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NEW ENGINEERING DESIGN FOR FUNCTIONAL SALES BUSINESS

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1 Introduction

Manufacturing companies around the world are striving to increase their revenues and profitability through, for example, obtaining a larger share of the market and controlling a larger share of the product value chain. Products and services are moving together, and a structural change is underway shifting the focus from production of products to production of services, see e.g. [1, 2 and 3]. This shift can potentially be achieved, in concert with environmental benefits, by a change or at least a move towards a higher degree of functional sales [4 and 5]. The environmental effects of functional sales are more closely described by Ölundh [6]. The business concept of functional sales can be defined as follows:

"…to offer a functional solution that fulfils a defined customer need. The focus is, with reference to the customer value, to optimize the functional solution from a life-cycle perspective. The functional solution can consist of combinations of systems, physical products and services" (modified from [4]).

Functional sales can be achieved, for instance, by selling the service of washing laundry loads, instead of the physical washing machine or the service of copied papers instead of copying machines. Within this paper, and in the survey, a rather broad definition of functional sales is used; for instance, businesses dealing with renting, leasing and similar concepts are included. The term for functional sales used in the survey is "product service combination".

Since the business concept of functional sales still is emerging, there is a lack of empirical data about its practical application. More data is needed in order to analyze how companies are approaching the concept in order to make it as successful as possible. This means for example that the service provider could put more focus on the use and end-of-life phases for the physical products included in the product-service combinations. When the service provider has the control over the physical products during the use phase, the incitement for cost reduction increases. This will for example turn revues from spare part and maintenance into cost for the provider. Related research concerning functional sales has been previously conducted by e.g. Ölundh [6], Mont [7] and Brännström [8].

This research explores how this new business concept affects the product development process, and especially product design at manufacturing companies in Sweden and Japan. This paper investigates if new engineering design methodologies are needed for this new business concept.

2 Methodology

Since several companies in both Sweden and Japan were analyzed, it was decided to use questionnaires as a method to collect data. It also gave good possibilities to display the results in graphs. All authors of the paper have experience with empirical research in the field of functional sales, which proved useful when developing the questionnaire.

2.1 Survey Generator

The methodology used for obtaining the empirical data described in this paper consisted primarily of a web-based questionnaire survey. The software used for the survey is called Survey Generator, and was developed at Kalmar University, Sweden[1]. The survey consisted of 56 questions altogether. Since it was web-based, the authors took the advantage to use dynamic questions, i.e. the respondents' answers affected which subsequent questions were displayed. By using these dynamic questions, most of the respondents did not need to answer all the questions, since many were not relevant for their kind of business. For example, if the company did not have any product remanufacture, the respondent was not asked any questions about their remanufacturing business. Having these types of questions made the survey much quicker for the respondents to complete, especially in the case where many questions were omitted.

Furthermore, the web-based survey allowed the authors to monitor the different respondents' progress in answering the survey. One could see when the respondent started the survey, and when he/she had finished it. Due to this, the authors could send out reminders or call the respondents knowing if they had started the survey or not. The Survey Generator also included templates for sending out invitation and reminder e-mails.

The 56 questions that the survey is based on were developed by the authors at Linköping University and the University of Tokyo. Potential participants and experts groups were consulted in order to create a well-structured and understandable survey. In order to obtain answers from the participants that were as accurate as possible, the authors decided to have the Swedish survey questions in Swedish and the Japanese survey questions in Japanese. The questions were first written in English and later translated into Swedish and Japanese, respectively.

2.2 Company Selection

The survey focused on manufacturing companies that have an increased interest in selling functions rather than their physical products. The authors chose to select companies in their home countries for the following reasons:

- Previously established company contacts.
- Extensive knowledge about the company structures of the countries.
- Increased convenience in communicating with the respondents, since they are situated in the same country as the researchers.

[1] For more information about the Survey Generator software, please contact Mattias Lindahl (malin@ikp.liu.se).

