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Methodical Product Program Planning within the aerospace industry

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Abstract
Issue of this paper is the case application of a method for Product Program Planning. The method consists of two major steps; first scenarios for the future structure of the program are elaborated and second potential carryover-candidates are conceptualised. The study is performed together with an aerospace supplier by a program of cabin interior monuments.

Keywords: Program Planning, Product Structuring, Strategy.

Introduction
Today's customer driven markets typically demand a high product variety [7]. Therefore it is important for the companies on one hand to adjust the offered product range to the market requirements and on the other to reduce the internal variety. Common methods for internal variety reduction are Design for Variety and Modularization [3]. However, it is desirable to consider the whole product program of a company instead of product families only, since consideration of all products can allow conceptualisation of broad synergy effects. Additionally, a successful product development should point at the future structure of the product program for incorporating potential market shifts.

Background
Figure 1 shows the integrated PKT-approach for developing modular product families [10]. Aim of the product-based view of the approach is a reduction of the internal product variety.

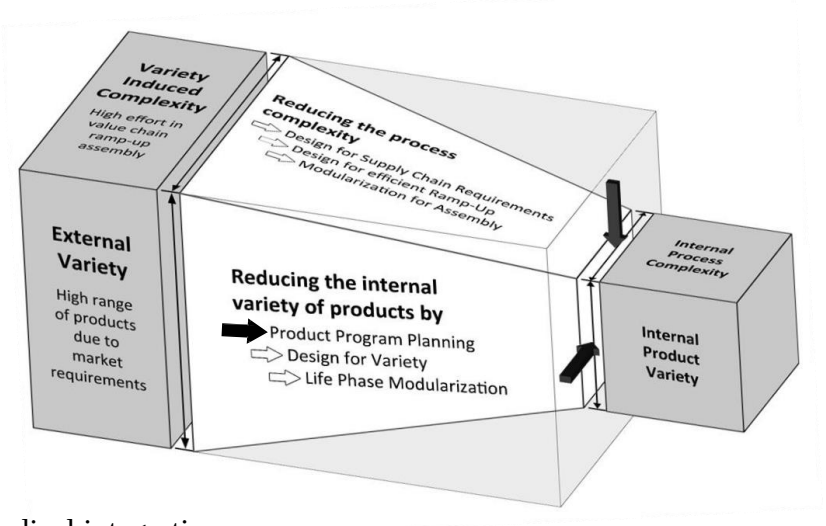

Figure 1. Methodical integration

The method of Design for Variety targets component embodiment design; the ideal model of 1:1 mapping of differentiating attributes and variant components is used. Life Phases Modularization sets the module definition for a product family by a comparison of different modularization requirements of all life phases. Issue of this paper is the method of Product Program Planning, which is part of the product planning phase and sets the input for both subsequent methods.

State of the art methods

The support for Product Program Planning addresses a synthesis of marketing/sales and future planning into product structuring, Figure 2.

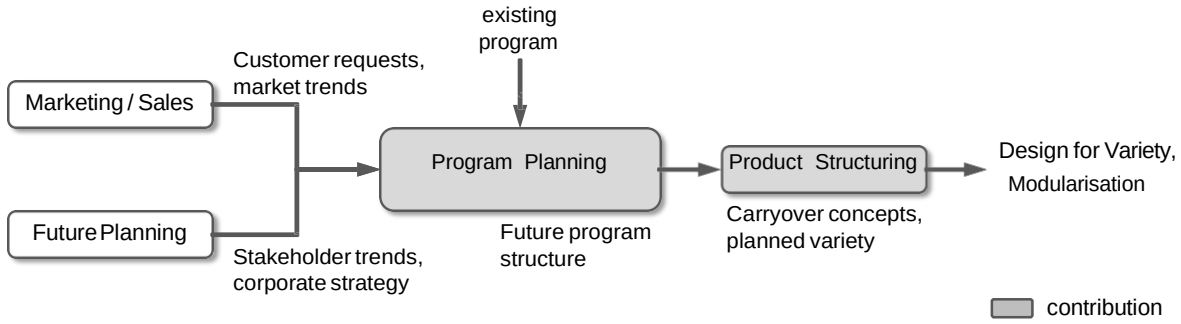

Figure 2. Research concept

Current methods of future planning such as Scenario Technique [5], Roadmapping [1] or Delphi Method [12] typically have a rather long-term focus including global environmental considerations. Often the methods demand significant resources which can be a barrier towards application in smaller companies. Product structuring is typically not incorporated.

