

Quality Support for the Development Process of Newspaper Products

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Keywords: Media Industry, Product Development, Newspaper

ABSTRACT

A newspaper has an extremely modular product structure, which permits it to be developed in parallel. Each module of the newspaper is quality independent of the other. In this study we analyzed the product development process of two different newspaper products with regard to the consequences of inexplicit work methods. The results imply that an already short production lead-time could be further reduced, if the product is fully evaluated and tested during the product development process. High product variety could be achieved if development teams of future newspaper products look beyond present constraints and instead design products that could fit different manufacturing processes and distribution channels.

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INTRODUCTION

The newspaper industry is a fast changing industry. The rapid development of technology has dramatically changed the pre-press and manufacturing workflow (Nordqvist, 1996). The digital technology has made it possible for the newspaper company to produce its products in a more flexible way. Newspaper products are interesting to study because their life-cycle and production lead times are short. In a highly competitive industry environment many companies have been pushed to shorten product life cycles and enhance the frequency of new product launches. This in turn requires new development techniques to improve product quality and reduce development costs and time (De Toni et al., 1999). It also becomes important for the companies to carefully measure trends in how their mainstream customers use their products. Otherwise, they might develop too superior products, that over-satisfy the needs of their original customers (Christensen, 1997).

Newspaper products differ from other industrial products in the sense that they are not defined when the production starts, which is unusual compared to other industries (Enlund, 1995). A newspaper has an extremely modular structure and can therefore be developed in parallel. Each module is quality independent. Its strict layout templates and design rules facilitate fast production decisions. However, modular production require co-operation and communication between managers and operators, which in turn requires interpersonal and social skills (Bailey, 1993). De Toni et al. points out that a reduction in number of components and identification of common modules can reduce both the cost and the managerial burden (De Toni et al., 1999). Layout driven newspaper production is an example of how modular product architecture permits the newspaper company to make fast changes within the modules without changing the entire product. The form and content is decided late in the production run.

A newspaper production can be divided into an editorial phase and a manufacturing phase. In the newsroom, external events are reduced to newspaper pages (Enlund, 1992). Despite the short lead time, the newspaper product is edited, manufactured and distributed within 48 hours. The editorial and manufacturing processes must manage radical and frequent changes and keep tight production schedules. Intensive competition in the media industry forces newspapers to offer its readers product variety (Rosenqvist, 1998). The aim of this paper is to show how newspaper companies can achieve a high degree of product variety by following a systematic product development process.

METHOD

A product development process is the sequence of steps or activities that an enterprise employs to conceive, design and commercialize a product (Eppinger and Ulrich, 1995). According to Sobek et al. serial engineering is traditionally a series of functions, each designing to a simple solution or point. Such development method should quickly converge on a solution and be modified until it meets the design objectives. In unpredictable, rapidly changing environment, "flexibility" in the development system is a particularly important factor. Sobek et al. defines "flexibility" as "...the ability to make design changes in response to a changing environment with little or no penalty"(Sobek et al., 1999). According to Christensen the way groups learn to work together and how the organization is structured affect the way it can and cannot design new products (Christensen, 1997). We studied the development process for two newspaper products at one of Sweden's major newspaper companies. Then we compared the development processes of newspaper products with other industry's development process.

Eppinger and Ulrich's generic development process begins with a mission statement and ends with the launch of the product. It includes five phases: concept development, system level design, detail design, testing and refinement and production ramp-up. The mission statement identifies the target market for the product, provides a basic functional description of the product, and specifies the business goal of the effort. A concept is a description of the form, function and features of a product and is usually accompanied by a set of specifications, an analysis of competitive products, and an economic justification of the product. (Eppinger and Ulrich, 1995).

In this study we have modified Eppinger and Ulrich's generic development process, which is most appropriate for market-pull products, and applied it as a reference process when analyzing the development process of newspaper products. The generic development process primarily refers to three dimensional objects. Since a newspaper consists of two dimensional newspaper pages its development is somewhat less complex than for three dimensional objects. Thus, the presented development process could be simplified but still includes those steps and activities that are considered significant.