In Sweden, mostly manufacturing companies with functional sales were identified. The identification was made through previously established company contacts with researchers at Linköping University, Sweden. Both the number of companies and people working with functional sales in Sweden is rather limited. Therefore, the selected respondents at the identified companies were closely followed-up by reminder e-mails, and at times reminder phone calls. In Sweden, 18 respondents were selected; 13 of these (72%) completed the survey, four (22%) started but did not complete the survey and one (6%) did not even start the survey. This is also shown in Table 1 below. Reasons provided from the respondents as to why they did not answer the questionnaire or did not finish it were, for example, that they did not have the time or that the scope of questions did not seem relevant for them.

In Japan, the University of Tokyo has developed a close collaboration with a group of companies in various business areas interested in functional sales. Within this group of companies, a business network has been established including companies that are just beginning to, or that have already begun to apply the functional sales business concept. In Japan, 21 respondents were selected; 13 of these (62%) completed the survey, five (24%) started but did not complete the survey and three (14%) did not even start the survey. This is also shown in Table 1 below.

Table 1. The participants' degree of completing the survey.

Country	Did not start	Uncompleted	Completed	Total
Sweden	1 (6%)	4 (22%)	13 (72%)	18 (100%)
Japan	3 (14%)	5 (24%)	13 (62%)	21 (100%)

In order to find out how large the functional sales business is at the companies being analyzed, the participants were asked how much of their total turnover was related to the functional sales business. For this question, we only obtained 12 answers of the total 39 selected participants. Most of the respondents (9) answered that less than 20% of their total company turnover was related to functional sales. The other 3 respondents answered that their company had over 25% of the company turnover related to functional sales.

Furthermore, the participants were asked how many functional sales offers were being sold annually. The number of answers was low (only 9 participants answered) on this question as well. The answers varied from less than 10 to over 1000 functional sales offers sold annually. This result shows that the companies have various sizes and/or that their physical products vary.

3 Identified Driving Forces

One of the objectives of the survey was to identify the driving forces that are connected to the functional sales business strategy. To cover this area, the participants were asked: *"Which reasons and motives got your company to start selling product–service combinations?"* The following graph shows the answers from the participants:

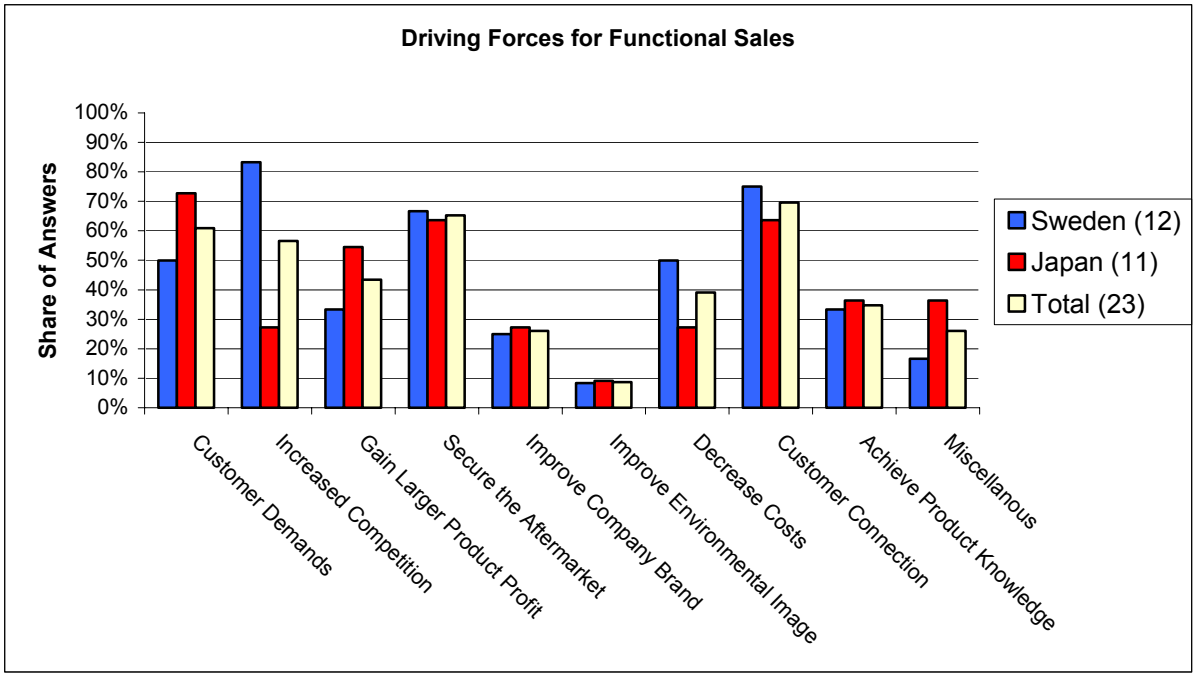

Figure 1. The driving forces for the companies to perform functional sales business.

Looking at the total scores, one can see that five of the suggested driving forces were 'ticked' (selected) by more than 40 percent of the survey participants. These are, in decreasing order:

- Closer Connection,
- Secure the Aftermarket,
- Customer Demands,
- Increased Competition, and
- Gain Larger Product Profit.

The figures in Figure 1 indicate that many incentives for functional sales business are connected to the customers and to the possibilities of gaining more profit. This is hardly surprising. Improving company brand and/or environmental image does not seem to be an important driving force for the companies in their functional sales business. These results are in line with a study conducted at three Swedish manufacturing companies by Ölundh and Ritzén [9]. Their study revealed that functional sales are driven primarily by evident economic reasons, and environmental benefits are considered only as a bonus. An important, indirect and economic driving force for companies to employ functional sales was the possibility to establish closer and long-lasting relationships with business customers. For the customers, functional sales mean risk reduction and increased flexibility.

The differences between the two countries, as seen in Figure 1 above, are not significant. The largest difference found was that Swedish companies find "increased competition" as a most relevant driving force for functional sales (83%), whereas the Japanese companies found it rather low (27%). This might indicate that the competition among the Swedish manufacturers is higher than in Japan, at least for the businesses included in this survey.

4 The Functional Sales Offers

In the survey, the contents of the functional sales offers were also investigated. The participants where shown eight different selections, i.e. physical products, operators, consumption goods, energy consumption, maintenance, repairs, take-back responsibility and licenses. The results are shown in Figure 2 below.

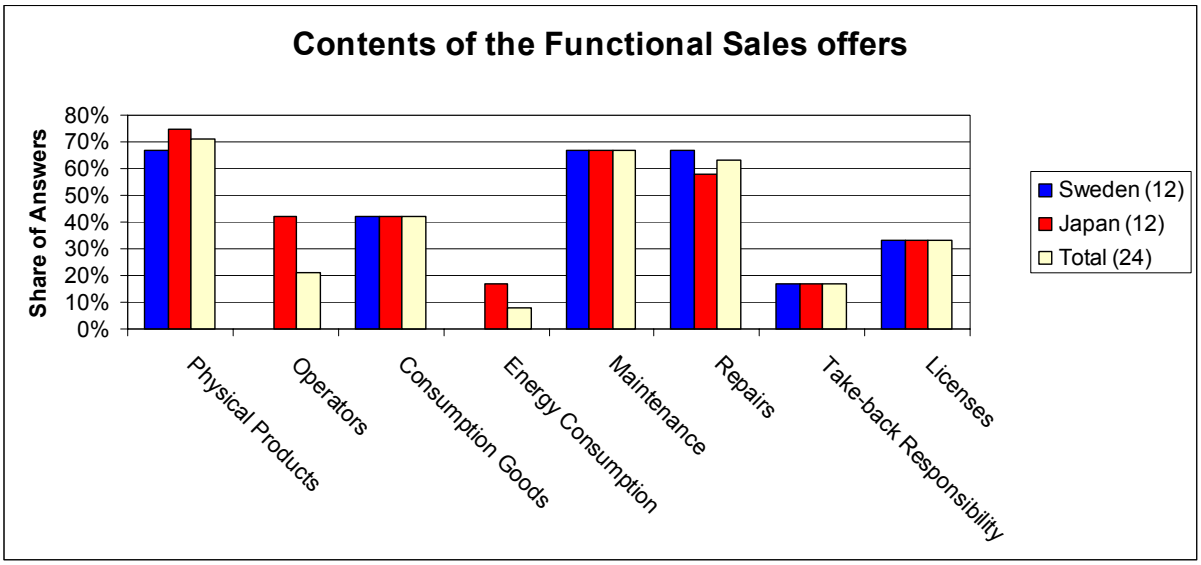

Figure 2. The contents of the functional sales offers.