The extensive state of the art in marketing/sales offers amongst others portfolio analyses, which investigate a company's product program. Portfolio tools to be referred here are given by Gausemeier [5] and Boston Consulting Group [12]. A new portfolio tool, the Program Structuring Model (PSM), has been introduced in [8].

Product structuring tools such as the Multi Domain Matrix [11], the Variety Tree [13] or the Product Family Master Plan [6] investigate interdependencies internal of a product family and to external systems. Holistic consideration of whole product programs, as well as preliminary investigation of market trends is typically not focussed.

Method to be investigated

The method of Product Program Planning (cf. Figure 1), which is investigated by this paper, was introduced in [8]. Figure 3 shows the procedure.

Phase 1 of the method contains an elaboration of the future structure of the program in terms of prospected revenue and produced units number of each product family. The scenarios are visualised by the Program Structuring Model (PSM). Phase 2 conceptualises carryover-candidates to the program. The resulting program plan is used as conceptual input to the subsequent development phases of Design for Variety and Modularization, which involve component embodiment design for variety and final module definition.

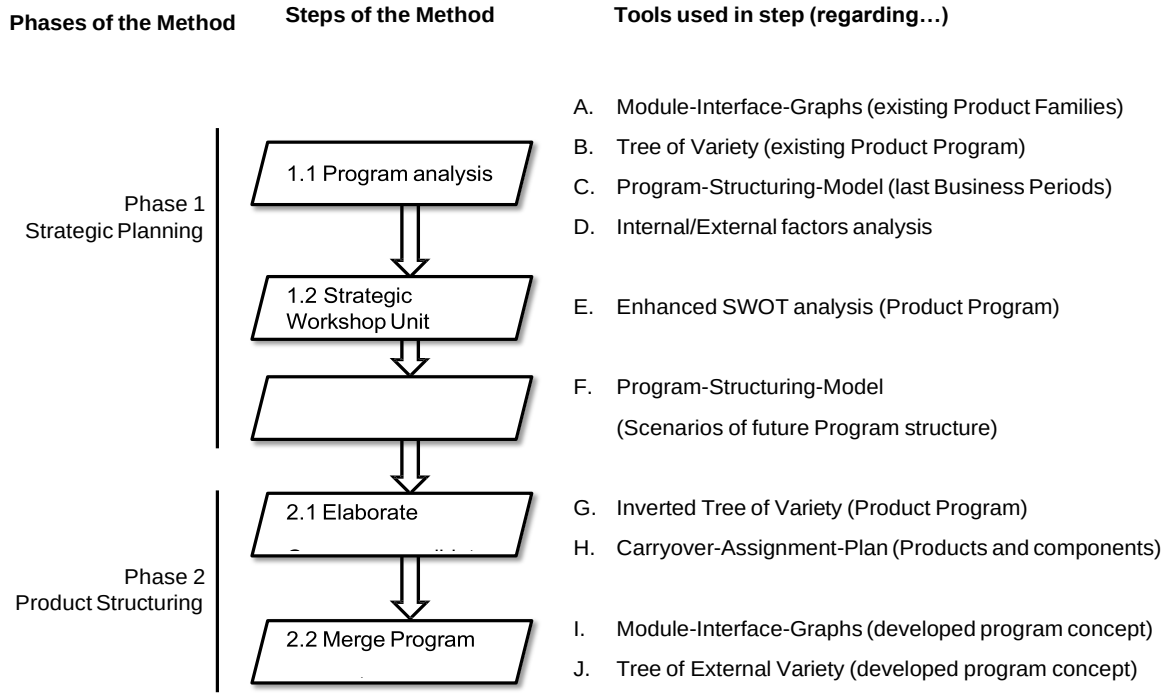

Figure 3. Method for Product Program Planning

Setup of the case study

Objectives

Aim of the current case study is to investigate the method presented in Figure 3 in industrial application. We targeted three main criterions, each addressing case study questions (cp. [14]).

- Usability
  How does the integration of different company departments into the method work practically? Is the granularity of the tools sufficiently balanced? Do the steps of the method align with a meaningful project timeline? Is the temporal scope valid?
- Relevance
  Does the method support product planning in the company? Do the outcomes match the needs of the company? Is the format of the outcomes sufficient?
- Acceptance
  (How) Do the participants accept the procedure, the tools and the outcomes? Which benefits are seen by the company? Would the participants apply the method a next time alone?