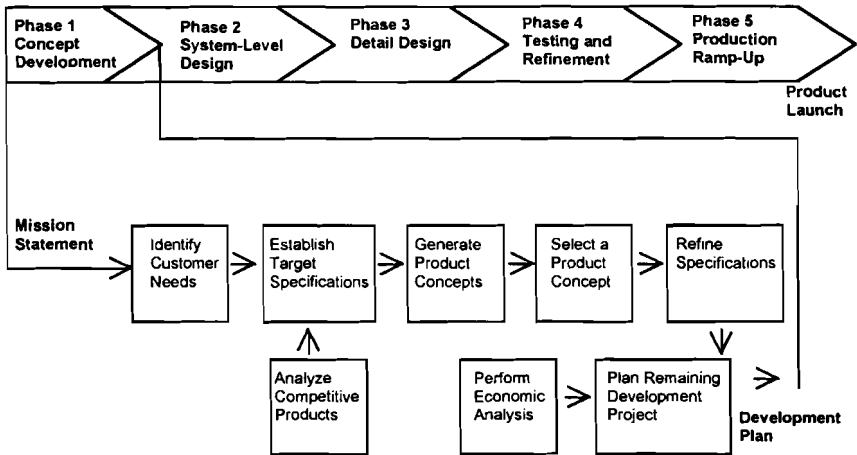


Figure 1. Eppinger and Ulrich's generic development process and a detail over the sub activities in the concept development step. (Eppinger and Ulrich, 1995).

An analysis of two newspaper products

This study investigates two separate editorial newspaper insert products, GP-Extra (product A) and TV-Tider (product B) at Göteborgs Posten Nya AB, one of Sweden's major newspaper companies. The two products differed in development time, development methods and format. The products were selected by the case company. In order to have a clear view of the format of product A, 35 issues had its components analyzed, and for product B a total of 40 issues were analyzed.

Product A

- 16 pages, all in color, broadsheet format, 16 x 22 inches
- 45 g/m² Newsprint
- Reused editorial material, published during the last week
- Production time: Editorial phase: 2 days, Printing phase: 8 hours
- Delivered to non subscribers in the local area
- 48 issues/year, weekly (Thursday) and every fourth week (Saturday)
- 39% of the space is used for advertising

Product B

- 24 pages, 12 pages in color, tabloid format, 5 x (13-16) inches
- 52 g/m² Newsprint
- TV-schedules
- Production time: Editorial phase: 3 days, Printing phase: 8 hours
- Included in the main edition of the newspaper
- 52 issues/ year, delivered weekly on Thursdays
- 5% of the space is used for advertising

In order to understand the development processes we interviewed those who had been involved. Interviews were made in three rounds. The interviews were all recorded on tape, with permission of the interviewees, and saved for double check. To estimate the time that was spent by the interviewee in the different phases of the development, we showed a matrix and the person indicated which part of the project and how long time he had been involved. The following questions were addressed in the interviews:

- Product development in general, how did you see it?
- With which products were they involved with?
- What did you do during the development process?
- How much time did you spend during the development process?
- What started the product developed process in the first place?
- What could have been done differently during the development process according to your opinion?
- What information would have been appreciated in the first phases of the development process?
- How was the decision process undertaken and how efficient was it at the newspaper?
- Which economic figures were used to plan and measure the product and the product development process?

Number of participants

27 people from the case company were interviewed in the first round. Most of them, 17, did also participate in the second and in some cases even the third round of interviews. In total we interviewed 47 persons.

Type of participants

The interviewees came from the following departments at the case company:

- The management board. This was where the main decisions, regarding product A and product B were taken. The person responsible for each of the projects was a member of the board.

- The advertising department. It has played a major part in both of the two projects and were responsible for the advertising income.
- The editorial department. It played a key role in the development of a new product as contributors of editorial material.
- The printing plant, with manufacturing knowledge of its staff could reveal problems in the early production phases and thereby avoid losses in time and resources in the manufacturing phase.
- Others, this section includes all other departments of the newspaper company that contributed to the product during the early stages of its development.

RESULTS

In the following paragraphs we will analyze the development of product A and product B from out the modified generic development process described below.

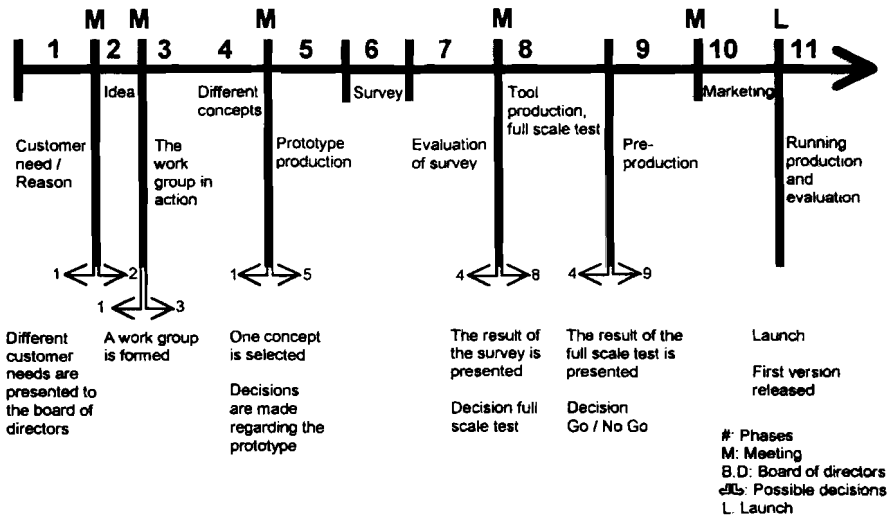


Figure 2. A modified generic process for the development of newspaper products.

