PANNON UNIVERSITY

Ph.D. School for Economics and Management

Repertory of the theses:

Logistics management of product phase-out –
Analysis of the path-dependency in the product life cycle using the example of the automotive

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Veszprém, 2011.

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1 Problem definition and purpose

The model cycles in the automotive industry shortened in the last 20 years from average 10.6 years by about four years – a new model is released on average every six years. Together with the shortening of the model life cycle, the number of the models in the product portfolio is increasing and the produced quantity per model is decreasing. The model offensives, multi-brand strategies of the manufacturers and the shifting of an increasing supply volume to fewer suppliers lead to an increased rate of diffusion of the technologies in vehicles of different manufacturers (Dannenberg, 2005).

The increase of variety and complexity of products, the growing number of constructive changes and the shortening of model cycles cause a huge challenge for the product ramp-up management. The complexity of the ramp-up phase is extended by cost-pressure, by strong integration along the supply chain and by focusing on the production of innovative and technological complex products and processes. This causes growing challenges for the ramp-up coordination and requires also a well-structured logistics process of the product phase-out along the entire supply chain. While the growing significance of the product ramp-up is addressed by many research studies and publications (Zäh/Möller, 2004), the product phase-out is still widely neglected. The factors that cause the ineffectiveness have not been researched in detail nor has it been established how this phase can be effectively managed. However, the product phase-out also provides possibilities for logistics improvements, e.g.: by decreasing obsolete stock's scrapping or by increasing the service level and customer satisfactory in the service part market.

Although many life cycle models exist, which classify the phase of introduction and divide it into sub-phases, the phase of product phase-out is till today not classified. Also missing a comprehensive examination of the logistics task during the phase-out: how this phase could be effectively managed – or when the control of this phase is necessary.

Because of the identified needs of research and the praxis-relevance of this topic the following research questions can be posed in terms of application-orientated business management:

(1) Under what conditions is a specific phase-out management required?

(2) Which tasks cover the phase-out management?

Furthermore the questions arise, what is the benefit for a company if the product phase-out is managed and how can this benefit be increased by the product phase-out management. Summarized follow the next two research questions:

(3) Which benefit has a specific product phase-out management got?

(4) How can the effectiveness of the product phase-out management be increased?

2 The model and hypotheses of the research

The thesis deals with the time dimension of the life-cycle concept and with the time-aspects in logistics management with the objective of structuring and creating a preconception for the research object. For this purpose the product life-cycle concept is considered, the basics and history of the terms logistics, logistics system, logistics and supply chain management are summarized and the time-dimension of industrial logistics processes is characterized. Finally the theoretical-conceptual framework of the research is created. This framework shows that the logistics management has got different tasks in the different phases of the life cycle. The several phases do not exist separately, but the decisions in one of the phases take effect the other phases of the life cycle and the tasks of the logistics management in the next phases. However, the operations of the logistics system affect not only for the given cycle, but also on all following cycles.

Based on the theoretical-conceptual framework results the theory-based analysis of the product phase-out. The chosen theory for this purpose is the theory of the path-dependency. After a short summary of the chosen explanation theory[1] the phase-out management will be analysed: it will be analysed how the taken decisions and occasions impact the later course and performance of the product phase-out.

From the previous abstract of the product life cycle and the theory-based analysis of the product phase-out management, the following hypotheses are deduced.

Hypothesis 1: If the lead-time of the product specific single parts is long, a specific product phase-out management is necessary in the phase of the product phase-out.

Product specific single parts cannot be used for a successor or an other offered product. It can not be also assumed, that the overhanging stock – independent from the quantity

[1] See e.g. David (2001), p. 15.; MAHMOUD (2008), p. 45.; PIERSON (2000), p. 251. and PUFFERT (2000).

of these stock - can be sold as spare part. Other characteristics of these products are that the spare part demand is in comparison with the serial demand relatively low and the storage life of the single parts are relatively short.

Hypothesis 2: If in the phase of product phase-out a phase-out management is needed, it includes the tasks of regular process monitoring of the factors, which have an affect on the product phase-out.

