Global Production Management in Newspaper Production and Distribution – Coordination of Products, Processes and Resources

Doctoral thesis by Johan Stenberg
Global Production Management in Newspaper Production and Distribution – Coordination of Products, Processes and Resources
Thesis for the degree of Doctor of Technology to be presented with due permission for public examination and criticism in Kollegiesalen, Vallhallavägen 79, at the Royal Institute of Technology on the 21 March 1997, 10 am.

Opponent: Prof. Robert G. Hacker
Examination committee: Prof. Karl Erik Gustafsson
                        Ass. prof. Sören Östlund
                        Stefan Wik, M.Sc.
Supervisors: Prof. Nils Enlund
             Prof. Simo Karttunen

© Johan Stenberg, March 1997
TRITA-GRT REPORT 1997:1
ISSN 1400-1853
ISRN KTH/GRT/FR-006-SE

KUNG TEKNISKA HÖGSKOLAN, AVDELNINGEN FÖR GRAFISK TEKNIK
The Royal Institute of Technology, Division of Graphic Arts Technology
Drottning Kristinas väg 47, SE-100 44 Stockholm, Sweden
http://www.gt.kth.se/

Printed in Sweden by Högskoletryckeriet, KTH, Stockholm.
Abstract

This thesis covers an introduction to the present conditions for newspaper publishing, definitions and analyses of the processes of newspaper production and distribution, expected future developments with respect to products and production processes, and finally, conclusions regarding the need for global coordination of products, production and distribution.

Primarily, the conditions in the Nordic countries have been analysed. Particular attention has been drawn to Swedish morning newspapers with a circulation exceeding about 50 000 copies per publishing day.

The study has been carried out mainly through literature research, through case studies using the SDA-method, and through acquisition and analyses of production data from the case studies. In addition, interviews and questionnaires have been used.

A modern newspaper printing plant requires heavy investments. The number of newspaper printing plants is decreasing, but the number of newspaper titles printed in each plant increases. The flexibility in and utilisation of the remaining plants increases as well as the complexity and variety of the products handled.

In all case studies of newspaper production, the companies use fixed production and distribution plans, following the same timetable from day to day. Delayed press starts, deviations from the calculated production speed, and interruptions during the production immediately cause disturbances in the distribution, delay costs, and goodwill losses.

The time needed to produce a fixed number of copies varies within a wide range. Days of more complex production in the production plants meet with problems more often. The average net production speed is progressively reduced at higher page counts. Inserting operations result in an accelerated reduction. The difference is mainly caused by product related differences in cruising speed and by the occurrence of unplanned stops. The coordination of products, production and distribution is essential already today, and will be even more important in the future.

More flexible production and distribution plans would imply controlled and predictable risks. In addition, it will render increased utilisation of the resources available. A product model can be used in order to identify an associated production process model as a set of separate activities. Detailed modelling of the different activities demands detailed tracking and systematic use of the production history. A detailed activity modelling will make it possible to predict the capability of a certain activity in terms of production speed and reliability. This will facilitate coordination on a global level.

Keywords: newspaper, production, distribution, management, printing, mailroom, inserting, runnability, tracking, product model.
Preface

How is a newspaper best created and produced? These questions have been asked several times – probably ever since the first newspapers were published during the last years of the 16th century. The concept of newspaper publishing has proven its strength over the years. Despite new technologies providing faster and less expensive distribution of information, in earlier times radio and television – today digital media, the newspaper product still holds a strong position.

The newspaper publishing industry has always been early in adapting new technology. Today, the development of basic technology makes it possible to develop new applied technologies that support newspaper creation and production. The new technology also means harder competition due to, e.g., opportunities for new business concepts based on digital technology and interactive services. From my point of view, newspaper publishing is fascinating with its continuous evolution, high pace and the mixture of creativity and high technology.

More than five years ago I was asked to join a research project in the field of newspaper production management. At that time, my knowledge of newspaper publishing, production and distribution was limited. I knew that journalists wrote articles, photographers took pictures, printers printed and carriers delivered. But I did not really understand how it happened. Five years later I know quite a few more details, but I am even more confused and impressed every morning when I pick up the newspaper – they have made it again!

It has been five years of very hard work and a lot of fun. This study has been carried out with strong support from a large number of persons. I am sincerely happy with the hospitality and openness that has met me not only within the academic world, but also at newspapers, printing plants, distribution companies and from most vendors. The contributions in terms of knowledge, time, enthusiasm, and sometimes financial support from these persons and companies have made this work possible. Thank you all!!!

The support from my wife Cecilia has been enormous throughout the study. Despite our three lovely but small children – Malin, Olle and Anton – a full-time job, and sometimes hard economic conditions you have always encouraged me and through extensive personal efforts made this work possible. Thank you Cecilia – this thesis is dedicated to you!

Stockholm, March 1997

Johan Stenberg
# CONTENT

1. INTRODUCTION .............................................11  
   1.1 Background .........................................11  
   1.2 Problem ...........................................14  
   1.3 Focus .............................................15  

2. METHODS ..................................................17  
   2.1 Introduction ........................................17  
   2.2 Literature research .................................17  
   2.3 Case studies – process definitions ....................18  
   2.4 The SDA method ....................................19  
   2.5 Survey methods ....................................20  
      2.5.1 Introduction ...................................20  
      2.5.2 A-graph interviews .............................20  
      2.5.3 Distribution questionnaire ......................21  
      2.5.4 Scenario interviews ............................21  
   2.5.5 Product, process and distribution questionnaire ....21  
   2.6 Case studies – acquisition and analysis of data ..........21  
   2.7 Analyses and model construction ......................22  
   2.8 Sources of errors ..................................23  

3. NEWSPAPER PUBLISHING, PRODUCTS AND MARKETS –  
   A GENERAL DESCRIPTION .................................25  
   3.1 Introduction ........................................25  
   3.2 A brief historic survey ..............................25  
   3.3 Newspaper definitions ..............................27  
      3.3.1 The newspaper in general ......................27  
      3.3.2 The newspaper products .......................28  
   3.4 The business aspects of newspaper publishing ..........31  
   3.5 The newspaper publishing market ....................31  
      3.5.1 A model of the market situation .................31  
      3.5.2 The buyers ...................................34  
      3.5.3 The suppliers ................................35  
   3.6 Newspaper economy .................................37  
      3.6.1 Introduction ...................................37  
      3.6.2 Income .......................................37  
      3.6.3 Expenses ....................................39  

vii
8. COORDINATION OF PRODUCTS, PROCESSES
AND RESOURCES ............................................. 151

8.1 Introduction ............................................. 151
8.1.1 Objectives ........................................... 151
8.1.2 Focus ............................................... 151

8.2 The current state and the predicted direction of product and process development ............................................. 152
8.2.1 The newspaper publishing industry .................... 152
8.2.2 Production and distribution of newspapers ........... 153
8.2.3 A process view of newspaper production and distribution ......................................................... 155
8.2.4 Development trends ................................... 156
8.2.5 The future newspaper product and production processes ......................................................... 157
8.2.6 Local and global production management ............. 158

8.3 Coordination between product, production and distribution planning ............................................. 160
8.3.1 A shift of paradigm .................................... 160
8.3.2 Considerations regarding production and distribution ......................................................... 160
8.3.3 The coordinating function ............................. 161

8.4 Models supporting PMS and GPMS ........................ 163
8.4.1 Introduction ........................................... 163
8.4.2 A structured product description ...................... 163
8.4.3 Modelling of the production and distribution processes and resources ............................................. 165
8.4.4 The linking mechanism between products, processes and resources ............................................. 165
8.4.5 The maintenance of product, process and resource models ......................................................... 168

9. SUMMARY AND CONCLUSIONS .......................... 169
9.1 Global production management in newspaper production and distribution ............................................. 169
9.2 Limitations ............................................... 174
9.3 Generalisation ........................................... 175
9.4 Future work .............................................. 176

REFERENCES ................................................. 179
1. Introduction

1.1 Background

Attractive products, efficient utilisation of resources and good customer service are necessities in the modern society. Newspaper publishing is no exception, but an obstructing condition is that newspaper publishing consists of two almost disparate activities – journalistic creative and investigative reporting and market oriented sales of advertisements and circulation.

The process of newspaper publishing is an indirect process of mass communication. The communication process can be described in a communication model, where the newspaper constitutes a channel for a message from a sender to a receiver. The sender transmits a message to the receiver through some kind of channel. The channel characterises the container of the message. A significant characteristic of the newspaper product is that it transmits messages from different senders in parallel – journalists and advertisers – to the receiver – the reader of the newspaper [Hadenius et al. 1993].

Traditionally, the daily newspaper has two categories of customers – readers and advertisers. The presence of readers makes the newspaper attractive as an advertisement channel. The advertisers use the newspaper to reach specific target groups.

The design and production of a newspaper is a special case of concurrent engineering [Andersson et al. 1992], characterised by an extremely short cycle time [Alasuvanto et al. 1994] – often twenty-four hours or less. The product itself – the newspaper – is a result of a mixture between creative work on one hand and high-technology based prepress production, printing and postpress production on the other hand. The deadlines of the creative work, the timetables of the production, and the structure of the product itself are dependent on the available production resources [Alasuvanto et al. 1994]. In the Nordic countries the mass production of morning newspapers is followed by an efficient and strictly planned home delivery operation [ENPA 1996], [Stenberg 1994a].

Late deadlines and flexibility regarding the product structure are essential, but production disturbances and delays may cause great harm both in terms of economy and goodwill [Stenberg 1994a]. The resulting product must in the long term both contribute to publishing objectives and be profitable.
The existence of most morning newspapers is dependent on a strong relationship to readers as well as to advertisers. The circulation sales are usually an important source of income. However, a major part of the total income originates from advertisers and the level of the advertisement income is set by the circulation of the newspaper, the household coverage and the quality of the editorial content [Gustafsson 1996], [Hadenius et al. 1993]. The relationship between the disparate activities journalism and advertisement sales is symbiotic.

Due to the nature of the product, tools that shorten the lead time for production and distribution have always been of great use [Marshall 1983]. The development and use of computer hardware and software as well as network technologies during the last decade has lead to new system solutions, new opportunities and new competitors [Jonason 1989a] – [Jonason 1991].

The prepress production has due to open systems [Rahkonen 1996], de facto standards and increased capacity become almost totally digital [Nordqvist 1994b]. The digital prepress production and the development of standardised network protocols and reasonably priced high speed communication facilitates distributed printing – the physical placement of the printing plant can be more flexible [Litzinger 1990], [Andell 1992].

The technology in the printing plants has also undergone a radical change due to the developments in information technology. Some examples are new automation technologies and improved control systems in printing presses and mailrooms [Alexander 1994], [Fuchs 1995b], [Monni 1988], [Petersen 1985].

Altogether, the new tools mean new conditions for newspaper publishing. The technology can be used to make the production less resource consuming and more flexible and to support improved quality of the products.

But the new technology can also be used to create competitive products. Mass communication does no longer depend on heavy investments and large distribution costs. The necessary technology has become easier to handle and more affordable. In the last few years, many publishing houses have been influenced by new competitors such as free advertisement financed newspapers and Internet based services [Jonsson 1996]. The competitors can win time and money from the potential readers. Many competitors can also compete as an advertising channel.

This is not the first time newspaper publishers have been threatened by other media based on new technology. Inventions such as radio, television and colour television have all been pointed out as serious threats to the printed newspaper [Witt 1953].
Today, many newspapers have set up programs to develop the product, the production process and the service level toward the customers. The main objectives of these efforts are to stay competitive, profitable and to keep, or even strengthen, the market position. It is no longer obvious that the customer is a traditional advertiser or the reader of the printed newspaper. The customer can also be a reader of an Internet-based edition or another newspaper buying editorial material. The customer might also be a company buying other services such as printing, inserting and distribution.

The present infrastructure – in terms of networks, databases and computers – can be an important factor in order to create a better controlled and more flexible production environment. The openness of the systems can be used to bridge the former system islands and to enable inter system communication and use of global production management systems (GPMS). The main objectives of the GPMS are to increase the flexibility and productivity. The systems can be used for tracking, scheduling and controlling on a global level. The GPMS collects and refines information from the subsystems and serves the overall organisation with information regarding schedules, status information, decision support and reports [Nordqvist et al. 1993b], [Nordqvist et al. 1995], [Nordqvist 1996].

The objective of this thesis is to describe the environment in which a modern newspaper publisher acts today, discuss probable future changes, define the newspaper production and distribution process from a global point of view and finally to analyse how products, processes and resources can be coordinated in an optimal way.

The occurrence of academic research in this field – newspaper production – is not very extensive. But a number of related work must be mentioned. In 1969, the thesis “A simulation model for the analysis of selected newspaper production operations” explored the possibility of developing a digital computer simulation methodology [Hacker 1969]. In 1978, Engwall performed a number of case studies focusing on newspaper production operations and newspaper organisations. The study was presented in the thesis “Newspapers as organizations” [Engwall 1978].

This study is part of a research project at the Royal Institute of Technology. The research group consists of people specialised in production engineering or computer science. The general purpose of the project is to form a theoretical base for creating a control and management system operating in a heterogeneous computer based environment. The conditions for product design and production is characterised by concurrent engineering. The research project also studies processes involving complex and time critical activities.
The concepts will focus on newspaper production and the suggested models applied in a prototype of a global production management system. A number of prototype systems, papers and theses will be the result of the research. This thesis is the second doctoral thesis in the project. The first thesis, focused on decision support and simulation, “A model for Global Production Management Systems in Newspaper Production” was presented by my friend and colleague Stig Nordqvist in December 1996 [Nordqvist 1996].

1.2 Problem

This study is mainly focused on the production engineering aspects of global production management systems in newspaper production. A number of questions have been penetrated. The thesis primarily addresses the following topics:

1) Under which conditions does the newspaper publisher act today and which predictions can be made concerning the next five to ten years?
2) Which technology related functions are included in the production and in the distribution?
3) What kind of information and material is required to perform the different activities in the production and distribution chain?
4) Which parameters set the limits regarding flexibility in product design and time tables?
5) How does the structure of the product influence productivity and reliability in the printing plants?
6) How can the market and technological development influence the product and the production process during the next five to ten years?
7) How can we design, implement and maintain models supporting coordination of products, processes and resources on a global level?

Question number one has been included primarily to investigate the surroundings of the newspaper publishing industry and to discuss how the surroundings can influence the need for management and control of the production. Factors to consider are the present market situation, the present and future customers and suppliers, and the organisation in the newspaper publishing companies.

The second question will lead to definitions of a number of technology related functions. The definitions will form a basic map supporting process definitions. The mapping must concentrate on functions that influence the structure of the product as well as the production and distribution process.
Question number three covers descriptions of routines in the production process. What kind of material, information and resources are necessary to perform a certain task? When does the information and material become available? Where does the material and information originate and which channels are used for their distribution?

Within the scope of question number four, the present time tables and production plans from case studies are analysed in order to identify control parameters and bottlenecks. The objective is to form a base for the scheduling process, and furthermore, to identify the potential for improvements regarding the flexibility of the schedules. The mapping and analysis will include a brief survey of the expenses related to production and distribution. The study will cover the entire process chain – from the circulation, advertising and editorial departments to the printing plant and distribution.

In relation to the fifth question we will discuss reliability in printing and postpress production. The interaction between product structure and productivity will be studied in order to identify how different products influence production speed, the occurrence of disturbances, and waste figures. A vital question when discussing flexibility in time critical production plans, is with what probability the output from the printing plant can be predicted when the structure of the product is known.

The sixth question includes a number of separate questions. Both the market situation and the technological conditions in the media market are undergoing rapid changes right now. It is therefore of great importance to perform a survey and to analyse how predicted future developments can be taken into consideration.

The final question, number seven, will lead to conclusions regarding coordination of products, processes and resources based on the former parts of the study. A central issue in the modelling process is the granularity – what kind of information is necessary and how detailed does it have to be? Other central aspects are input and maintenance of data, intersystem messaging, and the linking mechanism between models of products, processes and resources.

1.3 Focus

This study is focused on the production of morning newspapers in the Nordic countries, primarily in Sweden. The situation in the Nordic countries is somewhat different from the situation in many other countries.
There are a number of significant factors to consider:

- A large share of the circulation is subscribed.
- The home delivery operation is performed by professional carriers and the publishers often guarantee the customers delivery before 6 am.
- The number of printed newspapers per capita is among the highest in the world.
- The page count and advertisement volume in the products are relatively high – approximately 45% of the column space is covered by advertisements.
- The page count is flexible and changes from day-to-day. The page count is partly determined by the sold advertising volume.
- An average of approximately 60% of the revenue originates from advertisements.
- There is wide use of colour in advertisement and editorial contents.
- The pages in each section are glued or stitched together.
- The newspaper is managing the selling and most of the production of advertisements.
- The newspaper is managing the circulation department and sometimes also the distribution operation.

Recent studies show that approximately 70-90% of the circulation in the Nordic countries is subscribed [FIEJ 1996]. The readership of the daily newspapers is well known and the profile of the readers as well as the household coverage in different geographical areas is continuously measured. The reader habits are also measured continuously and are well known [ENPA 1996]. Through national research of the reader habits combined with statistics from the newspaper publishers, the advertisers know when, how and to whom their commercial message is sent. To a certain extent, they also know under what circumstances the information is consumed by the receiver. This makes the newspaper attractive as a marketing tool.

The history of the Nordic countries, our climate and culture, and early adaptation of new technology and new business opportunities are some explanations of the strong position of the Nordic newspapers [Gustafsson 1996].
2. Methods

2.1 Introduction

The study was carried out between 1991 and 1996. During this period a set of methods and tools have been used in order to achieve a proper scientific approach to the subject. The general approach has been to choose methods and tools that facilitate answering the questions raised in the first chapter of the thesis.