Phase 1: Customer need / Reason

The first phase is the igniting spark of the whole process. Somebody within the company apprehends or think that he apprehends a customer's need or a customer's demand. This leads to some interesting questions, for example which is the customer segment? Does the company know how to measure the customer needs? The ignition might also start by a reason or due to an event, for example an external threat to the company. A competitor might have come up with an idea and the

company has to react to save market shares, for instance. If this is the case it might be very difficult to regain the initiative. The main issue is that the customer thinks that you “act”, instead of “react”. As long as it looks like you are leading the market the customers will think that your competitors react, and you can maintain the initiative.

Phase 2: Idea

The second phase of the development process is to form an idea. The idea is generated in some way. This is solved differently in different companies. Some prefer the idea to generate in “jam sessions” in small groups, some prefer large brainstorm meetings and yet another prefer their employees to think by themselves. There is no patent solution of which way to prefer, so it depends on the company climate. And as long as it works, why change a winning combination? But one thing that these different idea generating ways have in common is that a work group is formed and that a project is started.

Phase 3: The work group in action

This means that the work group is now formed and that it has started its work. The group does different surveys of the market in order to identify the problem and to find out how to solve it. It also identifies and isolates the needs, wishes and demands of the market, the company’s market segment, and categorizes them into those that are critic and hard to satisfy and into those that easily can be satisfied. If the case is that a competitor is to launch a product, then the working team tries to find out as much as possible about the product and how to meet it with different actions.

Phase 4: Different concepts

The work group comes up with different solutions that satisfy the customer needs or that meets the competitive product. These solutions are made into different concepts in a creative process, which may consist of “jam sessions”, like the ones in the idea phase. Anyway, the solutions are in this phase, transformed into product concepts by the work group, or if that is the case the inventor. At the end of phase four there are some decisions to be taken, a concept has to be chosen and there has to be a decision whether to make a prototype or not.

Phase 5: Prototype production

In this phase one or several of the concepts from phase four is transformed into a prototype, by the work group or by someone assigned by the work group. If you are to connect this model to the newspaper business this is the phase were the dummy is done.

Phase 6: Survey

The prototype that was chosen for the testing session is thoroughly put through different tests, evaluations and investigations. What type of

tests that are interesting and accurate depends on the prototype. There are different tests for a prototype car than there are for a prototype toothbrush. If the prototype is a household product for instance, one of the tests might be to perform the desired action multiple times to find out where the point of fatigue is situated. A series of market surveys are done to find out what the consumers think of the new product. It is very important to know what to measure, so you can be confident that the series of data collected are relevant. This means that the questions are almost as important as the answers.

Phase 7: Evaluation of the survey

The survey is thoroughly examined and evaluated by the responsible department in the company. The results are presented to the board, if it is a major project or to some department if the project is somewhat smaller. After this presentation there are some different options available. The company can decide to move on in the product development process and do a full scale test or they can choose to do a new prototype, based on another concept or they can skip the whole idea.

Phase 8: Tool production, full scale test

A test in full scale is done just before the actual production starts. The test is to pinpoint details in the construction or in the production line that have been overseen. It is much cheaper to discover "infant problems" at this stage than in the production. If there are any problems the work group has to make changes in the construction or in the worst case if the product can not be manufactured a totally different concept has to be picked and the process starts all over again. The production line is tested as well as the construction of the prototype. The production tools are also being produced in this phase. If they are not made within the own company the orders to make them are distributed. If the results of the test are satisfying and the production tools are acceptable one moves on to phase 9.

Phase 9: Pre-production

The production towards a stock starts in this phase to meet customer demand in connection with the marketing campaign and product release. It is very important in this phase to give feedback to the work group regarding how the product is to be produced. It might seem a bit out of style to produce towards a stock when the ideal production of today is just in time, but at the launch of a completely new product there has to be a stock to meet the first orders.

Phase 10: Marketing

A marketing campaign is launched. It prepares the market and the customers for the new product and it might cause a "need" if there were

not one in the beginning. The marketing process is a process of its own and every company has to pay a lot of time to market their products in the right way, or they may perhaps find themselves out of the market in a short time. This phase ends with the launch and release of the product.