This means the regular monitoring of customer orders, the communication about demand changes, and the reviewing the own processes and process parameter, e.g. correctness of stock or order quantity.

Hypothesis 3: If the phase of the product phase out is controlled by a specific phase-out management and it is periodically monitored for path dependency, then the costs of the product phase-out can be reduced by avoiding overhanging stock and the profitability of the product can be increased.

The customer satisfaction can be increased by flexible response times to the fluctuation in demands at the end of the market phase and by shorter lead times in the phase of maintenance. A specific phase-out management has got a positive impact on the key performance indicators, e.g. stock, storage costs or stock turnover rate. The phase-out management had to control periodical the logistics system on factors, which can have an impact on the phase of product phase out. So possible lock-in-effects can be avoided or if a lock-in effect is already occurred, the path can be broken. The positive feedbacks in the decision processes of the phase-out management are summarized in Figure 1.

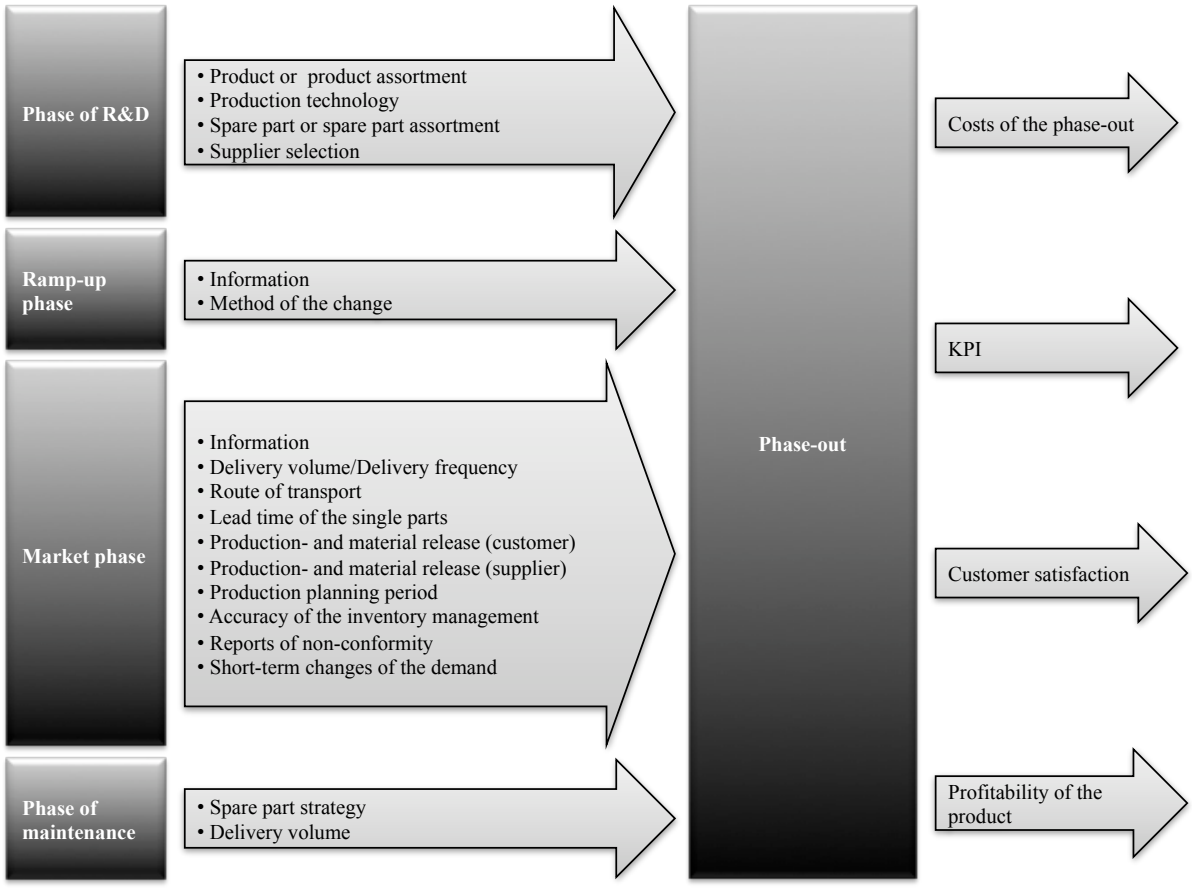

Figure 1: Positive feedbacks in the decision processes of the phase-out management