The study covers a wide range and the research has to consider subjects ranging from applied computer science development via assumptions on the future market of publishing to statistical analyses of production and distribution data. This implies the use of multiple methods and tools. The methods used can be divided into a number of categories:

- Literature research.
- Case studies.
- Survey methods.
- System analyses, model construction and simulation.

The methods have been used in parallel, but the main point has varied during the project work. Initially, most of the time was spent on literature research, the middle period of the project was focused on case studies and the later part of the work has mainly been focused on statistical analyses and model construction. A number of interviews and questionnaires have been carried out, especially during the second half of the study.

Papers and reports have been written and presented during the project. Results from the study have been reported at five scientific conferences. In addition, a number of reports have been published in Swedish and in the autumn of 1994 a licentiate thesis was written at the departments of Graphic Arts Technology, KTH. The following sections of the thesis contain a more detailed description of the methods used.

2.2 Literature research

Initially, most time was spent on literature research and on coverage of conferences and trade shows related to the subject. This work provided an introduction to the field.
The literature survey covered many topics such as previous research related to newspaper publishing including production and distribution. The survey also covered theories regarding manufacturing systems as well as methods and technologies used in the manufacturing industry. Another aim of the literature research was to obtain understanding of the general technological development that might influence the conditions for developing systems and tools used in newspaper publishing. Especially the areas of computer science and network technologies have been carefully observed.

A number of trade press magazines in the areas of newspaper publishing, newspaper techniques, media technology, information technology, manufacturing engineering and graphic arts technology have been studied on a regular basis during the project.

Useful methods in academic research, for the case studies and the statistical analyses are other topics covered by the literature research.

### 2.3 Case studies – process definitions

The initial studies mainly covered the flows of information and material in the printing plants – three different newspaper printing plants where covered in detail during 1993 [Stenberg 1994b]. This work was coordinated with my colleague Stig Nordqvist, who was performing similar investigations in the corresponding prepress departments [Nordqvist 1994b].

In 1994, process analyses covering the circulation and distribution operations were performed in cooperation with two daily morning papers, their printing plants and their jointly owned distribution company. The last case study, in order to achieve a consistent description of the processes, was carried out in the autumn of 1995 and resulted in a detailed study of the processes involved in edition planning and impositioning.

Different stages of the production and distribution operations have been covered by process analyses in eight companies. The selection of these case companies was based on a number of guidelines:

- An organisation large enough to have potential use for a global management system.
- Companies with an interest for and skills in production management and with ongoing activities in the field.
- Companies willing to allocate staff resources to support this study.
The initial approach was that most newspaper publishers would gain by using a global production management system. This idea has not changed during the project work. But through contacts with newspapers of varying size it was clear that the strongest support came from companies with a circulation exceeding 50,000 copies per day. This means organisations with approximately 200 employees or more, the distribution organisation excluded.

A systematic analytical approach to newspaper creation, production and distribution implies analyses of complex and heterogeneous processes. The processes involves creative work, production of digital originals in a computerised environment, followed by mass production of copies in the semi-automated printing plants and finally distribution to the readers via trucks, retailers and carriers. The objective of the case studies is to approach these processes from a global perspective.

The objectives of the mapping of the newspaper production are:

- A correct and consistent description of flows of material and information seen from a global perspective.
- Identification of similarities and differences in the companies studied.
- Support of the creation of a generalised process model of newspaper production.
- Identification of problems and requirements with regard to production management on a local and global level.

The resulting models were also aimed at supporting the design of TidSim, a simulator for the newspaper production process [Fällström et al. 1994], [Nordqvist et al. 1994a], [Nordqvist 1994b].

## 2.4 The SDA method

The processes were mapped and analysed through the use of the SDA method [Lundeberg 1978], [Boström et al. 1986], [Boström 1988]. Flows of material and information in newspaper production and distribution were observed. The SDA method origins in the ISAC project – Information Systems work and Analysis of Changes. The method allows the structured description of activities and flows of material and information in an organisation. The method satisfies the demands for a uniform tool able to map the production, in this case that of newspaper publishing. The method has been chosen on the basis of literature studies and contacts with systems experts at the University of Stockholm. The SDA method has been developed at the Royal Institute of Technology and at the University of Stockholm, Sweden.
SDA uses a graphical description technique called activity-graphs (A-graphs). The A-graphs are combined with verbal descriptions, text pages, and attribute tables presenting relevant data (frequencies, amounts or sizes) about elements in the A-graphs. The method defines a collection of symbols and rules of design and interpretation. Physical connections between activities are described in A-graphs by physical flows, communication is described by information flows [Boström, 1986].

The method is also supported by a software tool, GraphDoc. The tool has been used in the study and it simplifies the mapping of the activities. The tool supports the method fully and keeps the graphs consistent. The software was developed in 1983-1985 for DOS PC’s. A more detailed description of the method is found in [Stenberg 1994b].

**2.5 Survey methods**

**2.5.1 Introduction**

Interviews and questionnaires have been important tools used in various stages of the study. The input to the A-graphs was partly based on interviews. An investigation concerning information management and the effects of late delivery on the carriers was based on questionnaires sent to carrier foremen. The part of the study discussing expectations on future development is partly based on deep interviews and on a questionnaire.

The survey is a widely used descriptive research technique. It is often defined as a method of collecting standardised information by interviewing a representative sample of a population. In other words, the survey represents a probe into a given state of affairs that exists at a given time. Therefore, direct contact must be made with individuals whose characteristics, behaviours, or attitude are relevant to the investigation [Christensen 1994].

**2.5.2 A-graph interviews**

The activity graphs are based on observations and interviews. In these interviews persons in the administration, in the production process or involved in the planning and management of the everyday production were asked to describe the possibilities, restrictions, routines and problems surrounding their work. During the interviews, sketches and notes were made. The material from the interviews was then translated into A-graphs and verbal text documents in GraphDoc. The results were discussed, modified, and finally approved in cooperation with the interviewed persons.
2.5.3 Distribution questionnaire

In 1994, a questionnaire was sent to all foremen, approximately 100 people, in a distribution company responsible for the carrying operation in the Stockholm area. The aim was to investigate the need for improved communication tools. The questionnaire consisted of two kinds of questions – nineteen questions with four different answering alternatives and with the possibilities to comment, and six questions that each foreman answered in his or her own words.

2.5.4 Scenario interviews

A number of deep interviews concerning future developments in the media market were performed in the summer of 1995. Totally five executives and people responsible for the development of media products were interviewed. Each interview consisted of a relatively free conversation but was guided by a set of standardised questions. Notes from each interview were compiled and later examined, commented and approved by the interviewed persons.

2.5.5 Product, process and distribution questionnaire

In the spring of 1996, a questionnaire was sent to 100 executive managers and technical directors in the Swedish newspaper publishing industry. The questionnaire focused on future developments of products, processes and distribution methods in newspaper publishing. An answering profile had to be filled in as well as twenty-two questions, each of them with four different answering alternatives and with the possibilities to comment.

2.6 Case studies – acquisition and analysis of data

Empirical data from case studies have been used for two purposes:

- Initially, in order to identify the correlation between the output from the production process and the delays in the distribution process.
- Later, to identify the correlation between the structure of the products and the behaviour of the production process.

The first empirical case study concerned the interaction between the printing and distribution processes. The objective was to find out how delays, differences in production speed and disturbances in the production plants influenced the distribution operation. Production data and distribution reports covering a period of 8 months were compiled and analysed.

The second use of empirical data has been in the work of modelling the interaction between the structure of the newspaper product and the output from the
production process. Detailed characteristics of products have been compared with production data. In this context, statistical methods have been used. A number of software tools, such as Statview® and Microsoft® Excel have been used in the statistical analyses. The data analyses have mainly been guided by methods described in [Blom 1989], [Löfgren et al. 1995] and [Triola 1994]. The characteristics of the products have been defined through studies of product specifications. Production reports from the corresponding productions have been collected. A number of parameters have been matched through use of the statistical software packages.

Productivity is normally measured as efficiency of work – the relationship between input (in terms of man hours, machine hours, material) and output (in terms of the number of produced units, the produced quantity, the added-value) [Andersson et al. 1992]. In order to identify the process runnability, mainly one productivity related key figure has been used – the average net production speed, measured in good copies per hour (cph). The average net production speed is defined as the number of ordered copies divided by the production time from the first to the last good copy printed. This key figure have been used due to the time critical operations and the very special need for well-defined and reliable output from the printing plants.

2.7 Analyses and model construction

The results from the literature studies, process definition studies, interviews and questionnaires, and empirical case studies have formed a basis for the analyses and syntheses. The focus of the analyses and of the syntheses has been on identifying the most vital control parameters today and in the nearest five to ten years and then on creating models able to manage these control parameters on a global level.

An early result of the analyses and the model construction was the contribution from this study to the TidSim prototype [Fällström et al. 1994], [Nordqvist et al. 1994a]. This study has mainly contributed with models of the printing, mailroom and distribution processes.

TidSim is a prototype of a newspaper production simulator using hypothetical data or data from newspaper companies. TidSim has made it possible to validate functionality and user interfaces and to run simulations in order to evaluate how disturbances, variations in resources and different time tables affect the output of the process and the related expenses. The system has also operated as a data generation tool in the work on a global production management system prototype [Fällström et al. 1997], [Hedin et al. 1997].
This prototype system is partly based on the IFRA recommendation for mechanisms for exchanging tracking information between different systems – IFRA-track [Thoyer 1995].

2.8 Sources of errors

This study covers a large area but does not analyse all areas in detail. Parts of the study, especially the part concerning expectations on future development, should be seen as brief surveys aimed to give an idea of likely directions of development.

The study is primarily based on the situation in the Nordic countries. This means that the results are based on conditions valid in a limited number of countries in the north of Europe. The results must be treated carefully when applied to newspaper companies working under different conditions.

The analysis of the correlation between product structures and the productivity of the production process may include some errors. The study is mainly based on manually produced reports, sometimes lacking parts of the necessary information. Some obvious errors were identified during the research and probable assumptions were made. Another risk impossible to identify when using manual reports is that all errors and stops in the production are not reported. These errors will probably not influence the general results of the study.

When it comes to the mapping of the distribution operations, just one distribution company has been studied. The market situation and general conditions for newspaper distribution in Sweden are regulated and most distribution companies and distribution operations are organised in the same way.
3. Newspaper publishing, products and markets – a general description

3.1 Introduction

This chapter of the thesis discusses mainly the conditions under which the newspaper publishing industry in general operates in the Nordic countries. Special attention is drawn to the Swedish history and present conditions of newspaper publishing. Initially the chapter contains a generalised view of the historic publishing evolution. The chapter also discusses different definitions of newspapers and newspaper products. The latter part of the chapter discusses the organisation of modern newspaper companies and the operation of the different departments.

3.2 A brief historic survey

The newspaper publishing industry has developed in parallel to the industrial evolution. The first newspapers were published already in the end of the 16th century – approximately 150 years after Gutenberg developed lead alloys making type casting possible. The first known regularly published newspaper was started in Prague in 1597. The first Swedish newspaper was *Ordinari Post Tidender* – originally published in 1645. The paper is still published – today as *Post- och Inrikes Tidningar* – and is thereby one of the oldest regularly published publications [Dalin 1986].

Improved technology for printing during the 18th century implied an increasing number of newspaper titles, but the circulation of the published titles was rather limited. The printing and publishing industry started to grow, and the technical conditions for the newspaper publishing of the 18th century were a consequence of the breakthrough of the book-printing [Hadenius et al. 1993].

The book-printing required printing presses and printers, and many of these printers started newspaper publishing in order to expand their businesses. These bookprinters were responsible for the major part of the newspapers initially published. But the publishing intentions of the printers were probably not particularly apparent.

One of the most successful publishers from this period – Benjamin Franklin – writes in his memoirs that the success of his newspaper *Pennsylvania Gazette* partly depended on better type and better printing. Franklin also writes that
another reason for the success of the *Pennsylvania Gazette* was that the leading men in the society found the paper in the hands of one who could also handle a pen. Mr. Franklin’s newspaper business became in a few years extremely profitable [Labaree et al. 1964]. Many newspapers were started but most of them were not very successful due to high prices, lack of publishing intentions and a restricted market – most people were not able to read.

In Sweden, another initial obstacle was the government’s scepticism of uncontrolled publishing for the public. During the second half of the 18th century and in the beginning of the 19th century conditions for the free press were created and, in 1810, inscribed in the Swedish constitution [Hadenius et al. 1993].

The industrialisation in the 19th century involved important technological and market development for the publishing industry. New and rational production methods led to reduced production costs and, in parallel, the growth of the cities and the compulsory school attendance meant new conditions for newspaper reading and advertising. The growing urban middle class was able to read and needed information – a newspaper publishing market was created.

Pure publishing companies were started. An important year in the Swedish newspaper publishing history is 1830 when Lars Johan Hierta founded *Aftonbladet*. The product he created was influenced by French and English newspapers and is considered to be the first modern Swedish newspaper. After being published just two years, the circulation of *Aftonbladet* exceeded 2,500 copies per day – a Swedish record at that time [Fredriksson et al. 1980].

Another successful and still published Swedish newspaper of the 19th century is *Dagens Nyheter*. The paper was founded in 1864 by Rudolf Wall. The intention of Rudolf Wall was to create an inexpensive and accessible newspaper for a wide audience. *Dagens Nyheter* was the first newspaper published in the morning and home-distributed to the readers – the distribution became a method of competition. Other methods used in order to compete were the use of a clear language and a well designed layout. The introduction of *Dagens Nyheter* was a great success and the circulation was the largest in Sweden after just six months – reaching 6,000 copies per day [Hadenius et al. 1993].

The Swedish newspaper industry, as in many other countries, started to grow during the second half of the 19th century. From a total nationwide circulation of 100,000 copies per publishing day in 1850, the industry grew more or less constantly for 120 years. In 1900, the circulation reached 500,000 copies per publishing day and fifty years later, in 1950, the total circulation was 3 million copies per day.
The industry continued to grow during the 1950’s and 1960’s and reached 4.3 million copies per publishing day in the early 1970’s [Engwall 1978], [Tidningsutgivarna 1996b]. During the past twenty-five years the circulation figures have been quite constant. In 1995, the total circulation in Sweden reached 4.1 million copies per publishing day (newspapers published at least 4 days per week) [Tidningsutgivarna 1996b]. From 1990 to 1995 the circulation has declined – see figure 3–1. The reduction is mainly caused by declining figures related to a limited number of evening tabloids.

### 3.3 Newspaper definitions

#### 3.3.1 The newspaper in general

There is no generally accepted definition of a newspaper. The most common one, used in most countries, defines it as a general paper published at least four days a week. It seems that the national overviews, like most of the international statistics, are based on such a definition [ENPA 1996].
The UN organisation UNESCO has made a number of definitions [UNESCO 1989], often used in international comparisons:

**Definition:** A “daily general-interest newspaper” is defined as a publication devoted primarily to recording news of current affairs, politics, etc., which is published at least four times a week.

Newspapers published less than four times a week and other periodicals are also defined by UNESCO:

**Definition:** A “non-daily general-interest newspaper” is defined as a publication devoted primarily to recording news of current events in public affairs, international affairs, politics, etc., which is published three times or less a week.

**Definition:** “Other periodicals” are publications of a periodical nature other than general-interest newspapers.

The international publishers association, FIEJ (Fédération Internationale des Éditeurs de Journaux), often uses the following categories of newspapers [FIEJ 1996]:

- **Dailies (D):** published at least four times a week.
- **Weeklies (W):** published 1–3 days a week.
- **Sundays (S):** newspapers published only on Sundays.
- **Free papers.**

This project mainly focuses on “Dailies” in which the requirements on reliable production are the highest. A statement by Gustafsson is applicable to this study:

“…even though we are focusing on general newspapers there are, of course, a wide range of papers, going from the more traditional quality press to sensational popular tabloids, and from party political press to sports newspapers…” [ENPA 1996].

Further classifications can be made. There are two categories of newspapers in Sweden operating under very different conditions – the daily morning papers and the daily tabloids, often evening papers.

### 3.3.2 The newspaper products

A broad definition of the term *newspaper* has already been made, but in order to obtain a more detailed view of its structure and components, further definitions are necessary.
The logical and physical structures of modern newspapers have been discussed and object-based product descriptions have been proposed in, e.g. [Thoyer 1995].

In the object structure of IFRAtrack [Thoyer 1995], a proposed standard for the exchange of process status information in newspaper production, the following definition of newspaper-related products has been made:

Definition: “Product: a product is a collection of printed pages. It can be a newspaper, a section of a newspaper, a supplement that has been preprinted or an insert that has been printed externally”.

The use of this definition implies that the products may be printed in parallel or at different times and locations. If the production is finished in the printing plant, the different products are put together either in the printing press or in the mailroom. The production might also be finished during the distribution operation. This is the case if supplements or inserts are manually added to the main section during the distribution operation.

A supplement is, according to the definition, a product previously printed in the same plant as the final newspaper. The definition does not tell us anything about the character of the product or the production methods used in the finishing operation. Under normal conditions, this definition may not cause any problems – a supplement is usually a product with the same character as the newspaper, including editorial and/or advertisement content, preprinted on newsprint in the printing plant.

But deviations may occur, e.g. an editorial supplement printed in one location and later distributed and automatically inserted in several plants. Another example is an editorial supplement preprinted in gravure and later inserted into the newspaper. These two cases are seen as inserts, not supplements, according to the IFRAtrack object model (see chapter 7).

