 4: The analysis and definition of a family requires a number of iterations over the views in the reference architecture

To define a product family technical, business and application know how are a prerequisite. Figure 4 shows that this know how is often the result of previous experience with single products [1]. The curve indicates the architectural focus as a function of time. This focus is iterating over the CAFCR views. The diagram simplifies this learning curve to a single prototype and product, in reality more generations are required for the build up of the know how.

[1] recruitment of experienced people is also an effective way to obtain the know how. In fact the same learning curve is followed, but external.

When enough knowhow is present in the group of people, this know how is made explicit in the form of a reference architecture. The ”problem” is now analyzed by making a business analysis, feature space exploration and valuation of the features. As shown in figure 4 this activity ranges over the business, application and functional architectures.

The next step is to go back to a more fundamental question: What is an effective *scope* for the product family? A broad scope is attractive for customers when they benefit from a rich offering of product members and options. From business perspective a broad scope is desirable to increase economy of scale effects and to harvest synergy by sharing development efforts. However, at the same time a broad scope increases dependencies between markets and products, increases organizational complexity, and increases internal communication and process needs. Overstretching the product scope has been a major cause of product family failures.

Once the organization has sufficient know and the scope is clear, then the actual product family specification and design can take place in a more or less top down fashion[2].

5 Relation with the Technical Architecture

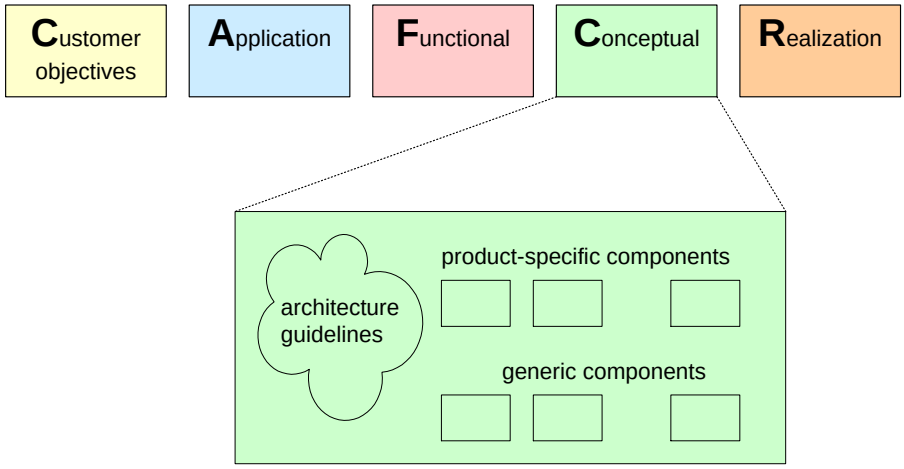

Figure 5: Technical Architecture for a Product Family

The family definition will have to iterate with the technical and implementation architecture. Figure 5 shows an example of the contents of a technical architecture in case of a Component Based Product Family.

[2] Although iterative (evolutionary, agile) development approaches are highly recommended.

Rather fundamental decisions which have to be taken for the technical architecture is where to address the requirements, in:

- Product Specific Components,
- Generic Components, or in
- Architecture Guidelines.

Ideally the technical structure closely resembles the functional structure, by a natural mapping of functions and features on components.

6 Requirements Capturing

Collection and analysis of requirements is indispensable. Many methods exists to do this. In [2] the requirements capturing is described for products. However the methods described in this article are also applicable for Product Families.

Product Family Definition requires special attention for commonality and variation analysis and for product positioning. In section 7 some more detailed method is described to address these issues.

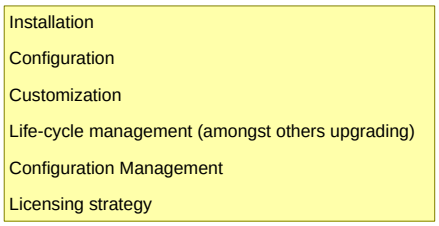

Figure 6: Subjects requiring special attention for Product Families

Also special attention should be paid to the life cycle requirements, these requirements often originate at internal stakeholders, such as sales, manufacturing, service et cetera. Figure 6 shows a list of subjects which require special attention in case of product families.

7 Feature Space Exploration and Value Engineering

Analysis of commonality and variation of features over products helps to define the product family in first instance and to make a family design in second instance. This analysis starts with an exploration of the feature space, and results in a valued set of features per product. Figure 7 shows which steps are taken in this process. See also [2] which describes how to obtain requirements.

1. Make an inventory of features
2. Map features on market segments
3. Determine products
4. Map features on products
5. Determine valuation criteria
6. Valuate features per product

Figure 7: From Feature Exploration to Valuation per Product

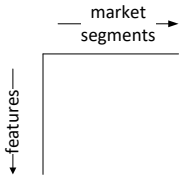

Figure 8: Market Feature Map

The features can be mapped on market segments, resulting in a matrix, see figure 8. The feature axis can be ordered, for instance by following the key driver, application driver derivation.

Again iteration is the magic word. Iterate a few times from Market segment to Features and vice versa. If key drivers are used as structure for the feature axis, then these key drivers should be included in the iteration. Market segments can have different key drivers!