Phase 11: Running production and evaluation

The product is launched and the production is running. The sales revenue is under constant control to discover differences and trends in the sales figures as soon as possible. A thorough examination and a survey are made after a couple of months to get an impression of how the market is accepting the newly released product. If there are possible improvements and there usually are, an upgrade or new editions are handled and developed in the same way as the original product was developed.

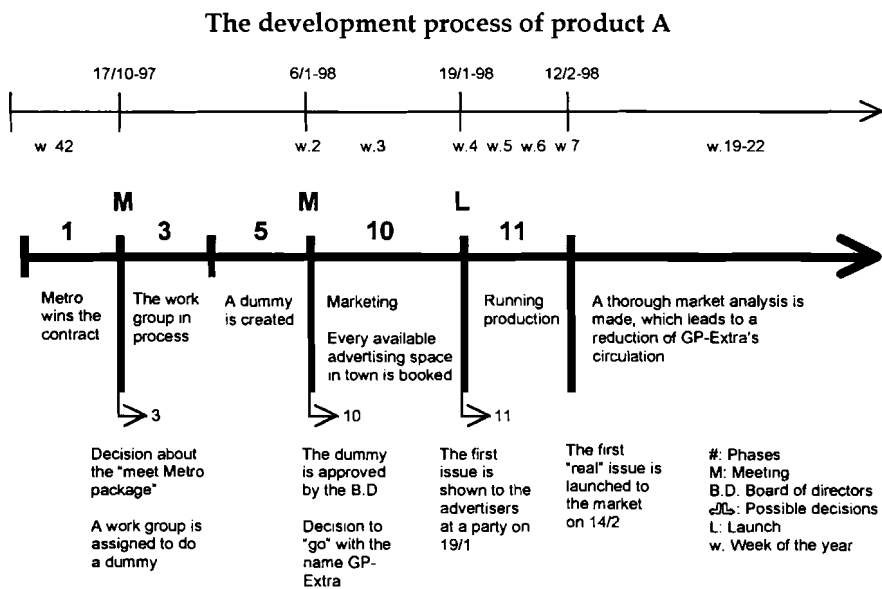


Figure 3. The development process of product A.

Phase 1: Customer need / Reason

The free daily newspaper Metro, owned by the Kinnevik Group, wins the contract announced by Göteborgs Länstrafik (GL). By this our case company's competing concept is shut down and they decide to put effort in developing a free newspaper, delivered to every person in Gothenburg that does not subscribe to their morning newspaper (about 30% of the inhabitants of Gothenburg). The board takes a couple of decisions regarding the "meet Metro package" and a work group is formed with a project leader and a person responsible for the dummy.

The work group receives directions regarding the product. It shall contain reused feature material and advertisements to give a taste of the main newspaper. To compare the actual steps taken according to the development process, one can say that the workflow followed phase one. The case company was reacting on Metro's introduction, instead of acting and had therefore some difficulties in retaking the initiative.

Phase 2: Idea

The idea creation phase was not a part of this project since the board knew what they wanted. One could ask oneself the strategic accuracy in this decision and also if every aspect were taken in count before the decision was made. Another relevant question at this point is, was this the kind of content people wanted to read?

Phase 3: The work group in action

The work group takes impressions by Sydsvenskan Direkt, a similar type of product, and develops a product under the name of GP-Plus. The priority for GP-Plus is not to harm the main newspaper, that is why there is no news in GP-Extra today. A quick analysis is done, based on the many years of experience inside the company. A regular survey regarding what the readers need was not done, instead they trusted personal judgement. The work group thought that they knew what the market wanted instead of asking it.

Phase 4: Different concepts

This phase is missing in this project since there was a clear vision of what to make, and while there were no other ideas there were no other concepts. The reason why this situation came up and this phase was neglected was the tremendous pressure of time. It was said that six weeks were too short to develop parallel concepts.

Phase 5: Prototype production

A dummy was made. It was presented to the board on the 6th of January 1998. The board was very satisfied and had no remarks and they decided to "go" with the name GP-Extra.

Phase 6: Survey

Due to the lack of time, no reader survey in traditional meaning was made. But a thorough follow up was made in phase 11.

Phase 7: Evaluation of the survey

Since there was no survey, there was nothing to evaluate.

Phase 8: Tool production, full scale test

Also this phase is completely left out, because there were no specific tools to be made and the production line is carefully tested every night during the production. The production tools in the newspaper business

are the printing presses and plates and there was no need to buy an additional printing press for GP-Extra. A full scale test was not done because the knowledge of printing exists already and from a printing point of view GP-Extra is not the least complicated.