A common distinction between inserts and supplements can be found in the character of the products. An insert is usually a pure commercial product using the brand and distribution organisation of the newspaper in order to reach a specific target group. The physical format, design and paper quality of the insert may show considerable differences from the newspaper. The inserts are usually delivered to the production plant and later automatically fed into the newspaper in the mailroom.

In the IFRAtrack object model a number of product related definitions have been made in order to achieve a common nomenclature. The object hierarchy starts with issue.
Definition: “Issue: The name of the newspaper on a certain date”.
A more accurate terminology would be “An instance of the newspaper published on a certain date”. In practice, the term corresponds to the publication of a certain product on a certain day, for instance The Daily Newspaper 23rd of July 1996.

The issue may consist of several editions
Definition: “Edition: A new edition of an issue is created when there is a planned change of the content of at least one page in the newspaper. A newspaper issue is usually made up of different local editions”.

The different editions may be printed in the same or in different locations. A common example of the term edition is a morning paper containing different local pages in different distribution areas.

An edition can be distributed in several edition versions. A new edition version is in the IFRAtrack model created in two different cases:
Definition: “Case 1: When different customers get the same edition but different inserts”.

For example, an advertiser decides to distribute an insert in all newspapers distributed in a certain geographical area. As a comment to the above definition, logically, case 1 should cover supplements as well.
Definition: “Case 2: When there is an unplanned change of the content of at least one page of the edition”.

This situation may occur if a last minute event occurs and should be reported in the newspaper. Under normal conditions a certain distribution area, for instance “City South”, will get identical copies of the product but in special cases multiple versions of the edition are published. For instance if certain pages (plates) are changed during an ongoing printing job [Thoyer 1995].

The definitions used in the IFRAtrack object model need to be commented. The distinctions between the terms newspapers, sections, supplements and inserts are not based on the character of the product. The definitions are related to the production methods used. For production tracking purposes this is logical, but the use of the terms may cause confusion in other contexts than in production management systems (PMS).

In the product definition, the terms newspapers, sections, preprinted supplements and externally printed inserts are used. But a supplement or insert may also be printed on-line and folded into the main (editorial) product. From a tracking
point of view, the supplements or inserts are parts of a product printed in a production run, even though the reader cannot see any difference from a preprinted supplement or insert.

3.4 The business aspects of newspaper publishing

The newspaper publishing industry may to some extent differ from industries in general. Usually, profit is the basic objective for running a company. In many publishing companies there are dualistic objectives – in addition to the profit objective there are publishing objectives.

The Swedish government decided in 1971 to introduce a selective support to newspaper publishers in order to further a multi valued debate in the society and strengthen the democracy. Also newspapers in Finland and Norway are, under some conditions, supported by their governments. The Swedish government has stated that the citizens must be able to choose between newspapers with different political perspective. Furthermore, the newspapers must be free from governmental interference, and the conditions for establishment and competition must not be regulated [Finansdepartementet 1993].

In parallel to the differences in business concept, the ownership of newspapers differs from other businesses. In Sweden, there are three kinds of owners: private owners, organisations and foundations. In 1990, 55% of the Swedish newspapers were privately owned, 27% were owned by organisations and 18% were owned by foundations [Hadenius et al. 1993].

Despite the somewhat different business concept, many newspaper publishing companies are very profitable. Especially the major newspaper in each city is often successful. From an international perspective, a great number of profitable media companies have newspaper publishing as one important and profitable part of their businesses.

3.5 The newspaper publishing market

3.5.1 A model of the market situation

The objective of the following description is not to give a detailed picture of the market situation. The section should rather be seen as an orientation, giving an idea of the market conditions under which a modern newspaper is operating.

In order to give a brief description of the market situation, based on the Swedish conditions, Porter’s model of the forces surrounding the market have been
used. Porter has defined five competing forces – rivalry among existing firms, the threat of new entrants, the threat of substitute products or services, the bargaining power of suppliers and the bargaining power of the buyers [Porter 1985]. Following are some reflections:

- Industry competition – rivalry among existing firms
  Most daily newspapers are operating on a local or regional market and international competition is unusual. The products very often have a strong connection to a well defined and limited geographical area and newspapers are often considered as important advertising channels needed to the daily local commerce. In Sweden, the most obvious competition is between the large evening papers, between national newspapers and local newspapers, and between local newspapers operating on the same market. In many cities there are only one or two local morning papers.

- Potential entrants – the threat of new entrants
  Most newspapers, at least in Sweden, have a long tradition and the number of subscribed titles started after world war two is limited. From that point of view, the structure of the industry has been relatively constant. Since the 1930’s, the number of titles has shown decreasing tendencies but the total circulation has increased [Engwall 1978]. Due to the development of relatively inexpensive equipment for prepress production and telecommunication, the newspaper publishing industry has become more accessible. The long-term consequences of this change are still not known, but initially one can note that the number of free newspapers directed towards specific target groups has increased. The free paper *Metro*, distributed on the subway in Stockholm, reached in 1996 a remarkable circulation of approximately 237 000 copies every weekday. The circulation was measured approximately one and a half year after the introduction of *Metro* [Metro 1996].

- Substitutes – the threat of substitute products or services
  New distribution channels in terms of high speed data communication and customer receiver devices will pave the way for new products. Today, both newspapers and other media actors are offering Internet services. In the future, broadband communication will enable new and enhanced services for the readers and advertisers. Many different kinds of companies are making great efforts to create new services and establish a market niche within the field of digital publishing. In general, the present situation is somewhat unstructured – newspapers,
radio and TV stations, telecommunication operators, cable-TV operators, and software companies are examples of participants involved in creating digital services able to compete with the printed newspaper.

A majority of the substitutes within the advertising market are still found among commercial TV and radio and among other printed products such as magazines, direct mail and advertising leaflets.

![Figure 3–2: The Porter model of the five competitive forces that determine industry profitability.](image)

- Buyers – the bargaining power of buyers
  The advertisers can reach their target groups through a number of channels. Newspapers are one. Other channels are TV- and radio-commercials, printed advertisements in magazines, direct mail or billboards, and the most recent channel – digital advertising. Tele marketing is yet another channel for the distribution of commercial messages. In order for the newspaper to stay competitive, methods like zoned advertisements, differentiated prices, increased colour flexibility and later ad-booking can be used.
The other customer category, the readers, might be able to choose from a variety of information sources. Their economy, habits and ability to choose from different media sources must be considered.

- Suppliers – the bargaining power of suppliers
  The suppliers can also influence the market situation. In newspaper publishing, costs for newsprint, distribution and production technology hold a relatively large share of the total cost of the product. This means that the outcome of negotiations with newsprint suppliers, distribution companies and transportation unions, and system suppliers influence the costs and reliability in production and distribution.

### 3.5.2 The buyers

The newspaper industry mainly deals with two different kinds of customers – the buyer of the product, i.e. the reader, and the buyer of space in the product, i.e. the advertiser.

The reader, in terms of a subscriber or a buyer of a single copy, usually has expectations regarding the content and the quality of the product. The newspaper title or logo often becomes a brand-name of its own. The editorial content of the product must attract different kinds of readers.

To stay competitive in the long run, new readers have to be tempted to read the paper at the same time as loyal readers must feel comfortable with the product. The quality aspects can include the editorial content and layout as well as technological aspects and a reliable delivery of the product at a specific, often well-defined, time. Especially in the Nordic countries, a reliable delivery is essential due to the home delivery and the high percentage of subscribed copies.

The second category of customers, the advertisers, is a very broad target group containing everything from multinational companies via local shops to private persons. In Sweden, the largest share of the advertising income originates from local grocery stores. A major part of the income of Swedish morning papers originates from advertisements and the advertising volume is extremely important for profitability [Tidningsutgivarna 1996b].

The advertising department of a newspaper is a service function and must be able to support the different needs of the advertising customers. This means service functions for administrating national campaigns as well as for classified private advertising.
The expectations of the advertisers vary – both coverage and precision might be important parameters, but in general the objective is to reach a specific target group at a specific time. There are theories concerning marketing through different medias, but this study does not include those aspects of the advertising. However, some expectations related to this study are worth mentioning – the customer service and the quality aspects. The customer service might include the ability to offer demographic data concerning the subscribers in different areas and detailed information about reader habits. The quality aspects include an attractive editorial product as well as technological aspects and a reliable delivery of the product. The advertiser might be anxious to reach the reader at a specific date or even at a specific time.

Delayed or cancelled delivery might cause great financial harm and loss of goodwill. If the delivery is late or if the product does not fulfil any of the other expectations, the product might loose its market value. If a delay occurs, the subscribers and advertisers are often compensated by the newspaper company. Subscribers might get an additional subscription day and advertisers might be compensated through discounts or free advertisements. Furthermore, delivery disturbances that influence the subscribers often cause a considerably increased internal administration [Stenberg 1994a].

To summarise the relationship between the publishing companies and their customers, it is possible to state that delays in the delivery operation might cause a major increase in terms of costs of the product. In parallel to this, the income from advertisements will decrease.

On-time delivery is essential. In addition to this fact, a number of other considerations must be taken. The product must be fresh – the readers expects latest news in the morning paper. This might be achieved through a well defined and secure process of publishing, production and distribution. In this issue the editorial department and production management have contradictive objectives. Thus it would be optimal that the latest news (editorial need) and the safe production deadlines (production consideration) could be guided by rules which are based on careful publishing, goodwill, marketing and cost considerations.

### 3.5.3 The suppliers

The newspaper industry deals with a number of suppliers. A rough classification of the most important suppliers has the following structure:

- Information suppliers.
- External service functions.
• Suppliers of systems and equipment.
• Suppliers of raw material and consumables.

The information suppliers are for instance news-, photo-, and ad agencies or other newspapers. Additionally, for instance TV and World Wide Web (WWW) are used as sources. The material delivered by the information supplier might consist of background information, editorial content or advertising material. Often the material delivered by external information suppliers may be used without extensive resource consumption within the newspaper’s own organisation.

External suppliers of service functions may be external companies responsible for printing or distribution. During the 1980’s, the printing plants often became separate companies. This situation lead to a new kind of relationship – the publishing house became the customer and the printing plant the supplier.

The relationship between the publishing house and the distribution companies has undergone the reverse change in Sweden. Today, there are five large distribution companies. Two of them are operating in the metropolitan areas of Stockholm (Pressens Morgontjänst KB) and Gothenburg (GP Distribution AB. The other three large distribution companies (Tidningstjänst AB, PS Distribution AB and Tidningsbärarna KB) are operating on a regional or national basis [Svensk Dagspress 1993]. During recent years, a number of newspaper companies have started their own distribution and the number of organisations responsible for the morning paper distribution has increased.

Service suppliers may also take care of operations normally carried out “in-house”. One example is qualified image processing that can be distributed to local repro houses.

Vendors of systems and equipment are important suppliers to the newspaper publishers. Especially smaller companies do not have resources to maintain, repair and develop equipment and systems used in the everyday production. Due to the importance of a reliable production system, vendors and/or external technical service experts are often contracted for managing the different systems.

The mass production process following the editorial work is very material intensive. This means that the main material supplier, the newsprint manufacturer, is important. Large regional newspapers in Sweden consume about 10–25 tons of paper per day. In order to avoid large capital costs due to the paper stock, the stock levels are kept at a minimum. The paper is often delivered every weekday or at least one or two times a week.
The administrative communication between the printing plant and newsprint supplier is intense. The routines regarding inks are often similar. In general, the consumption, and thereby the annual costs of plates, chemicals and film material are on a lower level which means longer inventory cycle times and less frequent deliveries from these suppliers.

3.6 Newspaper economy

3.6.1 Introduction

The objective of this part of the chapter is to give a brief summary of the income and expenses related to newspaper publishing. The description is based on the situation in the Nordic countries.

The main focus of the Nordic newspaper companies is newspaper publishing. As a rule, a major part of the income originates from the publishing business and the financial result is determined by the success of the newspaper publishing [Gustafsson 1996].

3.6.2 Income

The main sources of income are advertising and copy sales. In this context sales equals income from subscription and single copy sales. In 1993, the total revenue originating from advertising and copy sales in the Nordic newspapers reached 5.1 billion USD.

Figure 3–3 shows the advertising and sales revenues from each Nordic country. The numbers have been compiled from the FIEJ publication “World Press Trends – 1996 Edition”. In order to achieve comparable figures, statistics from 1993 have been used. Furthermore, the reported sums have been translated into USD.

The graphs in figure 3–3 on the next page represent average figures for all morning broadsheet and evening tabloid newspapers (D+W+S) in the studied countries. However, the ratio between sales and ad income differs between morning newspapers and evening tabloids.

For the morning papers in Sweden, the relation between sales and ad income in 1994 was approximately 39% sales and 61% ads [Tidningsutgivarna 1996b]. The relation between copy sales and advertising income in Swedish morning papers has also been studied in the REKT project [Sigfridsson 1993]. The REKT
project involved eight regional newspapers of varying size. Sigfridsson shows that the share of income from advertising in 1991, varied between 61% (Sundsvalls-Tidning) and 73% (Säffle-Tidningen).

In the evening papers, the situation is quite the opposite, 76% sales and 24% ads [Tidningsutgivarna 1996b]. The situation in other countries has not been studied in detail.

![Figure: 3–3: Annual sales and ad income of newspapers in the Nordic countries studied. The figures represent the situation in 1993 [FIEJ 1996].](image)

The population in the four largest Nordic countries varies between 4 million (Norway) and more than 8 million (Sweden) inhabitants. To achieve comparable key figures, the total annual income from sales and ads has been divided by the population in each country. The result, the annual income per capita, is shown in figure 3–4. Norway has the largest income per capita, 300 USD. The key figures for the other countries vary between approximately 185 and 240 USD per capita.

The share of income from copy sales and advertising in Sweden, is approximately 85–90%. Among the remaining 10-15% of sources of income in Sweden, approximately 2–3% originate from press subsidies [Svensk Dagspress 1993], [Tidningsutgivarna 1995], [Tidningsutgivarna 1996b]. Additional income-generating activities can be newspaper printing on commission, commercial printing and real property [Sigfridsson 1993].
Also the Finnish and Norwegian press receive press subsidies from the national governments. The support from the governments is controversial in both Sweden and Finland. In Sweden a number of investigations have been performed during recent years [Finansdepartementet 1993]. The overall income situation in the other countries has not been studied in detail.

![Graph showing total income/head in 1993 (USD) for Denmark, Finland, Norway, and Sweden.](image)

### 3.6.3 Expenses

In 1993 the Swedish newspaper publishers’ association compiled statistics regarding the expenses among their members. The summary did not separate the costs of the different activities involved, except for newsprint and distribution, but it gives a general view of the proportions between the different expenses. The summary, based on statistics from 1991, shows that salaries held the largest share, approximately 50%, distribution 16%, paper 12%, depreciation 3% and others 19% – see figure 3–5 on the following page [Svensk Dagspress 1993].

Sigfridsson [Sigfridsson 1993] mainly focuses on eight Swedish local and regional morning newspapers. A conclusion in the study is that in general the costs can be divided into four different categories of approximately the same size: editorial, marketing/administration, production and distribution. In the model presented each category represented 1/4 of the total costs – see figure 3–6 on the next page. Some differences between the individual companies were observed, but the conclusion was that the newspaper companies covered by the study showed a similar cost structure. In Sigfridsson’s study the total cost per distributed copy varied from 5.89 SEK to 9.35 SEK (1991).
Current and comparable key figures can be calculated through the use of official statistics. In order to identify the cost per printed and distributed copy regarding the largest Swedish daily newspapers, data from the Swedish publishers’ association have been studied [Tidningsutgivarna 1996a], [Tidningsutgivarna 1996b].

![Diagram](https://via.placeholder.com/150)

**Figure 3–5:** Compiled statistics regarding the expenses among Swedish newspapers in 1991. Source: [Svensk Dagspress 1993].

The main interest of the study was focused on daily morning papers with a circulation exceeding 50 000 copies per publishing day. The report “Ekonomi dagspress ‘95” includes compiled information on the economic result in all Swedish daily and weekly newspapers.

![Diagram](https://via.placeholder.com/150)

**Figure 3–6:** A general model of the cost distribution in the Swedish morning newspapers studied in the REKT-project in 1991 [Sigfridsson 1993].

By dividing the annual costs for each company by the number of distributed copies per year, a key figure describing the unit cost per printed and distributed
copy is obtained. To obtain comparable circulation figures, the weekday circulation has been used. In general, the Sunday circulation is 5–15% above the circulation on weekdays [Tidningsutgivarna 1996b].

The number of publishing days varies slightly between the studied companies. Newspapers published 7 days/week are assumed to have 355 publishing days per year and newspapers published 6 days/week are assumed to have 302 publishing days per year.