Application constraints

The case study was performed within a funded research project between university and an aircraft supplying company. The company roughly contains over 200 employees and is considered SME. Within the company the project involved

- Marketing, head of Sales,
- CEO,
- Engineering, head of Research,
- head of Program Management.

The analysis phase of the project (1.1) was performed by structured interviews, product study and smaller workshops on site. Central part became the strategy workshop involving all mentioned departments. Parts 1.3 and 2.1 of the method were performed at university; the final outcomes were presented and discussed in a board meeting at the company.

Case study application

This section describes application and results of the methodical steps according to Figure 3.

Step 1.1 – Program analysis

In the first step of the method, the program was investigated from technical and economical perspective. For technical investigation we use the Tree of Variety (cp. [3]) and Module Interface Graphs (MIG, cf. [2]). Figure 4 shows a section from the Tree of Variety, which represents the product choice tree from the customer perspective. Figure 4 also shows a typical product, given in case of a 4-Trolley twin aisle galley, for example used for A330 aircraft. A MIG sketches 2-dimensional components, media flows and rough packaging of the products, cp. [9].

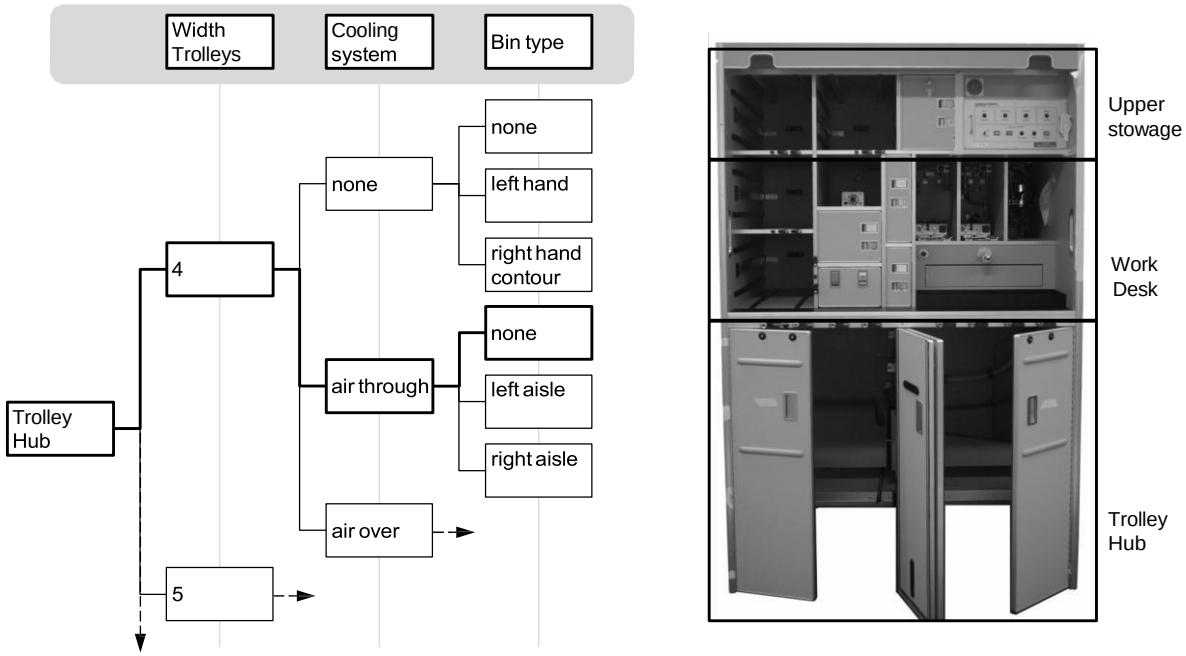

Figure 4. Tree of Variety (left) and exemplary product (right)

The customer, which is usually an airline, can choose between several product variants such as shown in Figure 4 trolley capacity, cooling system and bins. Individual detail solutions are ordered frequently. The Tree of Variety and MIG found the basic product understanding and showed in this case that amongst a high external variety the internal variety is very high, too. The produced number of a variant is typically one-digit, which leads to high development efforts in daily business, affecting whole products when custom detail solutions are added. There is no significant reuse of product components, which leads to high complexity (regarding the complexity term, cp. [4]).