One can see in the figure that the responses from the Swedish and Japanese companies are much the same except that the Japanese companies sometimes include operators and energy consumption in their functional sales offers. The three main parts of the offers seems to be:

- Physical Products,
- Maintenance, and
- Repairs.

5 The Physical Products

Looking at the physical products included in the functional sales offers, it was of interest to find out who owned the physical product when the contract had been signed. Having the ownership transferred to the customer/user limits the service provider's possibilities to increase profit during the use phase. Therefore, the participants were asked; *During the use of the product-service combination, who owns the physical products?* The following figure shows the results.

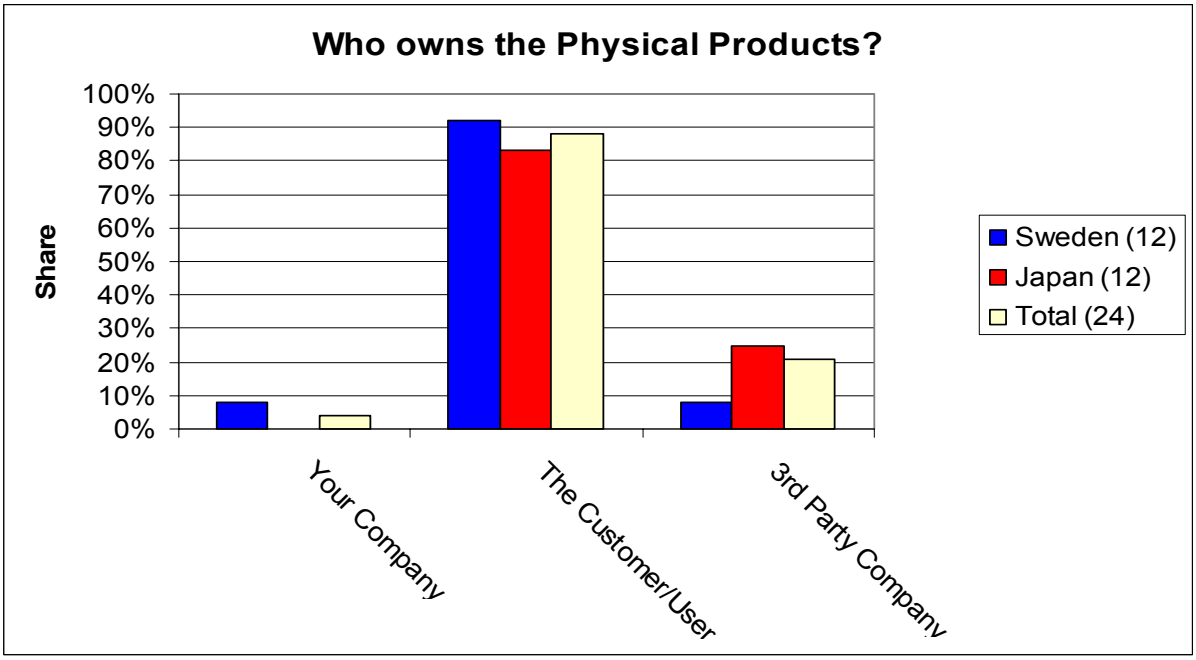

Figure 3. The ownership of the physical products.

This figure shows that although the companies are using the functional sales concept, they still let the customer/user own the physical products during the user phase. However, based on the authors' previous knowledge about the participating companies the result is slightly misleading. Based on the results, the authors are uncertain of how this question has been interpreted by participants. The reason for this doubt is that the authors know that some of the participating companies own the products at least during the use phase. Therefore this question needs more investigation and clarification before drawing the conclusions about ownership. This has not been conducted yet.