<table>
<thead>
<tr>
<th>Title</th>
<th>Circulation 1995</th>
<th>Depreciation a (%)</th>
<th>Total costs b Publishing days/year</th>
<th>Cost/copy (SEK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dagens Nyheter</td>
<td>374 200</td>
<td>28 1.6%</td>
<td>1801 355</td>
<td>13.56</td>
</tr>
<tr>
<td>Göteborgs-Posten</td>
<td>269 700</td>
<td>66 5.2%</td>
<td>1263 355</td>
<td>13.19</td>
</tr>
<tr>
<td>Svenska Dagbladet</td>
<td>194 900</td>
<td>18 1.9%</td>
<td>924 355</td>
<td>13.35</td>
</tr>
<tr>
<td>Sydsvenska Dagbladet</td>
<td>124 400</td>
<td>2 0.4%</td>
<td>540 355</td>
<td>12.23</td>
</tr>
<tr>
<td>Dagens Industri</td>
<td>95 200</td>
<td>3 0.9%</td>
<td>323 302</td>
<td>11.23</td>
</tr>
<tr>
<td>Nerikes Allehanda</td>
<td>69 100</td>
<td>22 7.2%</td>
<td>307 302</td>
<td>14.71</td>
</tr>
<tr>
<td>Nya Wermlands-Tidningen</td>
<td>66 450</td>
<td>33 16.7%</td>
<td>198 302</td>
<td>9.87</td>
</tr>
<tr>
<td>Östgöta Correspondenten</td>
<td>65 700</td>
<td>13 5.2%</td>
<td>249 302</td>
<td>12.55</td>
</tr>
<tr>
<td>Upsala Nya Tidning</td>
<td>63 500</td>
<td>12 4.4%</td>
<td>275 302</td>
<td>14.34</td>
</tr>
<tr>
<td>Norrköpings Tidningar 7</td>
<td>63 300</td>
<td>12 4.6%</td>
<td>259 302</td>
<td>13.55</td>
</tr>
<tr>
<td>Borås Tidning</td>
<td>54 100</td>
<td>6 3.9%</td>
<td>153 355</td>
<td>7.97</td>
</tr>
<tr>
<td>Helsingborgs Dagblad</td>
<td>50 100</td>
<td>8 4.4%</td>
<td>180 355</td>
<td>10.12</td>
</tr>
<tr>
<td>Barometern</td>
<td>49 300</td>
<td>6 3.9%</td>
<td>154 302</td>
<td>10.34</td>
</tr>
<tr>
<td>Vestmanlands Läns Tidning</td>
<td>48 100</td>
<td>9 4.2%</td>
<td>214 302</td>
<td>14.73</td>
</tr>
</tbody>
</table>

1 Including Västerviks-Tidningen 13200 copies.
2 Million SEK/year. Financial expenses not included.

Table 3–1: Costs per copy in Swedish newspapers with a circulation exceeding 45 000 copies per publishing day [Tidningsutgivarna 1996a], [Tidningsutgivarna 1996b]

As 85-90% of the income originates from newspaper publishing, an assumption has been made that most expenses originate from activities related to newspaper publishing. Sources of errors might be that the total annual costs include expenses related to:

- Printing on commission or commercial printing.
- Electronic and/or book publishing.
- Isolated costs related to, e.g., reorganisation.
- Other non-newspaper related businesses.

The key figures might not perfectly match reality, but should give an idea of the unit costs in Swedish morning newspaper publishing.
The result shows that the unit cost varies from approximately SEK 8 to SEK 15. The mean value is SEK 12.26 and the standard deviation 2.06 – most companies are found in the range SEK 11 to 14.

The use of advanced equipment and systems in the prepress, press and postpress areas means heavy investments, causing costs during a long period of time. The publication cited earlier [Svensk Dagspress 1993] shows that the average depreciation was 3% of the total costs. If the share of depreciation in 1995 is calculated for the observed companies, the mean value is 4.6% and the median value is 4.3%. In some of the cases, the printing operation is performed by one or several separate companies and the costs cannot be traced in the available data. For this kind of companies, the share of depreciation is 0.2–2.0%. Among the rest of the companies the share of depreciation is 4–5% of the total costs in a majority of the cases. This implies that the share of depreciation in larger regional and national newspapers is considerable.

According to [Svedheim 1994], 47 out of 67 Swedish newspaper printing presses were older than ten years in 1994. Among the 47 old presses, a majority were older than twenty years and needed to be replaced or extensively modernised in the near future. The large share of relatively old production plants may be one of the reasons for the small fraction of depreciation in the statistics from 1991.

Figure 3–7: The distribution of expenses in Östgöta Correspondenten in 1995.

In the annual report of the newspaper Östgöta Correspondenten from 1995 [Östgöta Correspondenten 1995], the expenses are presented on a relatively detailed level. Figure 3–7 shows that the company is quite representative with a unit cost and depreciation close to the mean values in the group.

Compared to the national average figures from 1991, the distribution of costs is quite similar. If the figures are compared to Sigfridsson’s study, the most distinct difference is found in the distribution costs. In Sigfridsson’s model, 25% of the
costs were related to distribution. In the national study and at Östgöta Correspondenten the share is 14–16%. A fact to consider is that the national average from 1991 includes evening tabloids with a less expensive distribution operation. Furthermore the household coverage of Östgöta Correspondenten is very high and as the distribution costs are strongly influenced by the household coverage this may be one of the reasons for the deviations.

The share of distribution costs is approximately 20% or more in most cases. This assumption is supported by the SEK 2.50 in average distribution costs at Pressens Morgontjänst in 1994 [Stenberg 1994a].

3.7 The structure of the Nordic newspaper publishing industry

3.7.1 The circulation in an international perspective

In an international perspective, the Nordic countries have among the highest figures of newspaper publication in the world in relation to the population. The ratio of circulation to population is a good indicator of penetration for the newspaper industry of a country [FIEJ 1996].

Figure 3–8: The ratio of circulation (Dailies) to population per 1000 inhabitants in the 20 most newspaper reading countries in the world. Source: [FIEJ 1996].
Norway, Japan, Finland and Sweden – have a newspaper penetration which is five to ten times higher than that of the western countries with the lowest penetration. European countries with a low penetration are, for instance, Greece (83 copies/1000 inhabitants) and Portugal (61 copies/per 1000 inhabitants).

Regarding the Nordic countries, one observation is that the number of newspaper copies sold per 1000 inhabitants shows substantial differences between the individual countries. Denmark has a lower newspaper consumption than its Nordic neighbours. However, Denmark has many more free sheets than any of its neighbours. About half of the total free sheet circulation is accounted for by free sheets owned by newspapers [ENPA 1996].

The average circulation of a daily newspaper in a majority of the studied countries varies from 20 000 to 200 000 copies per day. Only the statistics related to Japan show great deviations from these figures (average circulation approximately 584 000 copies). This indicates that the circulation (50 000 to 300 000) of the companies analysed in the case studies of this report is quite representative seen in an international perspective. Despite the relatively sparse population of the Nordic countries, the circulation of the medium sized and large newspaper companies seems to be rather average in an international comparison.

Figure 3–9: The average circulation (circulation per publishing day/the number of newspaper titles) of daily (D) newspapers in a number of different countries [FIEJ 1996]. Only Japan is missing from the list of the twenty most active newspaper consuming countries in the world.
The total circulation of the daily Nordic newspapers exceeds 10.6 million copies per publication day – corresponding to 73% of the total newspaper circulation (D+W+S) in the Nordic countries [FIEJ 1996].

The share of home delivered daily newspapers in the Nordic countries is approximately 79%. The remaining 21% represent mainly evening tabloids sold as single copies [Gustafsson 1996]. The large share of home delivery is often mentioned as one of the factors giving newspapers a strong position in the Nordic countries. Also outside the Nordic countries, for instance in Italy and France, there is a growing interest in home delivery [ENPA 1996].

3.7.2 The number of newspaper titles and newspaper printing plants in the Nordic countries

The total number of Nordic newspapers published at least once a week exceeds 600. If the UN definition is used – publication at least four times a week – the number of Nordic newspapers was 276 in 1995 [FIEJ 1996]. Fifty-three of these newspapers were distributed seven days a week and another 165 titles were published six days per week.

![Diagram of newspaper titles in Nordic countries](image)

*Figure 3–10: The total number of newspaper titles in Denmark, Sweden, Norway and Finland during the period 1979 to 1995 [NATS 1979] – [NATS 1995]*

Every year the newspaper publishers’ associations in the Nordic countries compiles technical information concerning the equipment used in the production and information concerning the circulation and the titles printed in the different printing plants. The technical equipment covered includes prepress equipment as well as equipment in the printing plants. The results are published yearly in the book “Nordiska Tidningsregistret” [NATS 1995].
Data from “Nordiska Tidningsregistret” for the past twenty-five years have been used in order to identify the number of titles printed in each plant over the period. An analysis shows that in the early 1970’s most printing plants just printed one newspaper title. The exception was printing plants producing both morning and evening newspapers. In these cases, the printed newspapers and the printing plant usually belonged to the same group of companies [NATS 1970]. At the end of the 1970’s the situation had changed. At that time, the number of titles printed in each plant varied from 1.4 to 1.7 in the Nordic countries [NATS 1979].

In 1993, more than 2 titles were printed per plant in Sweden and Finland. In Sweden there were 70 plants printing 169 titles which means 2.4 titles per plant. In Finland, 51 plants printed approximately 140 newspaper titles which means more than 2.7 titles per plant [NATS 1990], [NATS 1993].

There is some uncertainty regarding the Finnish figures. In the register until 1992, the Finnish data do not include all Finnish newspapers. Until 1992, there were two Finnish publishers’ associations – one for small newspapers (circulation less than approximately 5000 copies per distribution day) and one association for the rest of the newspapers.

The Finnish figures in this study do not include the small newspapers that were added in 1993. In Denmark, 1.8 titles are printed in each plant and in Norway 1.7 titles – see figure 3–12 [NATS 1979] – [NATS 1995].

There is some uncertainty in using data from the Nordic publishers’ associations. The information in “Nordiska Tidningsregistret” only covers member companies and printing plants owned by the members. There are some Nordic publishers and printing plants external to the listed members, but a vast majority of all newspapers and newspaper printing plants can be found in the statistics.
The number of newspaper printing plants used in the future will probably further decrease. The topic has not been studied in detail in this study, but many known facts makes this assumption probable. In a survey performed in Sweden in 1994 [Svedheim 1994], one of the conclusions was that 40% of the newspaper printing presses needed to be replaced in the near future. Most new plants are technically advanced and highly automated. This implies large capital costs and demands efficient utilisation of the production resources.

Many of the modern production plants in Sweden are highly utilised. The plants print not only daily newspapers, but also other kinds of periodicals and commercial products.

### 3.7.3 Distributed printing

Another tendency is the occurrence of distributed printing. The circulation is printed in multiple plants owned by the publisher and/or a separate company. Distributed printing implies:

- Reduced distribution costs.
- Later deadlines.
- Reduced dependency on train and air transportation.
- Distributed risks.

One example of distributed printing is the Finnish publishing company *Helsingin Sanomat* (HS). HS has three separate production plants: one in Helsinki, one in Forssa 120 km northwest of Helsinki and one in Varkaus 300 km northeast of Helsinki.
Helsinki. Also in Sweden, the use of distributed printing is increasing. The largest daily morning newspaper in Sweden, *Dagens Nyheter*, is printed in four different locations: one in the south of Sweden, two in the middle of the country and a further one in the north of Sweden. Another large Swedish national newspaper, *Svenska Dagbladet*, is printed in three different locations [NATS 1995].

### 3.8 A generalised newspaper organisation

#### 3.8.1 The overall organisation

The process of creating, producing and distributing a profitable and unique quality product on an everyday basis must be supported by an organisation covering many different areas. Due to the mixture of publishing and commercial objectives, many companies are operating under a leadership of two different persons – the editor-in-chief and the managing director.

![Organisational model](image)

*Figure 3–13: An organisational model presented by Andersson in 1992. The operations of the former prepress department have been distributed to the editorial and advertisement departments [Andersson 1992].*

The editor-in-chief is responsible for the publishing objectives and the editorial content of the product. The managing director is responsible for the commercial part of the business. The objectives of the business are dualistic. Examples of similar management, also with dualistic objectives, can be found in theatres and hospitals. Figure 3–13 is a generalised model of a newspaper organisation presented by Andersson in 1992 [Andersson 1992]. The model was presented as a future model and the production department in the prepress area has been integrated to the editorial and advertising department.
Extensive use of computers in the prepress area has been predicted during more than 25 years [Tewlow 1968], [Tewlow et al. 1970]. Many studies during this period have suggested new organisational models for digital prepress environments. The big difference between the present and past models of organisation is the disappearance of the prepress department, responsible for typesetting and reproduction. This kind of technical department was a necessity until recently. The traditional organisation in the editorial departments, advertising departments and the prepress departments are shown in figure 3–14.

The prepress department turned out the production following the creative and administrative operations in the editorial and advertisement departments. The prepress department managed the job process from the manuscripts of the journalists and editors or the sketches and texts from the advertising department to the print-ready plate in the printing plant.

The main reason for the earlier organisational model was that the operation of the technology used demanded special skills. Furthermore, the domains of responsibility in the different job processes were often strictly controlled through labour contracts.

Today, the technology and regulations surrounding the job processes have changed. A single person can perform both writing, editing and page make-up. In some cases the layout editors are even responsible for the transmission of digital pages to the printing plants. In the same manner, the situation in the advertising departments has changed. Digital ads or even complete paginated digital pages can be produced within the advertisement department. Still, the different operations needed might be performed by staff connected to different unions.
The prepress production of the ads can also be performed outside the newspaper, for instance by the advertiser or by an ad agency. The digital ads are then distributed to one or several newspapers through telecommunication networks or on a digital storage media.

A consequence of the changes is that the existence of physical material flows within the publishing houses have become rare. The physical flows of material have been replaced by digital workflows supported by databases and networks within the publishing house and between the publishing house and the printing plant.

The reason for the late breakthrough of these integrated organisation models was probably the need for large computer capacity and standardisation. Other important factors conserving old organisational models have been related to the often hard struggle between the management and the unions organising the workers. Many books have been written on the subject. Examples of different approaches to the matter can, for instance, be found in [Marshall 1983] and [Ring 1981].

3.8.2 The departments and their operations

In the mid-eighties, Enlund presented the SISU model [Enlund 1986]. At that time, the conditions for digital prepress production made it possible to start moving tasks from the prepress department into the editorial and advertising departments. The SISU model is still of interest and is shown in figure 3–15.
Organisations lacking production departments in the prepress area have been defined as “integrated newspaper organisations” [Tuukkanen et al. 1995]. The word *integrated* refers to the merging of creative work and production in the editorial and advertising departments.

Tuukkanen has presented a model of an integrated *prepress* organisation. The model consists of two separate units operating within the prepress production: The editorial department and the marketing department. The editorial department is, in addition to having the responsibility for the editorial content, also responsible for the prepress production in terms of text, image and graphics processing, page make-up and has the overall production responsibility for the pages. The marketing department is responsible for marketing, advertisement sales, and – in terms of prepress production – ad production and page make-up of the ad content. The marketing department also has the overall production responsibility for the advertisements.

The nomenclature may vary from one company to another. The “Marketing department” in Tuukkanen’s model may also be divided in two, three or even four separate departments. In case of two departments, they are probably named “Advertising” and “Circulation”, but “Circulation” may also be subdivided into “Subscription” and “Distribution”. It is also possible to define “Marketing” as a department responsible for public relations and marketing.

A number of case studies performed by Nordqvist concluded that the prepress production in Swedish newspapers was mainly carried out by two organisational units – the marketing and editorial departments. Nordqvist uses a broad definition of the marketing department:

Definition: “Marketing department: The marketing department is a jointly used name for the advertising department, the public relations department, and the circulation departments”

The study also presents three models of the prepress workflow: one model of the input to and output from the marketing and editorial departments, one model of the workflow within the editorial department and finally one model of the workflow within the marketing department [Nordqvist 1994b].
3.8.3 Summary

To summarise the present organisational situation in newspapers, a number of generalised conclusions can be made regarding the necessary departments:

- An editorial department responsible for the publishing operations as well as for the planning and production of editorial page elements in terms of stories, images and graphs. The editorial function may also be responsible for the production of complete digital pages containing editorial and advertisement content.

- An advertising department responsible for ad marketing, sales activities, ad production and administration of advertisement issues. In addition, an edition design function is often responsible for the planning of the product structure, including supplements, inserts, and the dummy creation.

- A subscription or circulation department responsible for marketing, sales activities and administration of circulation related issues directed toward the retailers and readers.

- A production function responsible for the activities related to the mass production of the newspaper, starting with a complete digital original and finishing with wrapped copies or bundles ready for distribution.

- A distribution function responsible for the organisation and planning of the daily mass distribution of newspapers from the printing plants to the retailers or subscribers.

- A number of supporting functions are also necessary, for instance, management, accounting, personnel, and technical support.

The creative activities within the editorial department, the marketing, administrative and creative issues within the advertising department and the general administrative tasks have not been observed in depth, even though efforts have been made to analyse the general development of the newspaper production. In order to give a complete picture, a brief summary of the work in the editorial and advertising departments will be given later in the thesis. The parts related to prepress are mainly based on literature research.
4. Essential, technology-related functions in newspaper publishing

In chapter 4, a number of technology related functions in newspaper publishing are defined. The objective of chapter 4 is to define functions and technology on a local level in order to create a foundation for process descriptions and analyses. The process descriptions and analyses are found in chapter 5. In chapter 7 the functions and processes described in chapters 4–5 are positioned in a global, i.e., company-wide perspective.

4.1 A retrospective overview

4.1.1 The interaction between technology and newspaper publishing

The newspaper publishing industry and the technology it uses have, ever since the first published newspapers, always been strongly influenced by the general developments in the society and the development of new technology.

Especially when it comes to technology this is obviously true in many other industries as well but the very special need for late deadlines and short lead times for the production and distribution of newspapers, makes lead-time reducing technology very usable in this industry.

The technology has also clearly influenced the organisation of the companies. In the early days of the publishing industry, the technology was relatively easy to use and one single person could manage the whole operation – from writing and typesetting to printing. One example was Benjamin Franklin (1706-1790). In 1729 Franklin acquired the Pennsylvania Gazette and started his successful career as a publisher. From the beginning Franklin was a book printer, but as a publisher he also wrote articles, performed the typesetting, and printed the newspaper [Labaree et al. 1964]. Of course the number of printed copies and the page counts were limited, but still – the history of Benjamin Franklin shows that all necessary operations and the technology used could be handled by one single person.