For economic analysis of the program we use the Program Structuring Model (PSM) which is described in more detail in [8].

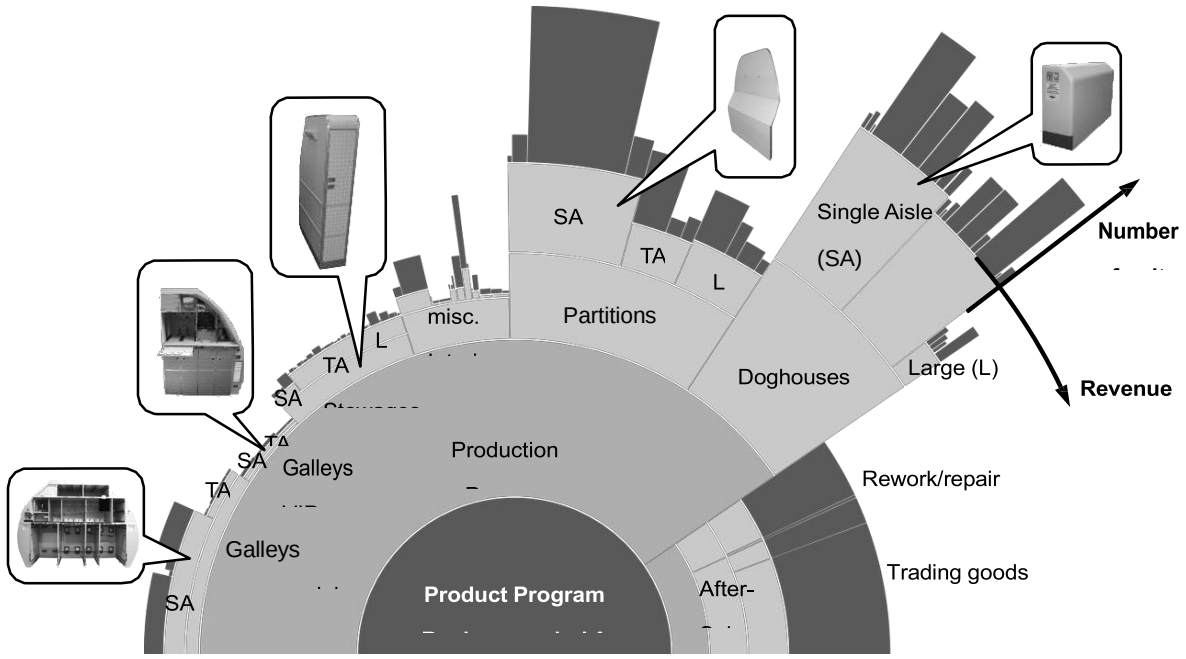

Figure 5. Program Structuring Model (PSM) of business period

We investigated the last two business periods; one of them is shown in Figure 5. The core business basically is realised by commercial galleys, stowages, partitions and doghouses (small stowage cases) as well as after-sales. VIP galleys have very low number of units but still significant revenue. A margin investigation, added as color of the elements in the PSM, showed profit contribution of the singular product lines but cannot be published here.
Second element of the economic analysis is an investigation of internal and external trend factors since the next element of the method is a scenario projection of the future program structure.
We used questionnaires and interview sessions for gaining the trend information as a preparation for the workshop. The questionnaires content is structured as follows

Part A – Internal analysis; questions regarding

- success factors of business, company and customer
- core competencies
- competitors

Part B – External analysis; questions regarding

- chances and risks of each business unit
- stakeholders and their influences

Step 1.2 – Strategic workshop Unit
In the next step we performed the workshop unit together with the mentioned participants of the company based on an enhanced SWOT analysis, Figure 6. The relevant factors of the internal analysis are taken into strengths/weakness rows; external factors are taken into chances/risks columns. In addition to the classical SWOT matrix, the factors can be ranked by their probability by the workshop participants. This helps later when prioritising the influences of the factors.
The analysis is performed on product level (i.e. Galleys commercial – Large body), which lead to several SWOT analyses by repetitive character.