The results of the theoretical connections are summarized in a heuristic framework and visualised in Figure 2. Before the research and development start, all the alternative output options of the phase-out are open. This is the phase of the decision selectivity. Together with the development activities occur the first positive feedbacks, which continuously limit the possible output options of the phase-out. The decisions made in the logistics system serve as positive feedbacks for the path-dependency of the phase-out till the „Lock-in" is released and the result of the phase-out is not influenceable any more – even though the product is in serial production.

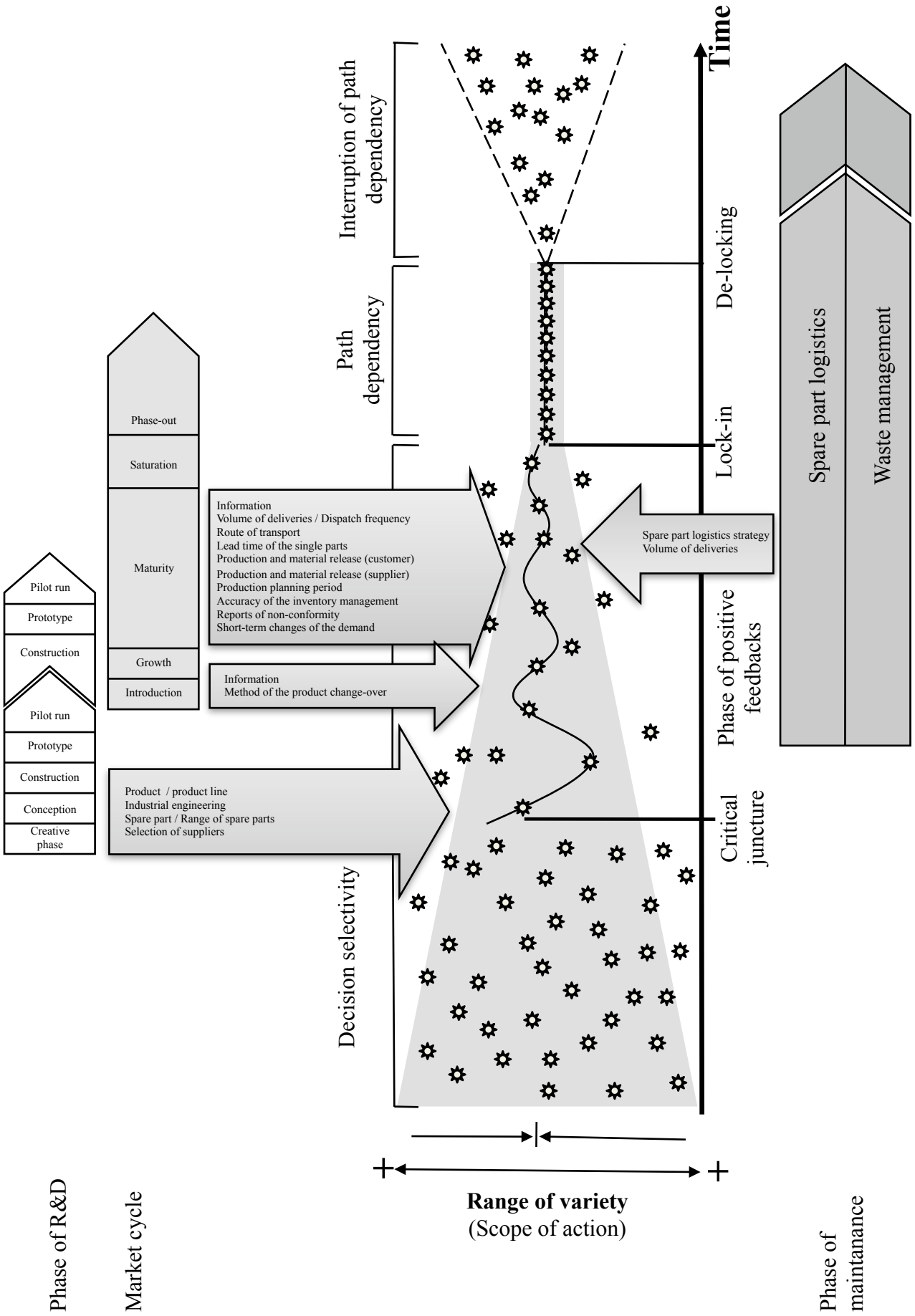

Figure 2: The model of the research

3 Design of the empirical research

The collected theoretical results are tested in practice. The core of the analysis is a case study – one company from one industry sector will be investigated. The four production plants of the chosen company are working in the automobile sector and the plants have got a customer-supplier relationship with each other. Two of them have got direct contact with the end customer. The methods of research used in Plant „A" are participated observation, group discussion and archival analysis. The observed time period extends to six years – from 2003 till 2009. In the Plant „B", „C" and „D" research methods were archival analysis and focused interview.

The participated observation was organised as unstructured, open and direct field observation (Lamnek, 1995). The observer is at the same time the researcher; she was working in one of the observed production plants as coordinator of new products and led many projects for the improvement of the phase-out processes. The observation is open, the research intent is by the investigated persons is well known.

The five participants selected for the group discussion meet both important requirements: all participants are already working in the phase-out process and they know Plant „A" and each other. The chosen discussion topic is the phase-out management in Plant „A" and how this process could be improved. The discussions take place for three years once a week. Each session takes 90 minutes. The discussion will be written down by the researcher and according content and thematic aspects evaluated (according to the object-related theory building).

In case of document analysis there are investigated procedures of ramp-up and phase-out management, training materials for phase-out management, product life-cycle-glossary for phase-out management and project documentation about phase-out management and the project group creates reports and queries from an own phase-out database.