Furthermore, the authors were interested in what manner the physical products are adapted for functional sales. Previous author experiences indicated that the products seldom are adapted for the functional sales business. To find the answer to this question, the participants were asked: *To what degree have the included physical products been adapted to the products-service offer?* The participants then received three options to choose from: *standard products designed for sale of products*, *standard products adapted for product-service offer* and *product designed for product-service offer*. The following graph shows the results from 24 participants.

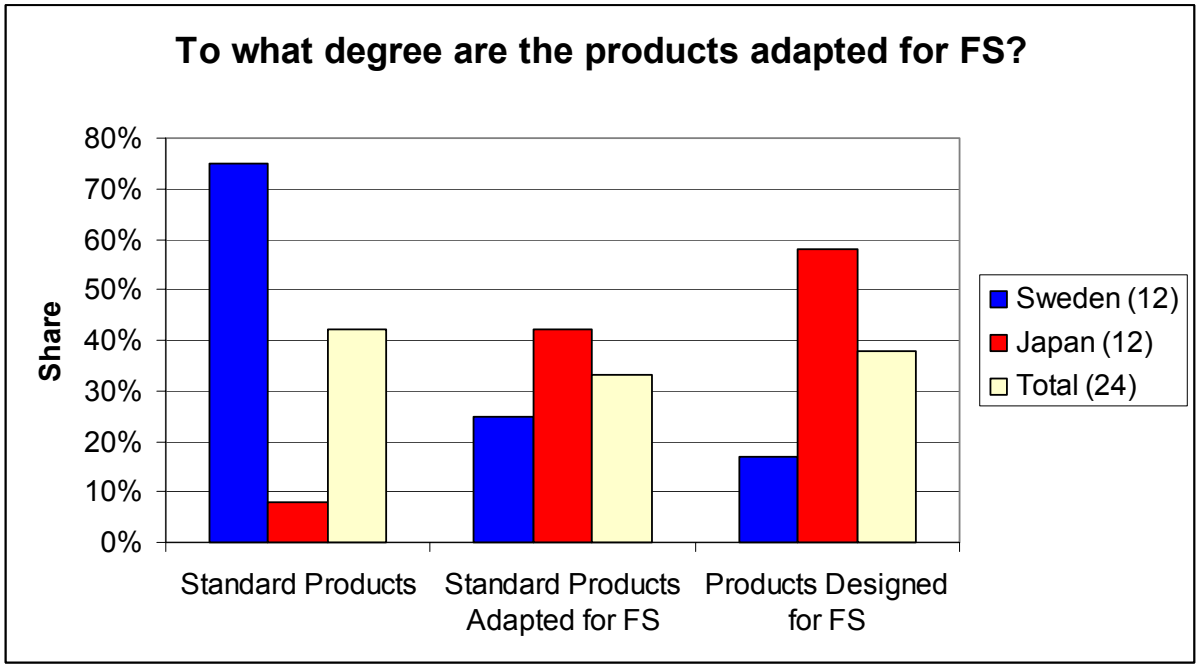

Figure 4. Physical product adaptation for functional sales.

For the Swedish companies, a majority of the products are standard products not adapted for functional sales. According to the graph, the Japanese companies seem to be better at adapting their physical products for their functional sales offers.

Examples of adaptations from the Swedish companies:

- "The products hold the right quality and are available when needed".
- "The products are adapted for our business strategy."
- "We have designed surveillance systems in order to reduce production stops for the customer and to maximize the maintenance intervals to reduce our costs. Machines all over the world are monitored."
- "The adaptation has been conducted to meet the demands on function that has been defined on the physical products being used in the business strategy."

Examples of adaptations from the Japanese companies include:

- "Realization of on-line service by designing a new device to integrate subsystems and adding communication functionalities"
- "Developing a structure for interactive communication with end users"
- "Modularization aiming at easy customization depending on customer requirements"
- "Interface customization meeting categorized customer purposes, an Information Communications Technology (ICT) system for a rapid maintenance support, and a modular design for exchanging parts"
- "Designing for easy disassembly, easy reuse by integrating several parts, and easy recycle by material unification"
- "Modularization to separate reused and non-reused parts"

- "Adding functionality to improve the efficiency of maintenance activities"

6 The Development Process

Focusing on the development of the functional sales offers, the following question about which departments were involved was asked; *What departments are participating in the development of product-service offers?* The following figure shows the results from 23 participants.