During the 19th century, a new industrial society started to grow. Many innovations influenced the newspaper products and the organisation of the companies. The equipment used became more advanced and special skills were needed in the different production steps. The organisations adapted to the new products
and production methods. Publishing was no longer a one-man-show. The one man operation was replaced by several departments – editorial, advertisement, circulation and various production departments.

Roughly there are, and have always been, two separate functions necessary to technically produce a newspaper – the original production in the prepress area and a function multiplying the original – the printing [Enlund 1992]. The borderline separating these two activities is still very clear and the tools used need special skills. The prepress and printing operations have, although the products and tools have changed, existed since the 15th century. In modern times, one completely new production step has been added to the process chain – the automated postpress production in the mailroom.

The following sections will give a brief summary of important technological steps in the evolution of newspaper products and production methods. The summary is not intended to be complete, but will hopefully shed some light on the history and thereby provide some explanations to the present situation. The summary will cover the areas of prepress and printing.

Until recent years, there was no doubt that the typesetting, imaging and page make-up operations belonged to a production department in the prepress area. Today, there is no longer any heavy machinery involved in these operations and in many cases there are no longer any production departments in the prepress area. These departments and their operations are nevertheless included in this historic survey in order to explain their past position in the process chain.

The printing processes have always influenced the prepress work and the development of prepress technology. Therefore, this survey will start with a historic overview of the development of printing technologies.

4.1.2 Printing – from winepresses to offset

During the first 350 years of newspaper printing, from the early parts of the 17th century until the 1950’s, the printing methods used were very much the same – the letter press printing – a direct printing method. The letter press technology means that the ink is transferred directly from the printing forme to the paper. The surface of the printing formes are divided into two levels, one printing level and one non-printing level.

The European printing presses, used in the middle of the 15th century, originated from different kinds of wooden presses already in use, e.g., wine presses. The wooden constructions were dominating until the beginning of the 19th century.
In the beginning of the 19th century, the Englishman Charles Stanhope constructed the first cast iron printing press and around 1810 the first cast iron cylinder press was presented by the book printer Friedrich König. In 1811 König patented a steam cylinder press. The physical work was partly replaced by steam power [Ridderstad 1986].

At the end of the 18th century, the paper industry started to manufacture web paper, but use of this paper in the printing industry required cylindrical printing plates. The invention of the papier mâché flong in 1829 allowed the production of many pages from one type forme and the replacement with cast metal plates of the individual type for press-work. As these plates could be curved, this allowed rapid evolution in the design of presses – from the flat-bed cylinder press to the faster rotary presses designed exclusively for newspapers, the first of which was built in 1836 [May et al. 1986].

One of the well-known rotary presses from the 19th century, the Walter press – designed and built by The Times in London, England, illustrates the importance of new technology in the newspaper industry. In 1869, the Walter press replaced the ten-feeder then in use, and with a crew of only seven men and an output which rivalled two ten-feeders (with a crew of 28), it brought massive savings, cut production time and pushed back copy deadlines [Marshall 1983].

The development of rotary letterpress technology continued for more than 125 years, but during the 1950’s rotary offset printing for newspaper production started to grow. The rotary offset newspaper presses, based on the lithographic principles discovered by Senefelder already in 1796, got their breakthrough in USA and the first reported installations in Europe took place in 1962 [May et al. 1986].

The introduction of the lithographic printing process in the newspaper industry meant improved possibilities to use colour images and illustrations in the products. The Nordic countries were pioneers in the use of offset technology in Europe. The introduction of offset technology raised new demands regarding ink and paper. Furthermore, there was a great need for improvements regarding offset plates and blankets. In the beginning of the 1980’s, offset printing had totally replaced the letterpress technology.

4.1.3 Text processing – from Gutenberg to laser technology

Around 1440, Johann Gensfleisch zum Gutenberg, born in the city of Mainz (in the present Germany) and a master craftsman in metalworking, succeeded in his attempts to develop a lead alloy that expanded during its cooling phase (5% tin, 12% antimony, and 83% lead). The expansion of the material led to an exact
duplicate of the matrix cavity and Gutenbergs original formula remains nearly unchanged to this day. Gutenberg’s most notable work, his forty-two line Bible was begun in 1452 and completed by 1455 [Adams et al. 1988].

The newspaper industry used many general technologies developed during the industrialisation in the nineteenth century. The steam power made the presses vastly more productive, the telegraph was relaying information at unimaginable speed, and railways were forming the basis of a distribution system. But the type itself was still laboriously set by hand: composition was the weakest point in an industry for which time is always of the essence [Marshall 1983].

In 1886 the automatic hot-metal typesetting machine was introduced by Ottmar Mergenthaler. His Linotype machine has been called one of the ten greatest inventions in the history of the human race [Adams et al. 1988]. The first machine, “The Blower”, was demonstrated in the composing room of the New York Tribune the 3rd of July 1886. “The Blower” was a linecasting machine. The text was composed through use of matrices and spacebands activated by keyboard control, each line was then automatically justified, the slug was cast and finally each matrix and spaceband was returned to its storage position.

As a consequence of the use of automatic typesetting machines, the productivity was remarkably improved. Many publishers utilised the new technology. The volume of both editorial content and advertisements increased and the changes made the products more attractive. The development of the publishing industry was strong – the circulation increased and the newspapers became more profitable.

More than 100 years after the introduction of the Linotype machine, the same kind of typesetting machines were dominating the scene in most composing rooms all over the world. This must be a proof of the correctness in the analysis of Thomas Edison who spoke of the first Linotype typesetting machine as the “eighth wonder of the world” [Linotype-Hell 1996].

In parallel with the use of hot-metal typesetting, the development of photo-mechanical typesetting technologies started in the late 1940’s. The first photo typesetter, Intertype introduced in 1946, used the idea of the Linotype linecasting system. Instead of using a die to cast molten metal and form a character, each individual character was carried in a small metal frame on a separate film negative. Light was projected through the film and the character exposed on a photographic paper.

The early attempts with photo mechanical composition were not very successful in the newspaper industry, and it took another twenty years to make photo
typesetting usable in newspaper composing. Around 1964, the number of photo typesetters sold to newspapers accelerated due to their increased capacity [Carlsson 1967].

The cathode ray tube (CRT) composition meant a photo typesetting breakthrough. One of the first high capacity machines, Hell DigiSet, was introduced in 1965 [Carlsson 1967]. The CRT technology dominating the photo typesetting during the 1970’s and the first half of the 1980’s. Still, the CRT production speed is hard to match, even with the latest available technology, but the technology is best suited for text columns followed by manual page make-up.

Today, the laser imagesetters are dominating. Laser technology, the universal page description language PostScript, and the development of reasonably priced high-performance computers have made electronic page make-up possible. Complete pages containing text, images and graphics can be produced electronically and the output is supported by raster image processors (RIP) and imagesetters. The result is not necessary exposed on film – computer-to-plate (CTP) and even computer-to-press technology may make the prepress production filmless.

**4.1.4 Images and graphics – from clay to laser technology**

It is known that images were printed in China already in 255 B.C. A ceramic stamp was pressed into a sheet of moist clay. When dry, the imprint served as a means of certifying the authenticity of the document. When paper was invented, around A.D. 105, the transition to the use of sealing with ink was a natural one. [Adams et al. 1988]. During the Middle Ages, print forms carved out of wooden plates or engraved in metal pieces were used.

The history of illustrations in newspapers is largely connected to the history of the photographic process. The first halftone engraving company was set up in England in 1884. In the initial phase, the use of halftone images was not very extensive, but at the turn of the century the first regular use could be observed in the *Daily Despatch* of Manchester. By 1910, virtually every newspaper of substance had a photo engraving department. Gallery camera, wet plate photography, albumen or fish glue resist on zinc plates with acid rocking bath was the technology in use from 1910 until as late as 1970. [May et al. 1986]. The prepress work necessary to produce a zinc plate was extensive and the letterpress technology was limited in its ability to reproduce images and especially colour images of good quality.

The introduction of computerised prepress technology and offset printing during the 1960’s and 1970’s made use of colour images and graphics common. The prepress work got film based and the four-colour offset printing justified the use
of scanners. Already in the end of the 1940’s analogue scanners were in use. One of the first scanners were used by Time-Life. Their analogue scanner could perform four-colour separations and colour corrections [Carlsson 1967].

During the 1960’s, the use of scanners in newspaper production became more common. The new scanner technology was supported by a general development in the field of electronics and computers combined with theories and methods regarding image processing. The result was increased performance and improved image quality.

Image processing is very information intense. The general development of microprocessors, computer memory and storage technology improves the general conditions for image processing. During the 1980’s, digital scanners were introduced. The scanning and output operation could be separated and the images could be digitally stored and manipulated.

Today, a majority of all images are digitally handled. The proprietary systems introduced in the beginning of the 1980’s are still in use, but relatively inexpensive standard hard- and software tend to replace the expensive high-end systems [Södergård et al. 1989]. A vast majority of all newspaper photographers are still using film based cameras, but the use of digital cameras has just started and the development is very rapid.

4.2 The present situation

4.2.1 Introduction

The task of describing the present technology used by modern newspapers in the developed countries is not simple. The situation differs between different companies and countries but an inventory of the latest technology available might help to define the technology used today. The inventory starts with the input to the production process – the circulation management and gradually moves forward in the process. The inventory presented does not claim to be complete.

The objective of this part of the thesis is to define the technology used and its most characteristic functions. The inventory is mainly based on information from a number of leading trade press magazines and reports from organisations like IFRA.
4.2.2 A common infrastructure

One of the driving forces making systems’ integration possible is the use of standardised hardware and software components. It is no longer necessary to use one proprietary system in order to achieve communication between different functions in the process of newspaper publishing.

Until the beginning of the 1990’s, systems developed especially for newspaper production dominated the scene in the publishing houses. Their main drawback was that the island solutions could not be networked to constitute a total solution [Prümmer 1994].

The use of open systems means standardised network hardware and protocols, relational databases supporting queries from external applications or systems, and client-server systems philosophy. The servers are often powerful and based on multi-user operating systems. The client software often runs on standard personal computers.

The system design can be centralised or decentralised. The trend is toward decentralised client-server systems in an open systems environment. A key trend among systems, e.g. for classified advertisements, in recent years has been the increased use of standard databases. In 1994 most systems were built around an SQL relational database [N.N. 1994b], and nothing indicates that this situation will change in the nearest future. The situations regarding editorial systems, image processing systems, and output systems are similar.

The modern infrastructure makes it possible to link the different subsystems and perform intersystem communication – the islands have been bridged.

4.2.3 The circulation and distribution operations

The operations in the circulation department were among the first to be computerised. The large amount of uniform text information made the operation suitable for early computerization. In most cases, the initial computerization phase took place during the 1960’s and 1970’s.

A larger newspaper might have a customer service centre with a staff of 20–30 persons working in parallel with the circulation system. The system must allow the operators to order delivery of paper at an address, bill for it, stop it for vacations, restart and account for the delivered copies [Cole 1994].

The circulation management is today almost completely computerised and often linked to printing and post press production. The older batch-oriented
databases running on centralised systems are often replaced by distributed client-server applications. The circulation systems in larger newspapers normally have the ability to handle address and order information, economy, and sales support.

Furthermore, the circulation database can be used as input to a separate marketing database, integrating data from circulation, advertising and external databases in order to deliver specific advertising messages to small groups based on known data such as demographics or lifestyles [Foss 1993].

In the German VELAS-project – a decision support system for improving the local edition structure of regional newspapers – a Geographical Information Systems (GIS) was linked to the circulation system as a decision-support system [N.N 1994].

Many European newspapers have a large subscription base and a smaller portion of street sales. This means that overall circulation control systems are very important and often used in different aspects of marketing, for controlling the mailroom systems, and for inserting advertising material. Because of this, many European customers place higher priority on purchasing a total system from one single supplier than is common in the U.S. A key aspect of this situation is the frequent requirement that databases be linked [Tribute et al. 1995].

It is often possible to generate control data for production and distribution from the circulation system. The system can generate printing orders regarding the circulation of different editions, address information for single copy addressing and bundle addressing, define bundles, as well as loading lists for the truck drivers and distribution lists for the carriers [Stenberg 1994a].

4.2.4 Prepress

The transition to digital production

Traditionally there has been a clear distinction between the creative work performed by, e.g., journalists, photographers, artists and layout-editors and the more mechanical work carried out in the so called production departments.

Typed manuscripts, photos, sketches and layouts were created by journalists, photographers, illustrators and designers. A technical department took care of the prepress production. The equipment used in the production process was often complicated to handle and special skills were needed.
Figure 4–1: Production flows described by Smith in “Goodbye Gutenberg” [Smith 1980]. The left hand production flow represents the “old” production, the flow in the middle the “new” production. The right hand flow was considered a future flow and became reality in the middle of the 90’s.
Completely digital prepress production was predicted already during the 1960’s. In an article published by Jules Tewlow in 1968, “Time-sharing and the Newspaper of Tomorrow”, the process and technology related to the digital prepress production was discussed. The article even predicted broadband links to satellite printing plants and the use of computer-to-plate technology [Tewlow 1968]. Two years later, Marcus and Tewlow identified five areas where computer terminals were required: editing of news story text, classified advertising, display advertising, page make-up and layout, and news story storage and retrieval [Tewlow et al. 1970].

Twelve years after Tewlow’s initial article, Enlund predicted that the ideal digital prepress system solutions were still a few years away. Enlund noticed that the systems available in 1980 were untested prototypes, but he also declared that the electronic page make-up would become a reality during the 1980’s [Enlund 1980].

Smith described three types of production flows in 1980 [Smith 1980] – see figure 4–1. The first flow represented the “old” lead-based typesetting and manual page make-up followed by letterpress printing. The second flow described the “new” film-based typesetting and manual composing for offset printing. The third production flow was a scenario of a production flow, similar to Tewlow’s from 1968, with complete digital prepress production ending with a computer-to-plate system.

Today, almost thirty years after Tewlow’s prediction, digital prepress production is a reality in some newspapers. A small number of newspapers around the world has technology, products and organisation to perform completely digital page make-up and to use computer-to-plate technology. The tasks of the technical department have gradually been reduced. The prepress production has moved into the editorial and advertisement departments.

Most of the traditional production related tasks performed by the technical department are now integrated in the work at the editorial and advertisement departments. The borderline between creative work and production has been erased. But still, newspaper prepress production is strongly dependent on technology. The mechanical production has been replaced by computers and is performed more or less automatically in parallel to the creative work.

The next move in the development of the prepress production is the elimination of the computer-to-plate function. This will enable the transmission of digital files directly to the press. Digital printing presses and supporting systems are already in use in some niche areas of commercial printing and business form printing.
Today, computer-to-plate and computer-to-press technologies are not in a competing situation. Computer-to-press is established for small size presses and computer-to-plate is preferred for printing with large size presses [Kipphan 1995].

The following part of the thesis will describe the most common functions in prepress production. The section has been divided into several parts covering the advertisement department, the editorial department, image processing, and the back-end of the prepress production – the output operation.

Advertisement related operations

The importance of advertisements has previously been pointed out. There are mainly two kinds of ads – classified ads and display ads. Classified advertisements in a newspaper is advertisements grouped according to the goods or services offered. Display advertisements coexists with the editorial content on the editorial pages.

In North America and in the UK, the large volume of classified ads plays a significant role in system selection. In Germany, on the other hand, classified ads constitute a much smaller percentage of the advertising area, which includes a large share of ads in the form of classified semi-display ads, built in a boxed style. As a result, an advertising system in Germany or Italy, for example, has to be suited to selling space, whereas in North America and the UK (and, to some extent, Scandinavia), it has to focus on rapid entry, scheduling and pricing of ads so the ad salesperson can move on quickly to the next ad [Tribute et al. 1995].

In the Nordic countries, a majority of all the ads are produced within the advertising department. The work in the advertising department is supported by an advertising system including functions for marketing, administration, management and production. The advertising system usually supports either parts of or most of the operations in the advertising department.

In 1989, NATS – a Nordic technical cooperation association in newspaper technology – defined functions and borderlines regarding computer-based advertising systems. A free interpretation of the definition will result in the following English translation:

Definition: “An advertising system is a computer-based sales and management system for advertising. The system will act as a tool for the advertising department, supporting interactive customer service, sales activities, and management of the advertising production process.”
NATS also observed that the design of an advertising system varied within a wide range. The design of the system in a specific company is determined by its ambitions, available resources, size and maturity in technology.

Six different sub-functions necessary in an advertising system were defined by NATS:

- Booking.
- Registration and processing of ads.
- Sorting and dummy production.
- Management of advertiser information.
- Abilities to manage prices, invoicing, and customer complaints.
- Sales support.

Figure 4–2: The system functions defined by NATS in 1989. According to NATS the grey-shaded area was usually supported by the advertising system [Monni 1990].

NATS also stated that the sales and management system must be able to communicate with other functions within the newspaper production process. The system is a combination of applications and databases [Monni 1990].

The NATS definition was mainly focused on classified ads. But the advertising systems used today also include tools for display-ad bookings, display-ad production and page make-up. Figure 4–2 shows the NATS description of an advertising system from 1990 and figure 4–3 is a modernised version of 4–2 – a generalised description of the functions normally included in advertisement systems used in the Nordic countries.
Figure 4–3: During the past five years the abilities of the advertising systems have increased. They grey-shaded area has expanded and nowadays often includes the production of display-ads, as well as marketing and economy functions.

In many cases the production of ads and the page make-up of ad pages uses standard software that is “built-in” into the system. It is also common to use standard software packages in the process of creating page elements and to import the elements either in their native format or in a standardised format like TIFF or EPS [Edwards et al. 1994].