Phase 9: Pre-production

The pre production phase was left out as well, since you usually do not produce newspapers towards stock. There are exceptions from this rule. You can see the rotadisc as a kind of stock, under a short period of time. The method of using rotadiscs is mainly used by very large newspapers, like New York Times, which have extremely thick weekend editions. In these cases the printing plant has to pre-produce the different supplements during the week, store them on rotadiscs and then insert the supplements into the Sunday edition.

Phase 10: Marketing

The supposed advertisers are being prepared for the new product, to create a need among the advertisers. All presumed advertisers were invited to a party at the newspaper company on the 19th of January 1998. GP-Extra was presented for the first time at this party. A dummy edition, containing real adverts and on-line printed pictures from the party, is handed out to all guests at the end of the evening. The party would have been held anyway but it was a golden opportunity to launch the new product.

Phase 11: Running production and evaluation

The running production starts on the 12th of February 1998 with the first real edition, a few days before Metro is launched. In May 1998, more correctly between May 4th and May 15th a market survey is made. The communications department orders a survey. The survey measures the public opinion regarding GP-Extra and how well it is read. The result shows that 66% of those who do not subscribe to GP is familiar with GP-Extra and that 40% of the readers reads almost everything in GP-Extra. Only 39% of the asked receives GP-Extra regularly since February 1998 and another 19% have received the product but not on a weekly basis. The average time spent on GP-Extra is 17 minutes and women generally spend more time than men. The total judgement of GP-Extra is rather average, 5,6 on a 10 graded scale, where 0 is very bad and 10 is very good. Despite this as many as 60% of the asked would like to have GP-Extra in the future.

A lot of people were involved in the development of GP-Extra. The actual project team consisted only of three persons, the project leader, one person from the editorial department and one person from the advertising department. The others were involved in the ways of making decisions, doing small surveys or similar things.

It was clear that most time was spent in phase 11, running production. The person who made the dummy also had to make the first editions before the revisers handled the job. If some more time had been spent in the early phases this might have been avoided. If you spend enough time generating ideas and turning them into concepts, heavy costs in the later phases of the product development process can probably be avoided.

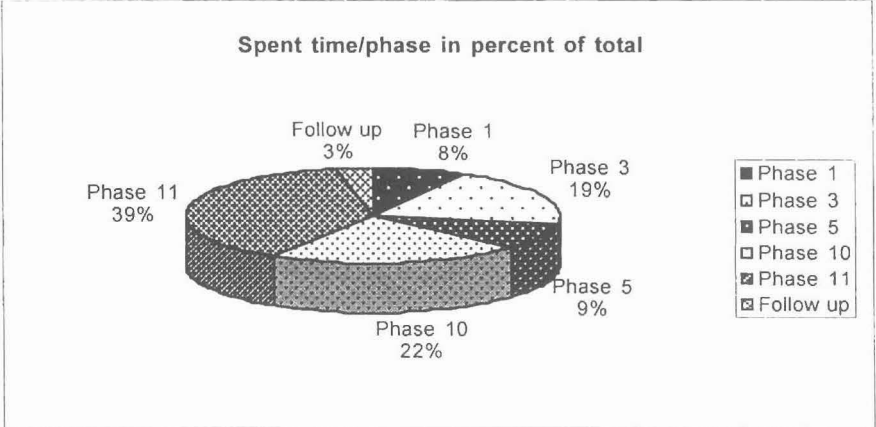


Figure 4. The graph shows spent time/phase in percent of total development time for product A.

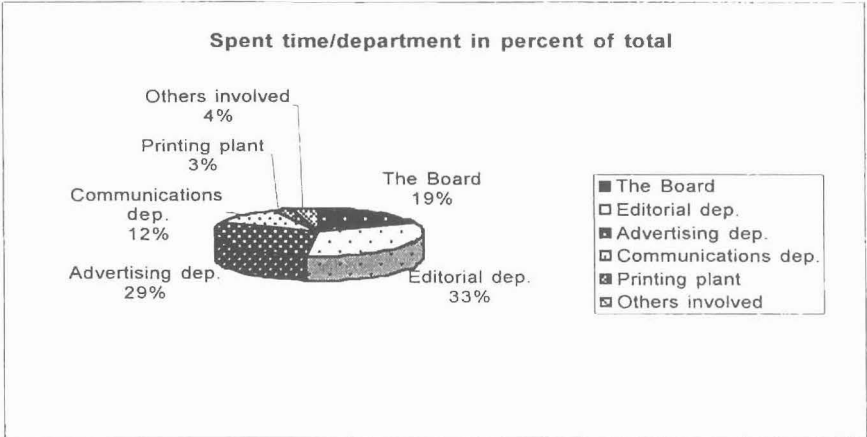


Figure 5. The graph shows spent time/department in percent of total development time for product A.