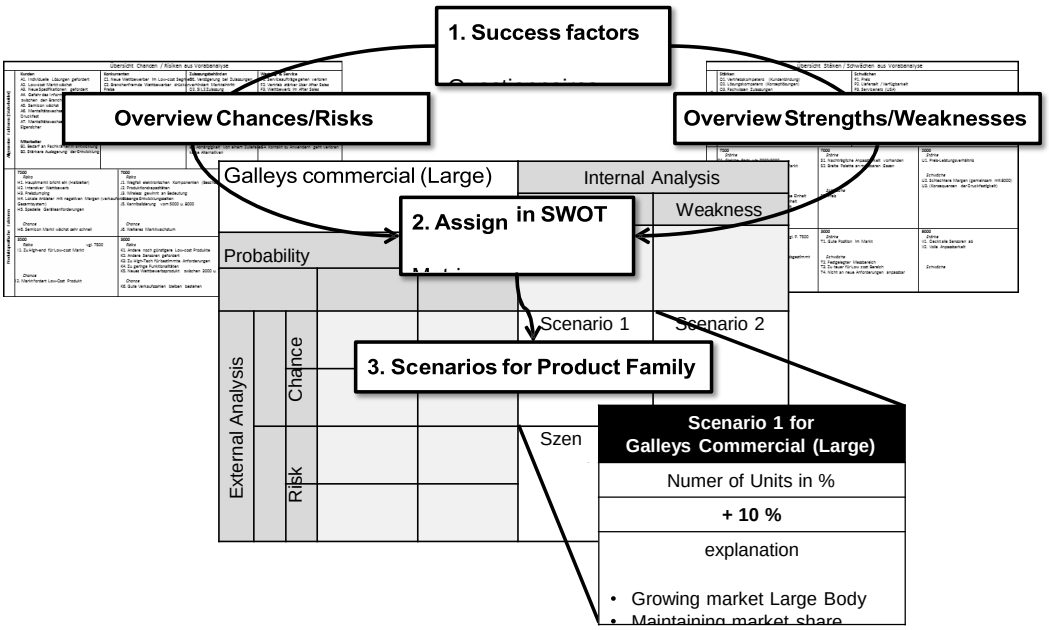

Figure 6. Enhanced SWOT analysis

Step 1.3 – Derive program Scenarios

After the scenarios on product family level have been elaborated in the workshop, scenarios to the whole program were derived. A challenge in this step is handling the theoretically high number of possible combinations of product family scenarios towards whole program-scenarios. A practical way to overcome this barrier is to compose first best and worst case scenarios for the whole program, Figure 7. The input values for best and worst case scenarios are directly taken from the according SWOT fields. Using best and worst case also ensures that extreme trends are not overlooked. On this basis, trend scenarios of the program can be elaborated. Figure 8 shows the resulting trend scenario with short explanations.