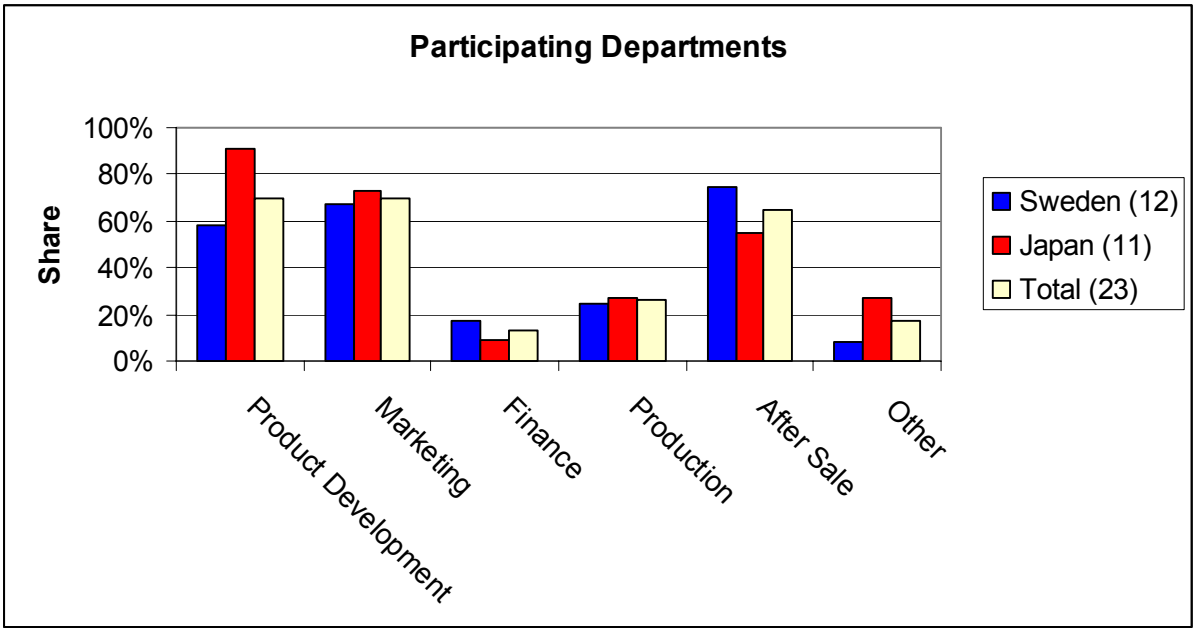

Figure 5. The departments that participate in the development of functional sales offers.

Figure 5 shows that the three most common departments that are involved in the development are product development[2], marketing and after sale. It is interesting to see that both the product development and the after sales departments in the Swedish companies are often included in the development work but, as seen in Figure 4, the physical products seldom are adapted for the functional sales offers. In Ölundh and Ritzén's study it was found that functional sales had little effect on product design, because the design of products and services respectively (sales, after-sale services, etc.) are performed by different departments in companies [9].

Almost the same pattern is showed when asking the participants which department holds the responsibility for the development of the functional sales offers, as Figure 6 shows below.

[2] Product development is in this paper mainly concerns the physical product design.