The fact that the editorial department and the advertising department were spending the same amount of time indicates that both departments took the development process seriously. The board spent much time in the process actually more than the communications department, responsible for surveys and marketing. This might be explained by the high level of competence involved, and by the fact that someone from the board was involved in most parts of the project in some way. There are two other possible reasons why this part is so big. The board was very interested in the development of product A and spend as much time as possible working with the project. Or the board did not trust the employees to do the project all by themselves and were therefore checking everything they did.

Development process of product B

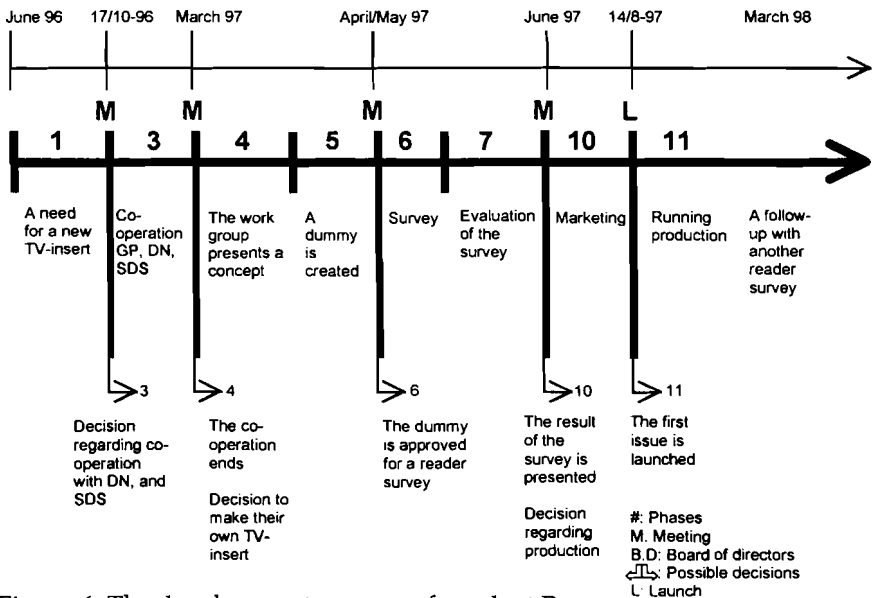


Figure 6. The development process of product B.

Phase 1: Customer need / Reason

The idea of a new TV-supplement came from the editorial department. It was thought that the old one, which was a part of the youth-supplement "Aveny", was the wrong place for a TV-supplement. These thoughts met with response from the other departments of the newspaper, since the readers of a youth-supplement and a TV-supplement differs a lot in age and interests. With these thoughts in mind the board decided to cooperate with two other newspapers, Dagens Nyheter (DN) and

Sydsvenska Dagbladet (SDS) in creating a national TV-guide. The advantages with this co-operation were many. Among others the range would be much greater since the product would cover the entire nation, with greater advertising revenue and lower production costs as a result.

Phase 2: Idea

The idea creation phase was not part of this project either, since the idea was all set according to the co-operation with the other newspapers.

Phase 3: The work group in action

For some reason this line of development was not carried to a conclusion. Therefore the board decided that a concept of their own ought to be developed. A work group was formed with a project leader and a person responsible for the format and layout. The work group received instructions to come up with a dummy in late April 1997.

Phase 4: Different concepts

The work group came up with a concept in the end of March 1997. Since the orders for the work group were to produce a dummy, no meetings were held so they moved into the dummy production phase without further decisions.

Phase 5: Prototype production

The dummy was made by the person responsible for the dummy within this phase and it was finished in late April 1997, as planned. During a meeting the dummy was shown to the board and the board approved it for a survey of the target group.

Phase 6: Survey

The communication department carried out a reader survey. A number of persons were put together in a room with a copy of the product to be evaluated. They all discussed the dummy and everything was recorded on tape to facilitate the compilation.

Phase 7: Evaluation of the survey

The outcome of the survey was evaluated and the result was presented to the board. The result indicated that the readers thought that the dummy was informative and looked good. The board took the decision to "go".

Phase 8: Tool production, full scale test

This phase is completely left out, because there were no specific tools to be made and the production line is carefully tested every night during the production of the main paper.

Phase 9: Pre-production

The pre production phase was left out as well, since you usually do not produce newspapers towards stock.

Phase 10: Marketing

In the marketing phase the salesmen tried to convince the customers to advertise in this new product. Advertisements were placed in the main newspaper, and in public areas in the city to attract attention to the launch of TV-Tider. The vice president tried to sell the supplement to different local newspapers in the western and southern parts of Sweden. The desired success was not there due to intensive competition.