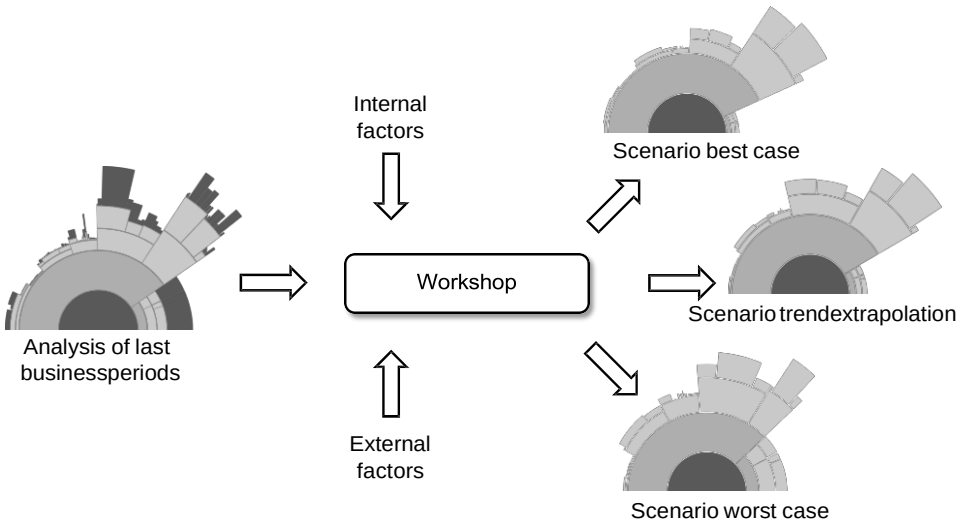

Figure 7. Scenario conceptualisation

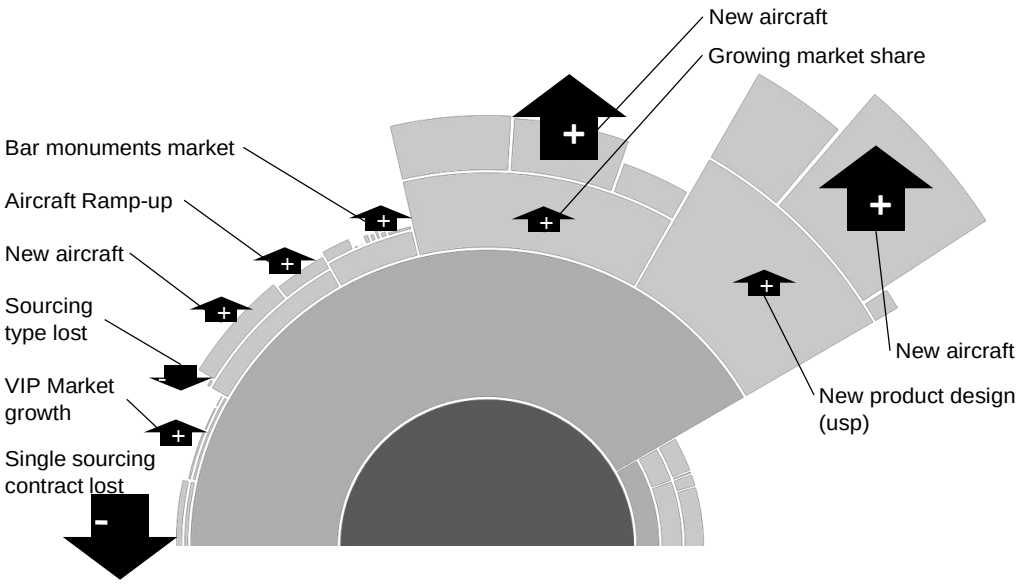

Figure 8. Elaborated trendscenario

Step 2.1 – Elaborate carryover-candidates

The next step is to elaborate carryover-candidates to the product program. Figure 9 exemplarily shows the procedure. All products of the program are listed by their components. A component is typically an assembly, but can also be a singular part, depending on the products part number and considered granularity. In this case we target assemblies. Each component is described by its characteristics regarding identification and classification. We differentiate between primary characteristics, which necessarily have to be matched for becoming a carryover-candidate, and secondary characteristics, which may be harmonised, e.g. by decoupling or oversizing.

Products	Components	Primary characteristics				Secondary characteristics	
		Width	Stowage capacity	Electrical equipment	Water installation	Additional stowage features	Illumi-nation
Galley SA G2 Nr ###	Trolley Hub	4 units	4 Trolley			1 bin attached, left aisle contour	
	Work Desk wet area	1 unit	2x misc. compartment, left aisle contour				yes
	Work Desk dry area	2 units	2 ovens	oven line	steam duct		
	Work Desk stowage area	1 unit	Standard units				
	Upper stowage	3 units	Standard Units	E-Panel triangular type			
Galley TA 4Trolley Nr ###	Trolley Hub	4 units	4 Trolley				
	Work Desk wet	2 units	none	3x Beverage provider	yes, full		yes
	Work Desk dry area	2 units	2 ovens	oven line	steam duct		
	Upper stowage	4 units	Standard Units	E-Panel rectangular type			
…							

Figure 9. Elaboration of carryover-candidates

The list form Figure 9 is transferred into the Carryover Assignment Plan (CAP), Figure 10. Shown are products and components including carryover-concepts. For example the Trolley

Hub/4units is conceptualised as carryover with three cooling variants, either used purely or with attached bin/contour modules (regarding the modularity term, cp. [10]).