In case of focused interview the hypotheses developed by the theory-based analysis will be reviewed in three other production plans and product groups. Some of the interviews will be made by phone and some of them are face-to face interviews.

4 Results of the research

The hypothesis 1 „If the lead-time of the product specific single parts is long, a specific product phase-out management is necessary in the phase of the product phase-out" is in the case study – as Table 1 shows – only partially verified.

	If...	then…
Plant „A" Produced parts	the phase-out management serves as communication channel for the product phase-out,	the phase-out management for all products is required.
Plant „A" Purchased parts	the phase-out product is a purchased part,	the phase out management serves only as communication channel.
Plant „B"	the purchasing lead time of the single parts is long and the overhanging stock can not be reworked,	the phase-out management is required.
Plant „C"	the raw material is not product specific, has got a short lead time and the production plan can be changed flexible every day,	the phase-out management is not required.
Plant „D" Produced parts	the phase-out management serves as communication channel for the product phase-out,	the phase-out management for all products is not required.
Plant „D" Components	the value of the single parts is low and the information flow about the product phase out along the supply chain is very good,	the phase-out management is not required.

Table 1: Summary of the analysis results of the hypothesis 1

The long lead time and the product specific single parts increase the complexity of the product phase-out management. But the phase-out management is necessary not only for product phase-out with long lead time and product specific single parts. It is necessary in case of all product phase out, if the phase-out management is used also as a communication channel. In all production plants, told: „no specific phase-out management is necessary", is this task taken over from Plant „A", from the 1st-Tier-supplier. A phase-out management is not necessary because the product phase-out is coordinated by Plant „A". So in these cases is the hypotheses 1 disproved: in the phase of all product phase-out a specific phase-out management is necessary because it is simultaneously used as communication medium for the product phase-out. The complexity of the phase-out management is influenced by the purchasing lead-time, the volume of the delivery, the chosen OES-strategy and the product-specifying of the single parts.