Phase 11: Running production and evaluation

The running production starts on August 14th 1997 with the first edition. No further development was done though there were ideas. The advertising space could be extended, for instance. A follow up was made during March 1998. This might seem like a long time to wait before a follow up, compared to the follow up made on product A. But the usual time to wait before doing a follow up is about eight months, according to the communications department. This is the time needed to establish a new product on the market. The follow up showed that the readers were satisfied with it and they found it informative and serious.

The editorial department answers alone for 49% of the total development time. This was not entirely bad, because it is the editorial department that adds value to the product. The content was created here. But the advertising department spends as much, or as little time as the communications department. We can draw the conclusion that the editorial department and the advertising department were not working on equal conditions in this process. If the advertising department had been allowed to contribute more in the development process, the economic result might perhaps have been better.

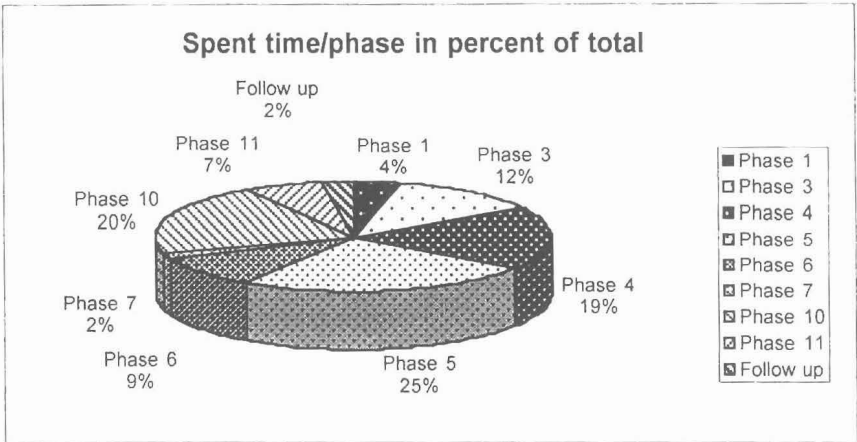


Figure 7. The graph shows spent time/phase in percent of total development time for product B.

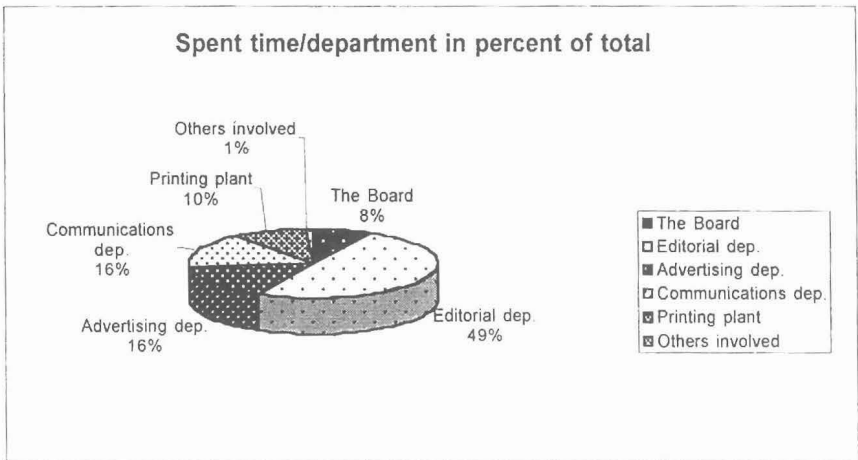


Figure 8. The graph shows spent time/department in percent of total development time for product B.

Since there were so many more phases here compared to product A it is harder to draw conclusions. But we can see that phases 4, 5 and 10 are somewhat bigger than the rest. Phase 4, the concept phase, which was completely left out in the development of product A was the third largest phase. It is remarkable that phase 1, the idea generating phase, was one of the smallest, with only 4% of the spent time.

DISCUSSION

Summary of the results concerning product A

- A very short period of development by skipping several phases in the product development process
- Despite the time pressure the newspaper company has shown a great ability to co-operate throughout the whole organization
- The development process lacked a firm evaluation of the advertising market for this particular product

Summary of the results concerning product B

- Product B is very personnel intensive
- Product B shows a low degree of innovation regarding the long period of development
- In product B, it is possible to automate the production of modules and their placement in the product
- Most phases of the product development process were systematically followed

The product development process

Since there is not yet an established development process present in the Swedish newspaper industry we modified a generic development process, presented by Eppinger and Ulrich, and used it as a reference point to our process description (Eppinger and Ulrich, 1995). At our case company most of the product development process is taken care of in the different departments. It is only the "big scale" projects that cross the borders between the different departments. All small changes and further development of an existing product are handled inside the departments. Today a number of different methods are being used for product development and this is one reason why there have been problems in knowing how much time and money that have been spent on different projects. "We are many capable doers, but it is wrong to redo the same thing instead of doing the right thing from the beginning"