Editorial operations

The editorial department is the hub of the publishing process and constitutes the soul of the business. The editorial department is responsible for the creation, gathering, filtering and processing of the information that is distributed to the reader. In many cases, the digital prepress production has implied further obligations – responsibility for the electronic page make-up and the output generation. The roles of the journalists, reporters, photographers, layout specialists and graphic artists have changed.

As in the communications and computer fields, digital technology has brought about significant changes – at first in the gathering, filtering and editing of information for the traditional printed paper product, but increasingly information is being processed and distributed electronically [Lamers 1996].
An increasing share of the editorial work is performed with the use of a computer system. Many tasks are supported by one or several computer-based systems: text editing, image processing, info-graphics, page make-up, management systems and electronic archives are just a few examples. An interesting aspect of page make-up (pagination) is how the control of the operation varies from country to country in Europe. For example, in the UK page make-up is handled nearly without any control by production departments, whereas the page make-up in France and Italy is still carried out in production departments. An underlying reason for these differences is that strong unions still rule in France and Italy. Each country has had to find solutions suitable to the conditions in that country. As a result there is a diverse collection of electronic pagination systems achieving a significant degree of pagination among newspapers throughout Europe [Tribute et al. 1995].

Image processing

According to Monni the image processing in most newspapers is in a transition mode, from a labour and material intense operation toward a database-oriented digital process [Monni 1994]. The different production steps are gradually reduced to a number of basic functions:

- Scanning or telephoto receiving.
- Short-time storage in an image database.
- Selection, image-processing and page make-up.
- Output of completed newspaper pages or separate images.
- Archiving or deleting of images in the database.

Fundamental theories regarding reprographics and operations in digital image processing are left out in this thesis by can be found in for instance [Bruno 1986], [Nyman 1995], [Södergård 1994].

Nyman states that the development of image processing systems has divided the image processing into three separate steps: scanning, quality corrections, and adjustments to the newspaper printing process. The automation of the adjustments is discussed in [Nyman 1996].

Because of the high volume of data in the images, current systems separate the processing of the low-resolution and high-resolution images [Antikainen 1993]. The low-resolution version of the image, with a reduced number of colours, is used for page make-up.
When the complete digital page is sent from the production server for output, the high-resolution image automatically replaces the low-resolution substitute. The servers equipped with this OPI (Open Prepress Interface) property of handling images with both high and low resolution are basic elements in current electronic page production [Södergård 1994].

**Page transmission and output operations**

The content of a digital page containing text, photos and line art is usually described in a PostScript-file. The PostScript-file is often generated automatically when the page is sent to a specific output device. The file is generated through the use of a PostScript-driver developed for the specific PostScript-interpreter used. The PostScript-interpreter or RIP – Raster Image Processor – translates (rips) the PostScript file to one or several bitmapped images. A number of additional operations can be performed by the RIP, e.g. sending presetting values to the printing press control system. The number of bitmapped images is determined by the number of unique films (colours) needed to reproduce the content of the page. Finally the bitmap is exposed on film in an image setter or directly on plates in CTP.

If the page is sent to a remote printing plant, a number of different transmission technologies can be used. The most common page transmission routines are:

- Physical transportations of complete page films.
- Page transmission through the use of films and page fax systems.
- Page transmission through the use of digital files and page fax systems.
Page transmission through the use of digital files and other data communication solutions.

Page fax technology has been in use for more than 20 years and is suited for companies using manual page make-up. The paginated page-films are scanned, compressed, sent to one or several remote plants, decompressed and finally output in a page fax receiver. The technology is well-known, expensive, and means one further process step influencing the quality of the page film.

In the third alternative discussed, the pages are ripped but not exposed on film before the page fax transmission. The resulting bitmap-files are transmitted through use of a page fax transmitter. The files are compressed, sent to one or several remote plants, decompressed and finally output in a page fax receiver.

The fourth alternative is suitable for companies with digital page make-up and common data communication solutions can be used. The RIP operation can either be performed before or after the file transmission. Distributed RIP:s and imagesetters have been discussed by Nordqvist [Nordqvist 1994b].

The communication between publishers and remote plants has been analysed by Åndell in a NATS-report [Åndell 1992].

**Platemaking**

A printing plate can be produced using a film or a digital file. Conventional platemaking exposes a plate through a film. Computer-to-plate technology is filmless – the film based imagesetter is replaced by a CTP-output device.

The CTP technology requires digital page make-up and has until recently not been able to match the capacity of conventional platemaking. In 1994 IFRA published a study which stated that CTP under certain circumstances could be an attractive alternative for newspapers. Another conclusion in the IFRA study was that CTP implies improved quality due to a more controlled production process. Cost savings can also be obtained through reduced labour, capital costs and material costs [IFRA 1994].

One of the remaining problems with CTP-technology is the lack of capacity regarding production of multiple identical plates within a limited time frame. The need for digital proofing systems and completely digital pages are other CTP drawbacks. CTP advantages and drawbacks have been discussed and analysed by Alexander [Alexander 1994].
Figure 4–6: An example of operations involved in conventional platemaking. The plate preparation in this case means that the plates are adapted (punched) to the plate register system used in the printing press.

### 4.2.5 Printing

**Introduction**

The dominating printing process in the Nordic countries, and in most other western countries as well, is printing in web-offset.

In rough terms, a rotary printing press for newspaper production consists of four different functional units: the reel stands, the printing units, the superstructure and the folder – see figure 4–7. These units are linked through mechanical and/or electronically connections. The overall production system is coordinated by the press control system.

During the past twenty years the printing process has been considerably automated. The earlier manual operations have been replaced by remote control, closed-loop control systems or automated devices. The results are higher production speeds, increased possibilities regarding the use of colour, improved print quality, reduced time needed for presetting, reduced newsprint consumption, improved working environment and less impact on the external environment [Monni 1988], [Lövman 1993]. The printing operation has also become less labour-intensive but instead the share of capital costs has raised.
Figure 4–7: A schematic picture of a double width–double round newspaper printing press with satellite printing units. 1) Reel stand. 2) Printing units. 3) Superstructure 4) Folder.

A newspaper printing press is a combination of a number of separate subsystems. The following subsystems are among the most important parts of the production system that constitutes a printing press:

- Motors, transmission and cylinders.
- Register control – circumference and side register.
- Web-leads, web-tension control, and web-registers.
- Control of ink and water in the printing units.
- Stitching and gluing devices.
- Colour supply and colour distribution to the printing units.
- Control systems coordinating the subsystems.
- Management systems supporting presetting, production planning and production control.

In 1993, there were 242 Nordic newspaper printing plants represented in the technology guide “Nordiska Tidningsregistret” [NATS 1993]. Three of these companies were using direct lithography in converted letterpress printing presses. The remaining 239 were using offset technology – most of them web-offset.
No Nordic newspapers were printed in gravure, flexography or letterpress. Therefore, the continued discussion in this thesis concentrates on newspaper printing in web-offset presses.

Fundamentals of the offset process have been described in numerous books and reports, e.g., [Adams et al. 1988], [Crouse et al. 1989] and [Karrtunen 1993] gives an introduction to the offset-process and the underlaying theories.

**The functions of a newspaper printing press**

Newspaper printing in web-offset means that the cylinder diameter of the printing cylinders is fixed and the measure of the product surface – height and width – is determined by the printing press. In the Nordic countries, most morning newspapers are printed in the broadsheet format (in short BS), approximately 40 x 56 centimetres. Evening papers and commercial products printed in newspaper presses are often in tabloid format (in short TAB), approximately 28 x 40 centimetres. Tabloid and broadsheet products can normally be printed in the same printing press.

The number of pages that are possible to print on each web in a newspaper printing press is determined by the construction of the press – from the smallest presses printing 4 BS-pages per web to the largest double round – double width presses printing 16 pages per web. This means that the number of webs needed to print, for instance, 32 broadsheet pages varies from 2 to 8. The total number of pages that are possible to print in parallel is determined by the construction of the printing press, e.g. the number of reel stands, printing couples and possible web-leads.

During the production, the webs pass through the printing units determined by the imposition scheme – see figure 4–8. The printing units are followed by the superstructure on top of the press. The superstructure normally contains equipment that makes it possible to split and turn the webs, move the webs sideways, or change the individual order of certain webs [Nicholson 1975], [N.N. 1994c], [N.N. 1994d].
Figure 4–8: Various web-leads through satellite printing units.

Figure 4–9: The web leads in the superstructure when producing a 64 page broadsheet product in collect run. The sections are collected in the folder.

In the superstructure the webs are arranged in the correct order [Dalin 1994]. The superstructure is followed by the folder were the main product is finished. In the Nordic countries, the pages of most products are either glued (BS products) or stitched (TAB products). These operations are carried out in parallel to the folding operation. Folders in double round presses usually allow printing in straight or collect run. The relation between the webs after the superstructure is shown in figure 4–9.

Straight run means that two identical products are produced per printing cylinder revolution. Two identical printing plates for every page and colour are
mounted on the first and second half of the printing cylinders. The output from the printing press becomes two times the production speed of the printing press (cylinder revolutions per hour).

![Figure 4–10: A double width–double round press with 4-high printing units. A total of 64 broadsheet pages can be printed in collect-run – all of them in four colour.](image)

Collect run means different pages on the first and second half of the double round cylinders. One printing cylinder revolution results in two sub-products collected into one in the jaw cylinder of the folder. In this case, the output from the printing press equals to the production speed of the printing press (cylinder revolutions per hour) [Nicholson 1975].

A reliable and simple configuration of the printing press can be achieved if the press has the ability to print four-colour on every page. The result is short and straight web-leads, and constant and controllable web tension [Kuusela 1993]. The number of presses only configured with 4-high printing units seems to increase. In Sweden the new plant of NWT is one example [Quervel 1995].

Due to the heavy investments needed to obtain four colour printing on all pages, investments in four-colour on 50% of the possible pages seems to be the most common solution in Europe [N.N. 1994e].

The press control systems normally covers production planning, presetting, real-time control of the printing process, and reporting. The real-time control includes remote controls for web-register, turner bars, ink keys, dampening systems, and print register.
The booking of colour pages and the impositioning of the product can be supported by software linked to the press control system [Güth 1992], but more often a number of pre-defined imposition schemes are preprogrammed in the advertisement system. TidSim, a newspaper production simulator developed at KTH, includes a dynamic link between the prepress systems and the press control system [Fällström et al. 1994].

The management functions of the press control systems can include functions for product/production planning integrated to the press control system; automatic real-time transfer of production data from press control to management information systems; and integration of automated guided vehicle (AGV) and press control systems [IFRA 1986], [Smith 1995].

4.2.6 Mailroom operations

The printing process is followed by the operations performed in the mailroom. The main task of the mailroom is to transform a uniform copy stream delivered from the folder of the printing press into bundles delivered to the distribution organisation.

As previously mentioned, the mailroom operations were until the 1970’s often manual and personnel intensive. The operations were often limited to manual counting and collection of copies delivered on a conveyor belt transporting the copy stream from the folder to the mailroom. The counted stacks of newspapers were manually tied with a piece of string and delivered to the loading bay.

A modern mailroom often has the following functions:

- Delivery of the copy stream from the folder of the printing press to the machinery used in the mailroom.
- Copy stream storage systems.
- Automated inserting of preprinted components into the product – these can be sections, supplements or inserts.
- Individual addressing of single copies.
- Counting of copies and stacking of bundles.
- Bundle addressing.
- Packaging of bundles.
- Loading systems for automated delivery of bundles to predestined trucks or pallets.
Figure 4–11: A systematic description of the mailroom functions defined by IFRA in 1985 [Petersen 1985].
In 1985, IFRA made efforts to define the functions in the mailroom. The result was reported in “Systematics of Mailroom functions” [Petersen 1985]. IFRA separated the different functions and operations into three logical sections:

- From the folder to the stacker.
- After the stacker to the loading machinery.
- The loading machinery to the loading dock for the trucks.

The production process of a modern mailroom has very little in common with the mailroom operations 25 years ago. A modern mailroom is highly automated. The overall production is controlled by a computerised control system, and none or very few manual operations are performed under normal circumstances [IFRA 1987a], [IFRA 1988], [IFRA 1989], [IFRA 1992].

Figure 4–11 shows the systematic description of the mailroom functions defined by IFRA in 1985. The description is still valid but new functions have been added, such as individual addressing and control of copies in order to obtain finer zoning [Burkhardt 1992], [Fuchs 1995b].

The control systems of the mailrooms have also developed fast and their flexibility and ability to control complex production processes is directed towards individual control of every single copy. Still, much development work has to be done and exacting requirements are made on the reliability of the whole mailroom process and on the quality of the inserts and the main products as well as on the control system [Fuchs 1995b].

**4.3 Summary**

The production of newspapers were roughly based on the same kind of technology and organisation from the beginning of the 20th century until the end of the 1960’s:

- Time and resource consuming prepress production – lead-based mechanical typesetting, etching of halftones on zinc plates, manual page make-up and production of stereotype plates.
- Large technical departments in the publishing houses.
- Printing in letterpress with limited possibilities of colour printing.
- Mass production of identical copies and manual postpress operation.

From the beginning of the 1970’s until today, the technology development has been rapid and has lead to a shift of paradigm – the conditions have totally...
changed. The prepress work is now almost 100 % digital and the printing and postpress operations are performed in highly automated and digitally controlled production plants. The development has implied the following changes:

- Refinement of printing technologies, automation in the printing plants and development of digital image processing has made extensive use of colour possible.
- The workforce in the technical departments has been considerably reduced due to improved technology – the production is gradually moved from specialists to creators and is more or less automatically performed in the background of the creative work.
- Digital prepress production combined with highspeed telecommunication has made it easier to geographically separate the printing plant from the publishing house.
- Higher productivity and possibilities to produce more customised products in the highly automated and digitally controlled printing plants.

Another aspect of the present production environment is that the digital and highly automated production process probably is harder to plan, survey and control. A number of factors contributes to the increased complexity regarding production management:

- Increased use of complex page elements, i.e. colour line art and colour photos, requires more capacity in the prepress area and increases the risks of disturbances.
- The digital prepress production is to a great extent invisible, physical material may not appear until the printing plate is produced in the printing plant.
- Increasing possibilities of achieving cost effective production of unique copies or small batches of targeted copies in the printing plants.
- An accelerating occurrence of paper based editions or edition versions implies an increased number of page elements, page versions, supplements and inserts – a number of different “products” are produced in parallel.
- Possibilities to reuse of the same basic material in different products (printed, on-line, CD-ROM) distributed at different times using different distribution channels.
Due to the heavy investments needed in the printing plants, the number of plants is decreasing, but the flexibility in the remaining plants is increasing.

The number of printing jobs in each printing plant is increasing as well as the utilisation of the plant. Many plants are printing a number of titles every night. The situation requires coordination between each editorial department, the printing plant and the distribution organisations.

Due to the printing and postpress capabilities of the printing plants, new categories of customers appear. In addition to newspapers they also produce products such as magazines and advertising leaflets.

The new market situation and the new tools and information formats have made the newspaper publishing industry a part of the information industry. The new tools can be used in order to develop the product, to manage and reuse the product components, to develop the production process and new services related to the present publishing industry. But the use of the tools is facilitated if the process is known and well defined.
5. The processes of production and distribution in newspaper publishing

5.1 Introduction

This part of the thesis mainly deals with five case studies performed. All five case studies have been carried out using the ISAC-method described earlier. The studies were carried out during the period March 1993 to March 1996. Five companies have been observed. The objectives of the case studies have been to map and analyse the processes of production and distribution. Special attention has been paid to the conditions for production and distribution and the behaviour of the processes.

Some companies have been involved in more than one case study. The production in the plant covered in Case A is analysed in more detail in Case E. One of the plants in Case D was also involved in Case E. Altogether, this means that the case studies cover five newspaper titles, five production plants and one distribution company. As some of the companies wished to stay anonymous, all company names have been left out.

In four of the cases, the processes have been mapped both with respect to the prepress production and the production in the printing plants. In Cases A-C the prepress studies have mainly been covered by Nordqvist. The results have been reported in [Nordqvist 1994b] and in [Nordqvist 1996]. The production in the printing plants has been covered by the present author and a detailed report, including activity-graphs, can be found in [Stenberg 1994b]. Case D mainly covers circulation determination, printing and postpress production, and distribution operations. Case study D was performed mainly in order to identify how the distribution operation was organised and carried out and how it interacts with the preceding production processes. A detailed report of Case D can be found in [Stenberg 1994a]. Case study E was carried out between August 1995 and March 1996. The study mainly deals with the edition planning process and the interaction between the structure of the product and the production method in the printing plants. Furthermore, special attention was paid to how the product and production method influences the productivity and reliability in the printing plants. Case studies D and E include extensive use of data from production and distribution reports in order to make it possible to perform statistical analyses.
The empirical case studies have all been performed in Swedish companies. The production of the companies studied has ranged from 55000 to 450 000 copies a day. The products are regional and national newspapers. The total number of Swedish newspapers with a circulation exceeding 50000 copies is eighteen. Their total circulation reaches 2.6 million copies per publishing day. The five companies covered in the case studies handle a total circulation of approximately 950 000 copies per publishing day [Tidningsutgivarna 1996b] – approximately 20% of the total Swedish circulation per publishing day.

In the case studies, the page count normally varies from 32 to 76 broadsheet pages in the main section with an average of roughly 50 pages. In addition, preprinted supplements and/or inserts were often inserted into the main section.

The prepress production was carried out in a mainly digital environment. This means electronic page make-up and transmission of digital files to each printing plant. The files consisted of PostScript descriptions or colour separated bitmaps.