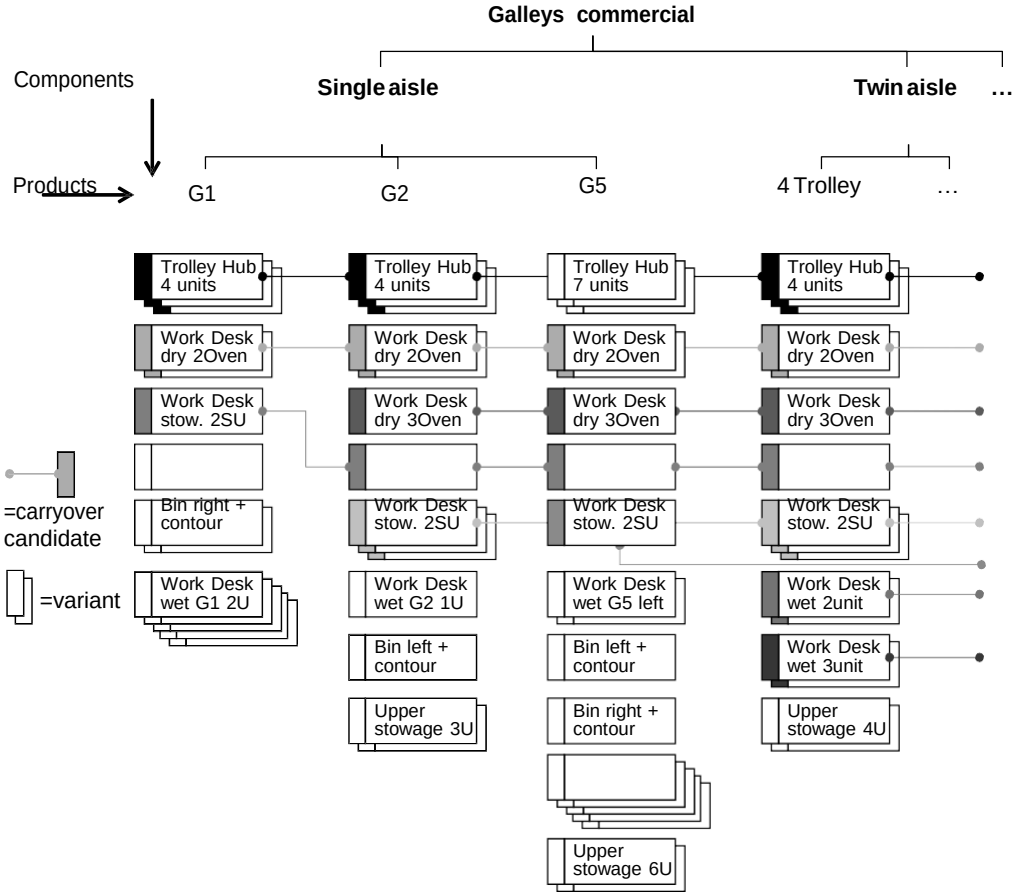

Figure 10. Carryover-Assignment Plan (CAP)

Findings

Given here are findings from two perspectives. On one hand the project results, represented by the technical output of the method. On the other hand a discussion on the results of the study.

Technical results (step 2.2)

Output of the method is the conceptualised program plan, visualised by Module Interface Graphs (MIG) of all product families. Figure 11 shows the MIGs for two exemplary products. The products consist of generic components (no carryover) and potential carryover components labelled by a color code. The MIGs will be used as input for the method of Life Phases Modularization, representing the module definition from the perspective of the product planning phase.