The hypothesis 2 „If in the phase of product phase-out a phase-out management is needed, it includes the tasks of a regular process monitoring of the factors, which have

an affect on the product phase-out" is in the case study – as Table 2 shows – only partially verified. Not all the factors with impact on the phase-out are influenced by the operative level.

	Confirmed	Partially confirmed	Not confirmed
Plant „A" produced parts		X	
Plant „A" purchased parts		X	
Plant „B"		X	
Plant „C"			X
Plant „D" produced parts		X	
Plant „D" components	---	---	---

Table 2: Summary of the analysis results of the hypothesis 2

According to these results the phase-out management of the operative level includes the tasks of the regular process monitoring of the factors shown in Figure 1 and the coordination of the product phase-out along the supply chain and in the own organisation. Next is the question: Which benefit has a specific phase-out management got?

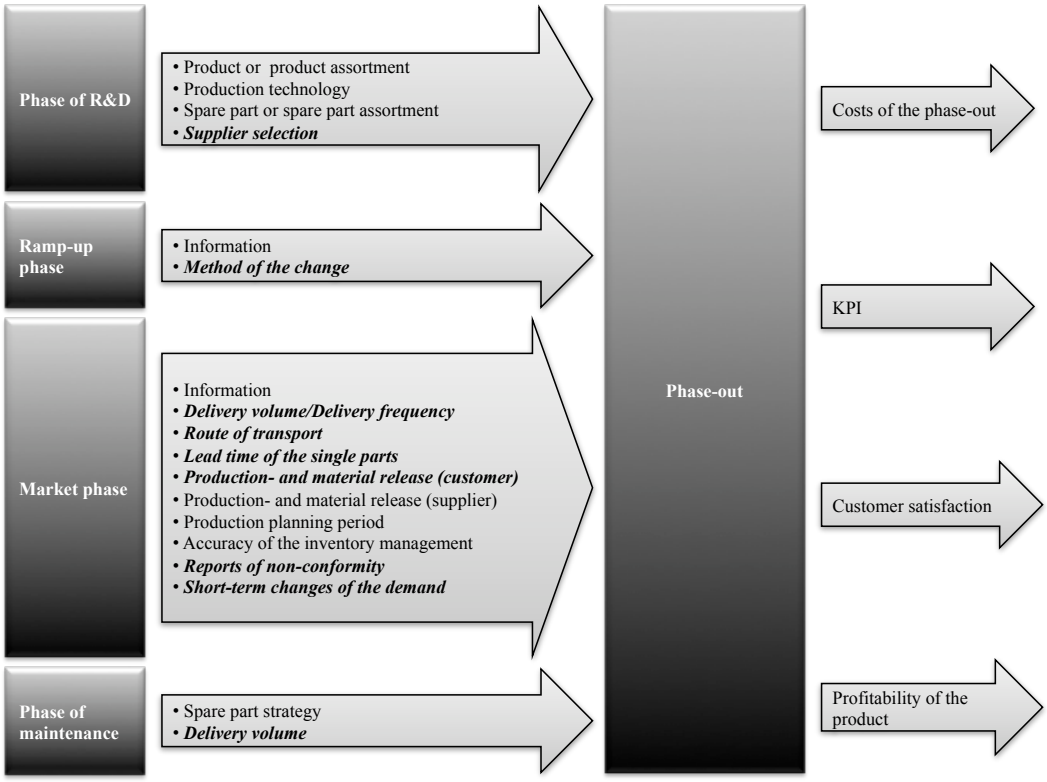

Figure 3: By the operative level not influenceable factors in case of phase-out management

The hypothesis 3 „if the phase of the product phase out is controlled by a specific phase-out management and it is periodically monitored for path dependency, then the costs of the product phase-out can be reduced by avoiding overhanging stock and the profitability of the product can be increased" could be checked in the case study – as

Table 3 shows – could be researched only in three cases, but it can be confirmed and expanded.