According to Sobek et al. the organizational functions at Toyota pass along their checklists in the very early stage of a vehicle program to update on what is possible, what type of new technologies have been developed since the previous program, and what type of new problems they have been able to solve. Toyota engineers develop structural plans for multiple design ideas and analyze them for manufacturability. The job exploring several solutions on one project can in a later project lead to a more focused search and much more rapid convergence on a later design (Sobek et al., 1999). However, most product development organizations consist of subgroups that correspond to a product's

fundamental architecture. Something Christensen argues facilitates component level innovation. But when architectural technology changes it requires people and groups to communicate and work in new ways (Christensen, 1997).

The general perception at our case company was that they lacked a documentation and following up process due to often unclear project goals in the early project phase. "We lack an overview, co-ordination and an arena for internal knowledge diffusion". The following up process for product A and for product B focused more on the product performance than on the applied work methods. Eppinger and Ulrich argue that an enterprise must define both a product development process and a product development organization when it carries out product development. A well defined development process helps to assure product quality, facilitate co-ordination among team members, plan the development project and continuously improve the process (Eppinger and Ulrich, 1995). Sobek et al. argue that it is worth to spend time to document feasible solutions from design and manufacturing perspectives. Something that leads to gains in efficiency and product integration later in the process and for subsequent development cycles. Furthermore they found that many companies seem to need a design process cook book, a step-by-step method that, if correctly executed, produces a high quality product quickly and efficiently. However, their research conclude that teams seeking to re-engineer development processes are often frustrated because re-arranging the steps does not offer much improvements (Sobek et al 1999).

The level of decision making

The analysis of the work groups of product A and product B shows that there were almost the same people involved in both projects. The level of competence is high within the work groups. There is a considerable number of managers, or persons in managing positions involved. In the early phases of the product development process, the competence level could be higher than in the later phases. According to Eppinger and Ulrich the concept development phase requires tremendous integration across the different functions on the development team (Eppinger and Ulrich, 1995). The short, but intensive development period shows that when everybody in the organization was working towards the same goal and if the goal is pinpointed by the board, the newspaper company had the resources and understanding of a flexible organization.

To produce and implement "new combinations" effectively, Vekstein suggests that a organization must experience a process of cross-fertilization of knowledge. Through open social interaction, involvement and commitment to working across many levels of people and functions the organizational members engage themselves in multiple transfers of knowledge. The level of cross-fertilization therefore develops over time

(Vekstein, 1998). At our case company the product development process depended on informal networks both in the decision making phase and in the execution phase. According to Vekstein and Hoffstede the cross-fertilization of knowledge in a company is crucial for the innovation process but might be particularly sensitive to the intensity of the norms of "individualism", that is, the degree to which people tend to act as individuals rather than as members of a group. Differences in corporate performance may well underlie differences in managerial cultures which are reflected in the organizational processes of innovation and selection (Vekstein, 1999),(Hoffstede, 1980).

Today many decisions at our case company are made by the management board. There are both advantages and disadvantages to this. The main advantage is that the board is aware of everything going on in the company, they are in control. But this might be dangerous, because the board might go to deep into details and lose the main view of the company. The board is also very direct in its wishes and directives, and this might cripple the creativity of the different departments. The persons working close to the products often come up with ideas of how to improve the product. It is very important not to oppress these ideas. At some departments at our case company it was felt that the spontaneous creativity was limited by informal power groups. Ideas got stuck because there was no obvious arena where these ideas could be discussed. These reflections did not specifically refer to product A or product B. However, due to the fact that organizational members felt that there was a large discrepancy between the apologizing organization and in many cases a repressive organizational culture, they were not prepared to discuss freely or undertake risky projects. According to Sobek et al. Toyota often imposes the minimum constraint needed at the time, ensuring flexibility for further exploration or adjustments that impose integration " Make each decision in its time". Since the newspaper format, manufacturing process and distribution channel in many cases are pre-defined before the development process starts, we argue that the newspaper industry until today has developed mainly new content concepts rather than new newspaper forms, formats and distribution channels. High product variety could be achieved if development teams of future newspaper products look beyond present constraints and instead design products that could fit different manufacturing processes and distribution channels.

ACKNOWLEDGEMENTS

To the foundation Stiftelsen Grafisk Forskning for their long-term financial support of our research project.

To Bosse Dahl and Gunnar Springfeldt and all participants involved in the project at Göteborgs-Posten Nya AB.

To our supervisor Nils Enlund and our reference group for showing great commitment in their support.

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