In all cases, the production plants were remotely located from the publishing houses. The number of printing plants and printing presses used in each case varies – from regional newspapers printed in one plant equipped with one printing press to large national newspapers printed at three or even four locations with 1–4 presses in each plant. The configuration of the printing plants have some common features:

- Double width and double round printing presses.
- Capabilities of four-colour printing on certain pages.
- Mailroom equipment that performs on-line inserting of preprinted supplements or inserts (Cases A, B, D, E).
- Mailroom equipment allowing production of unique sized of addressed bundles.

A double width and double round printing press means eight to sixteen broadsheet pages printed on each web. The number of webs used is dependent on the total number of pages in the main product and the imposition of the colour pages. The main products studied use two to five webs in collect run (Cases A, B, D, E).

Due to the high cost of four-colour printing units, the largest possible number of colour pages is usually below the total number of pages possible to print and a majority of all press installations world wide do not have the ability to print four colours on all pages. Instead, it is necessary to perform an optimised impositioning of the colour pages in order to efficiently use of the colour capabilities.
of the printing press. Some manufacturers of press control systems and prepress systems have linked their equipment together in order to simplify the impositioning and eliminate the risk of impossible colour bookings [Güth 1992], [Diergardt 1994].

The use of inserting equipment implies possibilities to complete the product in the mailroom. Parts of the product can be printed in advance, stored and later automatically or semiautomatically inserted into the main section. Production of unique bundles requires that the content and destination of each bundle is programmed. Production of unique bundles makes it possible to partly prepare for the delivery operation already in the mailroom. The objective with the mailroom delivery preparation is to simplify the handling in the distribution and carrier stage. The unique and addressed bundles have to be coordinated with specific trucks in the loading operation.

When it comes to the analysis of the distribution operations, just one distribution company has been studied. The market situation and general conditions for newspaper distribution in Sweden are very regulated and most distribution companies and distribution operations are organised in a similar way.

Section 5.2 consists of a generalised description of some activities in the publishing houses that strongly influence the printing, mailroom and distribution operations: edition planning, product specification and determination of circulation. The description is based mainly on [Nordqvist 1994b], [Stenberg 1994a] and case study E.

5.2 Production and distribution preparation in the publishing houses

5.2.1 Edition planning and product specification

Edition planning in terms of layout work, deciding of the page count, sections, and the location of the colour pages is a central function if the page count and layouts are flexible – based on a coordination of editorial requirements and ad bookings at a specific deadline.

Ad booking can start months in advance and may in some cases not be closed until five–six hours before the presses start. The long term ad booking is mainly concentrated to large format colour display ads in specific positions in the newspaper. The ad bookings made during the last hours before the final closing are often restricted to relatively simple classified ads (real estate, cars,...).
The volume and location of ads in combination with the editorial reservations of space and colour in different departments, set the total number of pages in the product as well as the colour configuration. Furthermore, collect run production means that the number of pages in sections printed during the first half revolution in the press must match the number of pages in the sections printed during the second half revolution [Nicholson 1975].

In the case companies observed, display ad bookings were in general not accepted later than the afternoon two days before the publication day. After that deadline the ad dummy must be produced. The time of this deadline was mostly guided by the need for a dummy at the start of the editing and page make-up. The starting time of the page production, in turn, was given by the available resources of the subsequent processes. As a consequence of the early dummy creation, the final ad volume is not known when the product structure is fixed. The ad department has to make an estimate regarding the remaining sales of classified ads. The estimate forms the base for space reservation and impositioning of pages containing classified ads.

The space and colour bookings in the dummy show the location of the different departments, the ad positions, the number of pages and the colour configuration. The dummy is normally distributed to all functional units involved in the page production.

Besides the determination of parameters related to the main section, there are a number of additional parameters that must be coordinated. Pre-produced supplements or externally produced inserts may be inserted in the mailroom and influence the production and distribution processes.

Supplements can be editorial products or products more or less completely produced by the newspaper for a specific customer. Additionally, a purely commercial selling of inserting services is available at most Swedish newspapers. The selling of inserts is mostly carried out by the advertising department.

The number of products possible to be added in the mailroom is limited and the bundle production and distribution operations are dependent on the total number of pages in the final product. This means that the page count in the main section and the occurrence of supplements and inserts must be coordinated with the printing plants and distribution organisations.
5.2.2 Circulation activities and the link to the preparation of mailroom and distribution operations

The structure of the circulation changes from day to day. Address and order information must be gathered, processed and the results forwarded to the printing plants and to the distribution organisations. The interface towards the customer consists mainly of the carriers and the subscription department. The subscription department administers a database containing all the subscribers, their addresses and administrative information. The database is continuously updated as new subscribers are added or the existing ones are moving or cancelling their subscriptions.

A distribution department of a newspaper or a separate distribution company can be responsible for the management of the distribution. The location of this function can vary from one company to another but the necessary operations are similar.

The distribution function must be supplied with updated information from the databases of customer addresses and orders every day. In addition, there is a continuous flow of messages, unfortunately mainly complaints, from the customers via the customer service to the carriers. In Sweden, the orders from the retailers are normally registered in a separate system quite similar to the subscriber system (retailer system).

The production in the printing plants is in between the circulation department and the distribution. The number of copies printed in each edition version and the bundles belonging to it, is determined on a daily basis. Data from the subscriber and retailer databases combined with product and distribution information generates control information for the mailroom. This information can be used to control inserting operations, the production of unique or standard bundles and the loading of the bundles on predestined trucks.

A subscriber or a retailer normally gets his copies through the local newspaper distribution company or the postal service. As the newspaper distribution in Sweden is partly subsidised by the government, major newspapers in a distribution area have to be jointly distributed [Finansdepartementet 1993]. Subscribers or retailers located outside the areas operated by the distribution companies, or minor titles in the distribution area, will get their copies through the postal service.
The distribution operation is expensive due to its labour intensive nature and inconvenient working hours. It must be time and resource optimised. The operative distribution can be divided into four different steps: truck loading, transportation, unloading, and carrier operation. The order in which the trucks are loaded, their routes and the timetables are defined in a distribution plan.

### 5.3 Case studies A–C

#### 5.3.1 Introduction

During 1993, case studies were carried out in three different Swedish newspaper printing plants. These case studies covered the activities in distributed printing plants – page transmission, platemaking, printing, mailroom operations, loading, and materials handling. The studies focused on production of morning newspapers. The page make-up was almost completely digital and the plants were all geographically separated from the newspaper publishing houses.

The main interest was concentrated on information and material flows, as well as timetables and routines related to preparation, production and reporting. The size of the plants as well as the number of printed copies per day varied.

**Case study A** covered the plant of a national newspaper published 7 days per week. In the plant, approximately 300,000 copies of the newspaper were printed every day. In addition, four other titles with a total daily circulation of approximately 100,000 newspapers were printed in the same plant. The production was carried out in four printing presses. The study only covered the production of the main title printed between 11 pm and 03.30 am every night. The transports to the carriers were mainly carried out in approximately 70 routes. The product was jointly distributed with other morning papers.

In **Case study B**, the production of a regional newspaper with a circulation of approximately 70,000 copies per publishing day was observed. The newspaper is published six day per week. In addition, the plant was used for commercial production during the day shift. The main section of the newspaper was printed in one printing press between 00.00 and 03.00 six days per week. The transports to the carriers were mainly carried out in approximately 25 routes. The product was jointly distributed with other morning papers.

**Case study C** concentrated on a regional newspaper printed in one single plant. The circulation of the newspaper was approximately 55,000 copies per publishing day (published 6 days per week). The newspaper was printed in one of the two newspaper printing presses located in the plant. A total circulation of
110 000 morning newspapers, divided into seven titles and published 3 to 6 days per week, was printed in the two presses. In addition, commercial production was carried out during the day-shift.

The study covered only the production of the regional newspaper. The main section of the newspaper was printed between 00.45 am and 03.50 am. The transportations to the carriers was mainly carried out in approximately 30 routes. The product was jointly distributed with other morning newspapers.

### 5.3.2 Technical conditions

All the observed plants were responsible for the production from film to addressed bundles delivered via truck loading systems or addressed single copies for distribution through the postal system. The operations included platemaking, preparation and presetting of the printing presses, printing, on-line-inserting (Cases A and B), bundle production and addressing, single copy packaging and addressing, and finally delivery of bundles to the trucks. All these operations were supported by automated equipment. The level of automation varied slightly between the plants.

#### Film generation

All plants used films in order to produce the printing plates. In Case A, most pages were transmitted through use of microwave links and a page fax system. The transmitted pages were exposed in page fax recorders. In parallel to the use of page fax technology, tests with file transfer of PostScript files were carried out. The file transfer was followed by ripping and exposure in page fax recorders. Full page colour ads were transported by car.

In Case B, the digital pages were transferred to the printing plant as PostScript files. The data communication was performed through the use of a microwave link from the publishing house to the printing plant. The PostScript files were ripped in the printing plant and exposed in one of two recorders. Full-page colour ads and certain large format colour ads were transported by car. Large colour ads were manually pasted-up.

Page fax receivers and leased data communication lines were also in use in the plant covered in Case C. But the publishing house of the product studied was located close to the printing plant and did not use the page fax system. Instead, complete films were transported to the plant by car.
Platemaking and page scanning

All plants used automated solutions in the area of plate making. In Case A, the films were scanned in order to generate ink presetting values for the printing press. The film scanner was manually fed with product data. The film scanning operation was followed by a platemaking operation performed in two automated plate lines.

In Case B, bar codes were attached to the films in order to later identify the plates during plate scanning. The plates were produced in an automated plate line equipped with an on-line plate scanner.

Case C used both film and plate scanners in order to identify the data for inker presetting. All films included codes supporting the identification of the scanned film/plate. The type of scanner used for a specific film/plate was determined by the position of the corresponding plate in the printing press. The plate exposure was mainly carried out in a manual operation. The exposed plates were developed and certain pages on-line scanned in the plate line.

Printing presses and press control systems

All products observed were in broadsheet format and printed in collect run. The size and abilities of the printing presses were quite similar. The presses were double width–double round newspaper presses and installed during the late 1980’s or early 1990’s. The only exceptions were parts of the press in Case C, which were 15 years old.

The plant in Case A uses 80-page presses with satellite units. Two webs can be printed in 4+1 colours, and 3 webs in 2+2 colours. The maximum production speed is 35 000 copies per hour in collect run. The presses are operated through control systems enabling remote control and storage of presetting values.

In Case B, an 80-page press with satellite units is used. Two webs could be printed in 4+1 colours, and two webs could be printed in 2+2 colours. The maximum production speed is 35 000 copies per hour in collect run. The press is equipped with a control system enabling remote control and storage of presetting values.

The product observed in Case C is printed in two presses combined into one 64-page printing press. This implies special arrangements – the use of both film and plate scanners mentioned earlier was caused by the use of two control systems in parallel. The borderlines and implications of the parallel press control systems were not analysed. The modern press consists of a 4-high tower (4+4 colours). The old part press consists of two 2+1 webs and one 1+1 web. The maximum
production speed is 35 000 copies per hour in collect run. The presses are equipped with control systems enabling remote control and storage of presetting values.

**Mailrooms and mailroom control systems**

All plants produce unique and addressed bundles and addressed single copies, but the occurrence of inserting, the level of automation, and the control systems vary between the plants. A number of similarities were found:

- All plants use gripper-conveyors for the copy stream from presses to stackers.
- All plants use stackers that produce preprogrammed unique bundles with route and carrier specific distribution information printed on the top sheets.
- Single copy addressing is manually performed off-line through the use of preprinted labels.

In Cases A and B, inserting operations are automatically performed in the mailrooms. Supplements are preprinted and the copy streams wounded and stored on cassettes (Rotadiscs/Minidiscs). Besides preprinted supplements fed from the cassettes, inserts can be manually fed via hopper-loaders. The supplements and inserts are inserted into the main products in an inserting drum. In both plants the inserting operation is manually coordinated with respect to specific edition versions.

In Case A, the operation of the stackers and the top sheet printers is controlled by a control systems working on two levels. A main computer distributes control data to the line computers managing the operation of the stackers and top sheet printers. The top sheet printing is coordinated with the bundles produced by the stackers and the top sheets are automatically attached to the bundles in the packaging line. The loading order can be changed and individual bundles moved from one route to another during the production run.

In Case B, the sequence of bundles is determined before the production. The top sheets are printed in advance and include bar codes controlling the operation of the stackers. The top sheets also include route and carrier specific information. During the production, the bar codes of the top sheets are identified, the correct number of copies stacked, and finally the top sheets attached to the bundles. The loading order of the trucks cannot easily be changed and the possibilities to move bundles between the routes are limited.
The production of bundles in Case C is preprogrammed in each stacker. The top sheets are printed in advance and contain route and carrier specific information. The top sheets are manually attached to the bundles after the stacker. The pre-programmed sequence can be changed and the top sheets rearranged in order to change the loading order or move bundles between the routes.

The loading operation of the unique bundles produced in Case A and B are guided by bar codes on the top sheet of the bundles. The bar codes are identified by the loading system and the bundles are directed to a predetermined truck. The bundles are transported on conveyor belts. The truck drivers manually piles the bundles on the platform of the trucks. In Case A, twelve trucks in parallel can load bundles from the four presses. In Case B, three trucks in parallel can be supported by the truck loading system.

In Case C, the loading operation is semi-automated. The top sheets are manually identified and the conveyor belts remotely controlled in order to direct the bundle to the correct loading position. In Case C, six trucks in parallel can load bundles from the two presses.

5.3.3 Preparation routines

The preparation routines are similar in all three case studies. The starting point of the preparation is the decision from the newspapers indicating the final number of pages, including all sections, colour configuration of the product and circulation. The decision is reported approximately 10 hours before the planned press start, and guides a number of activities in the plants:

- The preparation of the press control system.
- Identification of newsprint requirements from the paper stock.
- Adjustment of the daily newsprint orders from the paper mill.
- The preparation of the printing press.
- Basic information for the control of page films transmitted or delivered to the plants.

The press control system and printing press are prepared according to the specification of the product and the chosen production method. The preparation of the press control system includes, e.g., identification of web-leads and presetting web-tension values, definition of plate positions, and identification of the positions of process and spot colours.

The need for newsprint of certain reel-widths (160 cm, 120 cm and 80 cm) are determined by the ordered circulation and the knowledge of the configuration
of the printing press. In Case A and B, the required paper is moved from the paper stock to a buffer storage. In Case C, the required amount of reels are transported directly to the reel stands.

The mailroom production in the three plants needs updated control data every day. Daily information and material required for the mailroom production and control are:

- Control data for the stackers.
- Control data for top sheet generation/preprinted top sheets.
- Preprinted address labels for single copy addressing.

The necessary input originates from the subscriber and retailer systems and is delivered 5 to 10 hours before the mailroom production starts. In Plant A, digital control data for the stackers and top sheet generation is delivered on magnetic tapes. The preprinted top sheets used in Plant B are printed at the circulation department of the newspaper. In Plant C, the data (bundle sequence) controlling the bundle production in the stackers are delivered on disks. The pre-printed top sheets and address labels used in Plant C are printed outside the plant and delivered just a few hours before the printing starts.

5.3.4 Routines during the production

The routines during the production are similar in all three case studies and the slight differences between plants will be left out. The start of the production has been defined as the time when the page transmission (digital or physical) to the plant and the production of films and printing plates starts. The flow and order of pages sent to the plants are determined by a combination of publishing requirements, available resources, and necessary reliability margins.

The editing, page-make up and page transfer are guided by a timetable defining deadlines for groups of pages through the different stages of production. The timetables for the different groups are fixed, but the specific pages included in the different groups vary from day to day.

The transmission to the plants starts 4-5 hours before the planned press start, and the last pages are planned to be sent to the plant just before the press start.

The plate making department follows the page transmission according to the product specification. The platemaking department also performs a control of the technical quality of films and plates. Missing page elements and other issues related to the preceding processes are not controlled as a matter of routine.
All plates and/or films are scanned during the platemaking process. The prepared plates are picked up by the printers and mounted in the presses in accordance with the impositioning.

In parallel to the platemaking, the printing presses and mailrooms are prepared for the production. When all plates are in position and the press and mailroom are prepared, the printing starts. Normally 800 to 2000 copies of start-up waste are necessary in order to obtain good copies and deliver the copy stream to the mailroom. The normal cruising speed of the presses ranges from 27000 to 32 000 copies per hour.

All communication between the press crew and the personnel in the mailroom is carried out by oral communication, mainly through internal telephone systems. The internal communication within the mailrooms (Cases A and B), i.e., between rewinding stations, inserting drums, mailroom supervisors and the loading bay areas are carried out in the same way.

In addition to the operation of the printing process, the printers also note production-related time and circulation information during the production. In the same manner staff in the postpress area note the departure times from the plants for all trucks.

### 5.3.5 Routines after the production

After the completion of the production, a number of routine activities follow, mainly related to cleaning and preparation of the presses. These activities were left out in the studies.

The down time between one printing job and another varies in the plants. Normally the production of a new product can start 45 minutes to 1.5 hours after the completion of the earlier production run. The time needed depends on the available automation equipment in the presses, the available human resources and the differences in products and press configurations.

A number of reports are manually compiled after the production. The reports mainly cover time information related to a number of well defined activities and waste figures regarding newsprint. Major technical problems are also reported. In all case studies the reporting at least covers product specific information regarding:

- Last film completed.
- Last plate completed.
- Press start.
• First good copy printed.
• Last good copy printed.
• Number of good copies printed.
• Departure times of the trucks.
• Waste figures.