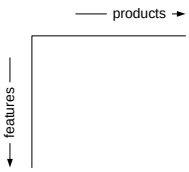

Figure 9: Product Feature Map

The Market segmentation can be transformed in products, once sufficient insight is obtained in the market segments and the features involved. This results in a Product Feature Map, see figure 9.

Valuation criteria are needed to determine the value of features. Figure 10 shows an example of Valuation Criteria.

Figure 11 shows the result of the entire process. Here all the features have been

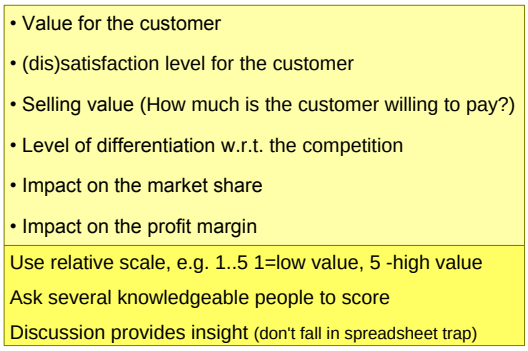

Figure 10: Example of Valuation Criteria

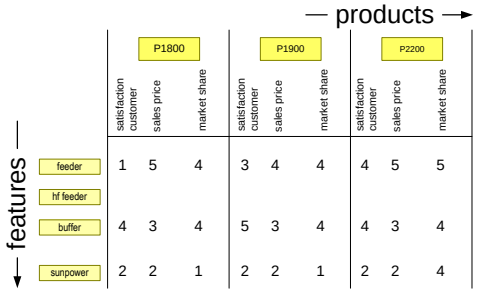

Figure 11: Product Feature Map with substituted Numbers

valuated, the corresponding values are substituted in the matrix.

This matrix is the starting point for the selection process, see section 4, which finally has to answer:
Which Feature will be realized When for Which product?

A much more elaborated method for feature space exploration, valuation and scoping can be found in [1].

8 Scope Determination

A fundamental question in Product Family approach is the scope of the family
Which part of the Market do we want to serve?

A clear shared answer on this question is the key to an efficient continuation of the Family Creation Process. Some more nuance can be added to the question by including the time dimension (*When?*).

Note that figure 4 also simplifies the scoping to a single iteration. In reality some iteration with the technical and implementation architecture takes place.

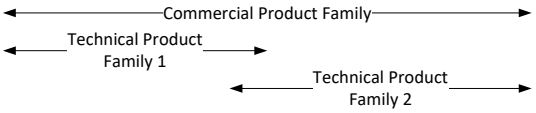

Figure 12: Commercial and Technical Viewpoint on Product Families

The scope determination is primarily a commercial scoping. Later in the process, as part of the Family Design, also technical scope determination is needed. Figure 12 shows that a commercial Product Family can be realized by two technical product Families.

Example High end products (”Up-market Televisions”) will emphasize a richness of features, irrespective of for instance memory and processor constraints, while the mid range products (”Mainstream Televisions”) have a severe cost constraint, which translates in memory and processor constraints. From commercial point of view it should appear as one continuous family. From technical point of view the requirements could be conflicting too much, while two technical families with a different optimization focus, match perfectly with the commercial requirements.

9 Acknowledgements

Frank van der Linden wrote a position paper on this subject to trigger the discussion for the ”Family Engineering Handbook”. After Frank left Philips Research to join Philips Medical Systems I inherited the job to write this section of the handbook. I thank Frank for writing the original position paper which served as a starting point of this article.

Discussions with Jürgen Müller helped to sharpen the contents of this article. Discussions in the composable architecture meeting, attended by Pierre America, William van der Sterren, Jan Gerben Wijnstra and Jürgen Müller helped to make the article more complete and consistent. Ad van den Langenberg pointed out a number of spelling errors.

James Sirota pointed out that the explanation of the Yoyo-figure was very limited. He also suggested to add a warning about opportunistic re-use.

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[1] Jean-Marc DeBaud and Klaus Schmid. A systematic approach to derive the scope of software product lines. In *21st international Conference on Software Engineering: Preparing for the Software Century*, pages 34–47. ICSE, 1999.

[2] Gerrit Muller. Requirements capturing by the system architect. http://www.gaudisite.nl/RequirementsPaper.pdf, 1999.

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History

Version: 2.1, date: June 8, 2010 changed by: Gerrit Muller

- replaced lists and tables by figures

Version: 2.0, date: April 12, 2006 changed by: Gerrit Muller

- updated figures
- extended JoJo description

Version: 1.4, date: March 2, 2005 changed by: Gerrit Muller

- minor spelling improvement

Version: 1.3, date: August 5, 2002 changed by: Gerrit Muller

- minor changes

Version: 1.1, date: September 21, 2001 changed by: Gerrit Muller

- abstract added

Version: 1.0, date: March 31, 2000 changed by: Gerrit Muller

- added section: Roadmapping, Requirements Capturing, Scope Determination and Finalizing the Definition.
- more consistent terminology in Figure 1, Product Family Reference Architecture
- updated the "Yoyo" figure
- added some examples

Version: 0, date: March 27, 2000 changed by: Gerrit Muller

- Created, no changelog yet