	Confirmed	Partially confirmed	Not confirmed
Plant „A“ produced parts	X		
Plant „A” purchased parts	X		
Plant „B“	---	---	---
Plant „C“	---	---	---
Plant „D“ produced parts	X		
Plant „D“ components	---	---	---

Table 3: Summary of the analysis results of the hypothesis 3

If the product phase-out is controlled by a specific phase-out management and it is periodically monitored for possible path-dependency, then the costs of the phase-out will be reduced phase and the profitability of the product will be increased by avoiding scrap and obsolete stock respectively by ensuring the single part logistics and supply availability in the OES-phase.

5 Interpretation of the results

The subject of the present study is the theoretical-conceptual description of the phase-out management and the theory-based analysis of the path-dependency in the product life cycle. The interpretation of the results includes the comparison of theory-based and empirical results and discussion about the discrepancies.

- The product life cycle concept as an operational planning and decision-making model support the definition of different types of product phase-out and product ramp-up. The different phases of the product life cycle also mean different planning and control tasks in the logistics system. The acts and decisions in one of the phases of the product life cycle affect the next phases.
- The theory of path-dependency can be used to analyse the relationship between the different product life cycle phases and the decisions made in the different phases. This theory can show which events from the development and market phase effect the efficiency of the product phase out and which factors can influence the phase of phase-out.
- The theory-based findings will be critically analysed by a qualitative, exploratory empirical study. This includes the case study analysis of the phase-out management at Continental AG.

- The results of the case study analysis suggest that the developed theory-based statements and hypotheses for phase-out management partially or fully considered their validity in individual cases in business practice.
- In the phase out of each product a specific phase-out management is required because it also used as a communication channel for the product phase-out.
- It can be observed that the operational level of logistics management cannot control all factors which affect the phase-out management. The group discussion shows that some factors are determined for the operation level as external circumstances.
- The factors, which are not controlled by the operative level of the logistics management, can be divided into two groups: they are determined by the own company or by external factors. The first group includes the selection of supplier and the production and material release (for the supplier). The second group includes the method of the product change-over, the delivery volume, the delivery frequency, the transport route, the lead time of the single parts, the production and material release (by the customer), the OES delivery volume, quality complaints the short-term changes in demand.
- Factors, which cannot be influenced by the non-operative level, can be classified, if controlled processes can influence the effect these factors or not. The factors, which are not influenceable at the operational level, but identifiable and influenceable by controlled processes, are: reports of non-conformity and short term changes in demand.
- In addition to reducing the phase-out costs and increasing the profitability of the product the phase-out management has got more benefits, e.g. reduction of scrap costs and inventory, guarantee of the spare parts deliveries and supply availability in the phase of maintenance.

6 The theses of the research

Following the results of the empirical research are summarized in form of theses.

1. Thesis

The product phase-out management contains the tasks which have to be fulfilled for the control of the phase-out process. In the phase of the product phase-out a specific phase-out management is necessary, if it is simultaneously used as communication medium for the product phase-out. The complexity of the phase-out management is influenced by the purchasing lead-time, the volume of the delivery, the chosen OES-strategy and the product-specifying of the single parts.

2. Thesis

The product phase-out management covers the regular control of the factors which can be influenced by the operational level.

The tasks of the product phase-out managements are as follows:

1. *Planning of the product phase-out*
    a. *To know and to represent the logistics goals of the company in the phase of product development and in the product ramp-up*
    b. *Identify and track the product phase-out and product changes*
    c. *Assistance to ensure the product ramp-up*
    d. *Define the purchasing strategy of the OES-phase*
2. *Organisation*
    a. *Define the task units in form of jobs with corresponding authorities and competencies*
3. *Implementation of a communication system for product phase-out*
4. *Human resource allocation*
    a. *Adequate cast of the defined jobs*
    b. *Personal appraisal and human resources development*
5. *Leadership*
    a. *Define, set and control of the disposition parameters (e.g. purchasing lead time, optimized order quantity)*

   b. *Monitoring of delivery bottleneck parts and critical phase-out single parts (e.g. purchasing lead time is longer, as the phase of the product phase-out) and tight coordination with the suppliers*
   c. *Review the usability of overhanging stock*
   d. *Monitor and negotiate with the customer and suppliers about the overhanging stock regarding the release to purchasing and production*