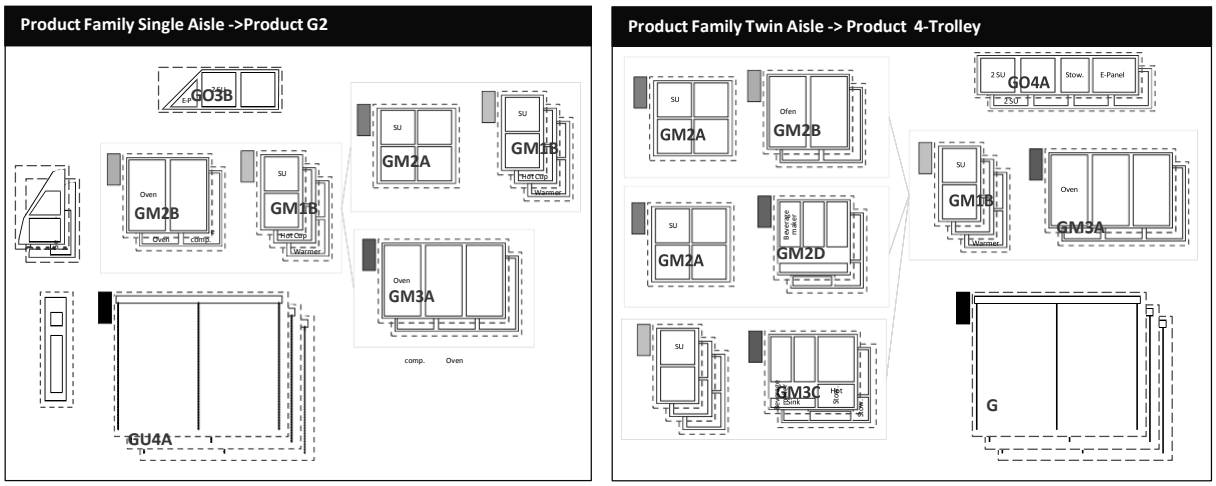

Figure 11. Example for MIGs of elaborated Program concept

Another output is the tree of variety, realised by the current program plan. Figure 12 shows a section using the same color notation. The tree is used as input for the method of Design for Variety [3], which aims part embodiment design with respect to variety reduction.

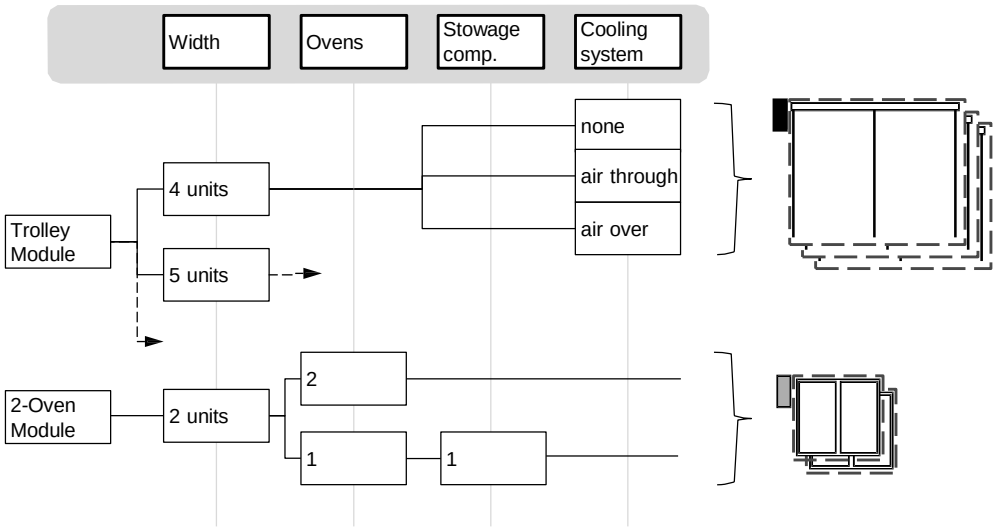

Figure 12. Section from tree of variety, realised by elaborated program concept

Methodical observations

Aim of this case study was to investigate the method presented in Figure 3 with respect to the given objectives by a practical study. Regarding usability, we found out that it is important to incorporate different departments independently before the workshop in order to collect the requirements self-contained. A participation of the management board in the workshop is mandatory for embedding its contribution. In the project, we agreed on a temporal scenario outlook of 3 years. According to the participants, this was the maximum for valid prospections due to the volatile aircraft cabin sales business. The operative timeline of the project aligned with the company's workflow. Regarding relevance, the participants stated high usefulness of the scenario-PSM prints, particularly if margin is included. A regular use is planned. Limitations were expected by visual confusion if the program becomes too large. The participants stated that the methodical procedure guided product planning in a contributing way. The granularity of the CAP was stated rather rough, which is natural for the planning phase. The traceability of the outcoming program plan was stated sufficient. The

overall plan was stated feasible and innovative, although high engineering resources are estimated for further embodiment design, which may be a crucial barrier.

Conclusion

This paper presented a case application of the method for Product Program Planning. The case was applied with a SME aircraft cabin interior supplier. The first phase of the method deals with the strategic planning of the future program composition; a central workshop developed product family scenarios which were composed into program scenarios. A trend scenario was extrapolated and presented. For this phase of the method, case observations gave insight into incorporation of the different company departments as well as acceptance and relevance were confirmed as beneficial contributing to the company's product planning. The second phase deals with conceptualisation of program-wide carryover candidates. A plan for broad carryover use was elaborated and visualised by product family concepts. For this phase, traceability and benefit of the concepts were confirmed by the participants, although high resource demand for further realisation was stated.

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