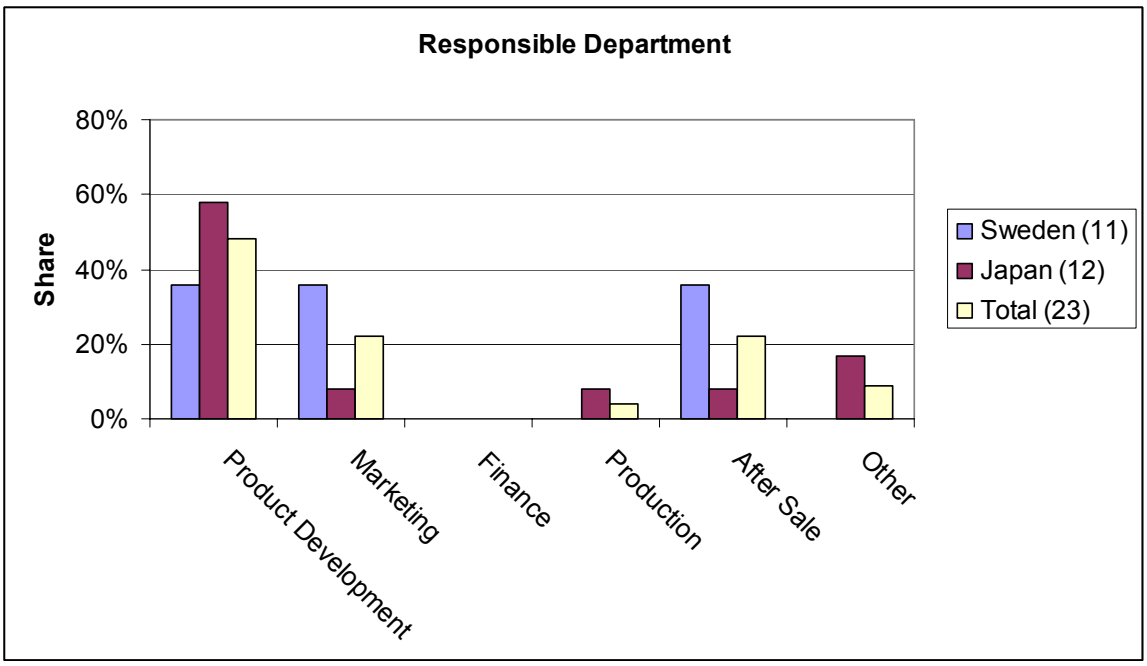

Figure 6. The responsible department for the development of the functional sales offers.

The results show that the responsibility is rather equal between the major departments for the Swedish companies. Among the Japanese companies, the responsibility is more often set to the product development department. This could be a good reason why the Japanese companies are better than the Swedish companies to adapt their products for functional sales offers (see Figure 4).

Furthermore, it was interesting to see if the companies were using specific methods for developing physical products for their functional sales offers. Hence, the participants were asked: *"Is any specific method utilized for developing the product-service offer?"*. There were 21 participants answering this question, of which about half of the participants (11) stated that they used specific development methods. According to a follow-up question, the participants described that the methods were of various kinds.

A second follow-up question explored whether the participant was satisfied with the method used. Out of the 10 participants using specific methods, 7 participants stated that they were satisfied with the method. The eleventh participant did not leave an answer.

7 Discussion and conclusion

The survey shows that few of the companies still do not have the ownership of the physical products that are used in the functional sales offers. Also, Ölundh and Ritzén [9] showed that functional sales rarely stimulated reuse and recycling because the producer seldom continued to 'own' products after a leasing or renting period, but instead sold products to customers in a traditional way. This might be a reason why hardly any of the companies in our survey remanufacture the physical products when the functional sales contracted time has ended. Savings could be achieved by adapting the products for functional sales especially if they are to be remanufactured, see e.g. Sundin and Bras [10].

Another conclusion related to above is that functional sales so far have had little influence on the physical design of physical products. Most of the physical products are standard products not adapted for functional sales. This is also in line with the study conducted by Ölundh and Ritzén [9].

This survey indicates, in coherence with Ölundh and Ritzén [9], that there are no specific methods established and used in industry for developing functional sales offers. In a report written by Tischner and Verkuijl [5], a suggestion for how a development method for functional sales should be performed has many similarities to the already existing ones within ordinary product development. This is an area that needs more investigation.

This paper shows that the development of functional sales has many similarities to ordinary product development, since driving forces are alike as well as the design methodology. There do not seem not be any special methods or tools developed to support the development of functional sales offers. The functional sales offers seem to have emerged from ordinary product development offers, and there is room for more adaptation in form of methodologies and physical product design.

8 Acknowledgement

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