6. *Control*
   a. *Monitoring of planning horizon and planning cycle in case of product phase-out*
   b. *Target/actual performance comparison: Is obsolete stock existing? In case of deviation corrective action should be defined.*

3. Thesis

If the product phase-out is controlled by a specific phase-out management and it is periodically monitored for possible path-dependency, then the costs of the phase-out will be reduced phase and the profitability of the product will be increased by avoiding scrap and obsolete stock respectively by ensuring the single part logistics and supply availability in the OES-phase.

7 Praxis relevant recommendations

On the basis of the case study findings and of the identified need for action, the following first praxis relevant recommendations can be made:

Expansion of the process consciousness: for a successful phase-out management it is important that all involved parties know their role and the impact of their actions on the phase-out management. The involved parties can be sensitized to the effect of a missing or not effectively phase-out management in a defined period by visualizing of costs and overhanging stock.

Building a cross-functional and cross-department phase-out team: The operative level cannot solve the tasks of the successful phase-out management alone – many factors are defined by other departments, suppliers or customers. A cross-functional and cross-department team can positively influence the impact of such factors on the effectiveness of the phase-out management.

Company-wide coordination and control function: critical events in terms of the phase-out management can be responded to in several ways. For example, in case of a short-term increase of a customer demand the agreed supplier cumulative quantity can be increased or the date of the phase-out should be brought forward. Which of these alternatives will be implemented should be decided by a cross-company coordination function. This coordination function should be responsible for the relationship in the supply chain and for certain actors. It is important that such activities may not be executed without a consultation between the parties of the supply chain.

Expansion of the project costing: not only the product ramp-up cost but also the costs of a product phase-out should be identified and assigned to a project. It is important that in case of all product phase-outs the cost are systematically recorded and assigned the project – this is the only way to measure the effectiveness of the phase-out management and sensitize the actors for the phase-out process.

Defining of KPI´s: in addition to the phase-out cost the effectiveness of the phase-out management can be measured by other KPI´s, e.g. inventory turnover rate. These KPI´s can be defined for individual companies or for the all supply chain.

8 Further Perspectives of the research

The customer focus and the cost reduction in the phase of the product phase-out can be verifiably improved by a specific phase-out management. For this purpose, it is required that the all the factors, which can influence the product phase-out, their character, direction and intensity are well known. The results of the thesis show which factors are – taking the path-dependency in consideration – principally influenced by the logistics management and how they can be improved the customer orientation and cost decreasing in the whole logistics system on the basis of these approaches.

The reported analysis gives first answers to the research questions but it does not cover the research field in total. Because of the case study method, the research results cannot be declared as generally accepted. The restriction, using a case study, is convenient for the present explorative study, but the finding should be confirmed or maybe adjusted by broader scientific investigation. Therefore, for further scientific analysis in the field of phase-out management, it is recommended to conduct further case study analysis or even more empirical survey.

The present theses structured the wide area of the phase-out management and expanded

their main aspects. But it was not the intention of the theses to cover the research field in total – e.g. the relationship between cost and benefit was not researched. In this case it is expected that the coordination costs in comparison to the cost of the phase-out costs will shorten the number of product phase-out which need specific phase-out coordination.

The theses give first praxis relevant recommendations for the phase-out management of a company. The results of the study can be transferred only for other plants of the Continental AG, working in the same division, with similar size and similar products; the results are not generally valid. Further research is needed for a generalized, cross-company coordination model of the phase-out management along the whole supply chain.

A large number of researches and publication deals with the development of methods and models for the coordination of the phase-out management. It is necessary to analysed, if and how these coordination models can increase also the effectiveness of the phase out and if it is possible, to control both of the phases by the same organisation unit.

In summary the present thesis gives first praxis relevant recommendations for the phase-out management. The analysis opens new further research perspectives which are able to serve as starting-point for future scientific analysis.

9 Publications

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