Plant A has an extensive reporting from the production. Disturbances and waste are divided into standardised categories. A separate system for reel tracking is used. All reels are registered as well as the reel stand used for a specific reel. Reports showing statistics regarding web-breaks, e.g. per reel stand or per paper mill, are generated on a regular basis.

A detailed mapping and analysis in the field of production reporting in newspaper printing plants can be found in [Carlerud 1996].

5.3.6 Summary

In the case studies A to C, the circulation of the observed newspapers varies as well as the sizes of the plants. But, the activities and routines related to the daily production of the main product are relatively similar. A number of general conclusions can be drawn from the case studies.

The product specifications are determined and sent to the plants approximately 10 hours before the planned printing start. The specification contains page counts, sections, and colour configuration. The product specification initiates a number of preparation routines in the plants.

The page transmission/delivery of films to the plants is normally carried out in the evening, starting approximately 4-5 hours before the planned press start. The pages are divided into groups with different deadlines. The deadline (prepared page film in the plant) of the last group is approximately 10-20 minutes prior to the planned press starts. The trend regarding page transmission is towards digital (PostScript) files transmitted to the plant.

The number of four-colour pages is limited and the structures of the products are flexible. Normally the page count, colour configuration, and occurrence of inserts (Case A and B) be changed from day to day. The mailroom production consisted mostly of addressed and unique bundles. The plants are highly automated with respect to presses and mailrooms (Case A and B).
A major part of the page make-up is performed during the last day and evening the day before the publishing day. A number of critical times can be identified: $t_1$– starting point of the page make-up, $t_2$– dummy creation finished–product specification to the printing plants, $t_3$– planned press start in the plants, $t_4$– distribution deadline. The activities performed during the last 24 hours before the delivery to the readers are found in figure 5–1.

Figure: 5–1: An example of activities and time schedules, related to production and distribution, performed during the last 24 hours ($t_4$–$t_1$) before delivery to the customers.

The production and distribution plans are fixed from day to day and seldom changed, but manual real-time re-planning occurs – changed loading orders in the mailrooms (Case A and C) due to delays and disturbances. The trucks are normally loaded in parallel and the loading operation is mainly manual – the truck drivers manually pile the bundles on the platforms.

A number of production reports are manually compiled at the different departments. The reports mainly consist of basic information: last film completed, last plate completed, press starts, unplanned major stops, first good copy, last good copy, good copies printed, truck departures and waste figures.
5.4 Case study D

5.4.1 Introduction

Case study D was carried out during the period from January to October 1994 in collaboration with a large Swedish newspaper distribution company operating in the Stockholm area. A number of objectives were defined before the study started. These objectives included:

- Study and analysis of the distribution process and its interface to the newspaper publishers and the printing plants.
- Documentation of the material and information flows in the processes.
- Identification of how delays influence the distribution with respect to time and costs.

The study briefly covered the work at the subscriber departments, and the routines and logistics related to the printing and distribution in more detail. The main focus was on the interaction between the mailroom production, the loading operations and the distribution. The analysis of time and costs related to distribution was based on extensive available data. Case study D has been reported separately in Swedish [Stenberg 1994a].

The study was more detailed than the previous case studies A-C. From the earlier case studies it was known that the interaction between the processes of original creation, printing and mass distribution was important, and that delayed production implied risks of severe losses with respect to goodwill and economy. A detailed analysis of borderlines and control parameters between the publishing houses, the printing plants, the distribution company and the customers were judged important.

Every night the distribution company delivers 175 000 kgs of newspapers via approximately 75 routes, 104 distribution centres and 1500 carriers to 430 000 subscribers and retailers. The newspapers are distributed via trucks that operate from midnight to 4 am, and professional carriers working from 2 am to 6 am every night. The carriers pick up the newspapers at distribution centres located in strategic positions all over the Stockholm area. The number of carriers districts is 2 200. The average distribution cost per copy in 1994 was 2.50 SEK.

The largest customers of the distribution company are its owners – two national daily morning newspapers. Every night, the distribution company delivers approximately 310 000 copies of the largest newspaper, Product 1 printed in Plant 1, and another 140 000 copies of the second largest title, Product 2 printed in Plant 2.
In addition to the delivery of the owners’ newspaper titles, the distribution company also distributes a number of other titles with smaller circulation in the Stockholm area. The number of retailers operated by the distribution company is approximately 2,000.

5.4.2 Distribution planning and preparation

Between the distribution company and the newspapers there are mainly three separate interfaces in daily use transferring the following types of information:

- Subscriber information.
- Retailer information.
- Customer complaints.

Responsibility for information exchange is distributed within the organisation of the distribution company. The subscriber departments are responsible for a continuous updating of the subscriber databases. The subscribers phone or send written messages to the newspapers to order new subscriptions, report changes or complain about the distribution. The registration of the information is performed on-line by the subscriber departments of the newspapers and files containing the information are automatically generated from the subscriber databases and transmitted to the distribution company every weekday.

The files from the newspapers are used to generate information for the carriers. The information is printed on paper and sent to the distribution centres. Subscriber information and messages containing complaints reach the carriers as printed subscriber cards or complaint messages. The daily printed distribution material contains subscriber cards, complaints, loading lists for every truck and distribution lists for every distribution centre.

Complaint messages are immediately printed and forwarded to the distribution centres the following night.

The file transfer from the subscriber database is performed either in the evening two days before the publication day or at night the day before the publication day. The printed delivery information is sent to the distribution company in the morning of the day before the publishing day. The distribution information is processed in a number of steps, and the lead-time from the registration in the subscriber database to the printed message to the carrier is often three days.

Information originating from the subscriber databases is also used in order to generate daily files used as input to the control systems in the printing plants. The files generated are used to determine the number of copies in each edition version and to control the mailroom production and loading. The mailroom data
can be very detailed and contains information regarding the number of copies, the addressing and the loading of every single bundle. The production and loading data are transferred to the plants the day before the publishing day.

In order to calculate the salaries of the carriers, detailed data are stored in the payroll systems. The monthly salaries are regulated on a very detailed level in a national agreement [N.N. 1995]. In addition to the national agreement the carrying operations are regulated by one further local agreement.

The monthly salaries of the carriers are based on work during Monday through Saturday. The basic level is determined by the distance from the distribution centre to the last subscriber in a carrier district. Both indoor and outdoor distances are included. In addition to the distance, a number of other factors are considered, among others:

- Weight compensation if the daily weight exceeds 38 kg.
- Special agreements for Sundays.
- Compensation for manual inserting performed by the carriers.
- Compensation for inserts differing from the format of the newspaper.
- Compensation for delays.

Carriers forced to wait for the newspapers due to delays are compensated for every 10-minute period of delay. At the time of the study, the total delay costs related to carrier salaries were 20 SEK per 10-minute-period and carrier.

An agreement with the transportation companies regulates delayed truck departures. The first 29 minutes of delay are not compensated, but from delay minute 30, an extra hour of 225 SEK is charged. If the truck departure is more than 89 minutes late, one further hour is charged. Delays of more than 2 hours are very unusual.

The copies of the two largest newspaper titles distributed are printed in plants located next to each other. The remaining products distributed by the company are printed in plants at other locations. These products are printed earlier in the evening and then delivered to the loading bay of Plant 1 at 10 pm every night.

The loading and transportation operations are guided by a fixed distribution plan. The distribution plan consists of distribution routes operated by pre-defined trucks. The routes are collected in loading groups based on a well-defined time table.

The design of the distribution plan had to take into account a variety of factors [Bäck 1993]. One of the most important factors is found at the end of the process chain – the deadline of the delivery operation.
The organisation of the carrying operation implies that all newspapers are delivered to the distribution centres two hours before the distribution deadlines and approximately 50% of the newspapers are delivered to the distribution centres four hours before the distribution deadline. The distribution plan is mainly guided by the following parameters:

- Production times and production speeds in the printing plants.
- Time needed for loading in the printing plants, for transportation, and for unloading of trucks at the different distribution centres.
- The location of and load to the 104 distribution centres operated daily.

In addition to these parameters, a number of other factors related to the service toward the readers and to the carrier work are taken into account:

- The delivery operation should be completed before 6 am on weekdays.
- The time needed to complete the carrying operation within a district should amount to two hours.
- A carrier should be able to manage two districts per night.
- As a consequence of the deadline at 6 am, the two-hour limit per carrier district, and the two districts per carrier and night condition – the newspapers must be delivered to the distribution centres before 2 am and before 4 am.

The printing plants are responsible for the printing and mailroom operations. The output from the mailrooms consists of a mixture of un-addressed standard bundles, often 30 or 40 copies per bundle, and addressed bundles with a pre-defined number of copies each intended for a predestined receiver.

Immediately after the first good copy is printed in each plant, the mailroom production – including, manufacturing and loading of bundles – starts. A certain number of prepared bundles can be stored in the loading systems of each mailroom, but the buffering routine is seldom used. Normally the prepared bundles are sent directly to pre-defined trucks. As most trucks load bundles in both plants, the distribution plan has to consider the starting time of the printing and the production capacity in each plant.

Product 1 is printed in straight runs in three presses and the distribution plan is based on an output of 110,000 copies per hour. This output corresponds to 1,800 copies per minute. A normal loading operation means that four trucks are loaded in parallel with a calculated speed of 450 copies per minute per truck.
Product 2 is printed in collect runs in two presses. The distribution plan is based on an output of 45,000 copies per hour. This implies that the mailroom must manage 840 copies per minute. Normally, four trucks are loaded in parallel, corresponding to a delivery of 210 copies per minute per truck.

The mailroom delivery schedules are based on ideal conditions. No bottle necks are considered — bundles produced in the stackers are supposed to be handled in the remaining operations without disturbances.

Important factors in the production and loading of bundles are the number of copies in each bundle and the loading capacity of the truck drivers, who manually pile the bundles on the platform of the trucks. Increasing number of pages in the newspaper means that the maximum possible number of copies per bundle is reduced. A reduction of the number of copies per bundle means an increased number of bundles per minute (at comparable press speeds), leading to an increased loading time for each truck. Under certain conditions, the bottleneck turns out to be the number of bundles a truck driver can load per minute. More than 15–20 bundles per minute is very difficult to manage. A truck distributing 6,000 copies from Plant 1 must load 150 bundles, if the average number of copies per bundle is 40. The loading operation takes at least 10 minutes from the first to the last loaded bundle (at a speed of 15 bundles per minute). If the average number of copies per bundle is reduced to 30, the number of necessary bundles increases to 200 and the loading takes another 3.5 minutes.

The maximum load and materials handling equipment in each truck varies. The largest trucks can carry approximately 8 tons and the smallest trucks 2 tons. The distribution plan considers the maximum load on each truck. The general rule is that each truck should manage a specific number of 0.5 kg copies. A copy of 500 grammes corresponds to approximately 100 broadsheet pages (45 g/m²).

The page count in the main product and the occurrence of inserted products vary from day to day, which leads to irregular utilization of the trucks. Certain days the load of each truck is close to the maximum load, but in general only 50–60% of the maximum load is reached.

For every route described in the distribution plan, the loading time in each plant and the distribution time to the distribution centres are considered. Every truck is connected to one or two routes. Trucks serving two routes load bundles in the plants, deliver bundles to the distribution centres, return to the printing plants and repeat the procedure. In general, a route consists of two or three distribution centres. Particularly in the case of trucks that operated two routes, the loading, transportation and unloading time were critical.
The time-frame from the completion of the loading until all distribution centres belonging to a specific route are managed, can be divided in two parts: time for transportation and time for unloading. The time for transportation is easily calculated but the time for unloading varies slightly depending on, e.g., the number of bundles delivered and the unloading method used (manual unloading of individual bundles or unloading of pallets).

5.4.3 Routines during the distribution

This section focuses on distribution-related activities that take place every night in the printing plants and within the distribution organisation. A rough division into sub-activities is the following:

- Loading operation in the printing plants.
- Transportation to the distribution centre.
- Unloading of bundles.
- Updating of carrying information regarding a specific district.
- Loading of newspapers to a specific district.
- Carrying operation.
- Reporting of carrying operation.

Every loaded truck that leaves the plants carries between one and five different newspaper titles. A majority of the trucks carry the two main titles and, in addition, the 40 first routes delivers other titles as well.

Approximately 75 routes are scheduled from the two plants between 00.30 am and 03.25 am. Before the loading operation starts, the truck drivers collect loading lists containing information regarding the number of bundles per product to each destination. Information regarding new subscribers and other kinds of information that influences the daily carrying operation are delivered to the distribution centre with the first truck every night.

During the observed period, the printing of Product 2 started at 11.30 pm every night and the printing of Product 1 started at 11.45 pm every night. Just before the production starts, the trucks in the first loading group are directed to the loading bay. The loading order is given by the distribution plan. As soon as good copies are printed and the loading bay in question is activated the truck loading starts. The trucks normally load between 25 and 300 bundles at each plant.

The first loading group is scheduled to depart at 00.30 am for further transportation to distribution centres and retailers given by the distribution lists. Every departure from the plants is immediately reported to a distribution database.
When a truck arrives to a distribution centre, a distribution foreman takes care of the printed distribution material delivered. The foremen are also responsible for directing carriers to the carrier districts operated by the distribution centre. If the distribution centre lacks carriers due to sickness or delays, the foremen are responsible for managing the situation. Lack of carriers can be handled either internally at the distribution centre, which is the case if a carrier operates an extra district to manage the absence, or through ordering of extra carriers from a centralised unit.

The carrying operation consists of several tasks. Initially the carrier goes through the printed information and updates the distribution information collected in the distribution book. Each of the 2 200 distribution districts are covered by a specific distribution book. Customers complaints are answered and returned to the responsible staff at the distribution company or the newspaper in question. The updated distribution book helps the carrier to identify the correct number of copies for the distribution district. When the copies are packed the carrying starts.

At 05.30 am, when most of the carrying operation is completed, the distribution centre foremen start an on-line reporting to a centralised distribution database. The reporting covers the arrival time of every truck and the status of all carrier districts – completed or delayed. If a carrier district is delayed the report also contains a prognosis regarding the completion time (hh.mm). In addition to the time- and status-related information, the reporting also connects specific carriers to specific distribution districts and provides information regarding carriers entitled to compensation due to delays.

The reported information is used as input to payroll systems, for generation of distribution reports used by the distribution company, and as input to the subscriber databases of the newspapers – enabling the customer service to inform the subscribers correctly regarding the status of the distribution operation.

5.4.4 The interaction between production and distribution processes

An analysis of the interaction between production and distribution was carried out for the period February 6 to June 5, 1994. The analysis is based on data from the distribution system and production reports from the two printing plants covered by the study. Data regarding production time and the accumulation of good copies in the two plants, the truck departure times from the plants and the number of delayed distribution districts were compiled. The data have been used for basic descriptive statistic calculations, curve plots and regression analyses.
The curve plots showing the output from the printing presses have been matched against curve plots of the output from the plants in terms of circulation on departing trucks. The departure times of the trucks were compared to the planned departure times. Furthermore, the delay costs have been calculated through the use of a simplified model based on the departure times from the plants. Daily information regarding the transportation delays and the number of delayed distribution districts have been collected from the distribution database. The daily need for extra carriers, managed by the centralised office, has also been identified.

<table>
<thead>
<tr>
<th>Date</th>
<th>Reg</th>
<th>Distribution centres</th>
<th>Total delay (minutes)</th>
<th>Late drops</th>
<th>Distr Carr SBB</th>
<th>Distr Late SBB</th>
<th>City distr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>940501</td>
<td>All</td>
<td>All</td>
<td>0</td>
<td>0</td>
<td>98</td>
<td>84</td>
<td>0</td>
</tr>
<tr>
<td>940502</td>
<td>All</td>
<td>All</td>
<td>-8766</td>
<td>206</td>
<td>232</td>
<td>185</td>
<td>77</td>
</tr>
<tr>
<td>940503</td>
<td>All</td>
<td>All</td>
<td>-4878</td>
<td>179</td>
<td>242</td>
<td>192</td>
<td>89</td>
</tr>
<tr>
<td>940504</td>
<td>All</td>
<td>All</td>
<td>-5446</td>
<td>168</td>
<td>269</td>
<td>204</td>
<td>82</td>
</tr>
<tr>
<td>940505</td>
<td>All</td>
<td>All</td>
<td>-21728</td>
<td>195</td>
<td>262</td>
<td>205</td>
<td>289</td>
</tr>
<tr>
<td>940506</td>
<td>All</td>
<td>All</td>
<td>-8971</td>
<td>182</td>
<td>274</td>
<td>211</td>
<td>119</td>
</tr>
<tr>
<td>940507</td>
<td>All</td>
<td>All</td>
<td>-9334</td>
<td>176</td>
<td>277</td>
<td>211</td>
<td>103</td>
</tr>
<tr>
<td>940508</td>
<td>All</td>
<td>All</td>
<td>-9570</td>
<td>186</td>
<td>270</td>
<td>223</td>
<td>123</td>
</tr>
<tr>
<td>940509</td>
<td>All</td>
<td>All</td>
<td>-896</td>
<td>56</td>
<td>255</td>
<td>201</td>
<td>83</td>
</tr>
<tr>
<td>940510</td>
<td>All</td>
<td>All</td>
<td>-6574</td>
<td>163</td>
<td>262</td>
<td>208</td>
<td>84</td>
</tr>
<tr>
<td>940511</td>
<td>All</td>
<td>All</td>
<td>-2362</td>
<td>109</td>
<td>244</td>
<td>194</td>
<td>74</td>
</tr>
<tr>
<td>940512</td>
<td>All</td>
<td>All</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>78</td>
<td>0</td>
</tr>
<tr>
<td>940513</td>
<td>All</td>
<td>All</td>
<td>-1392</td>
<td>69</td>
<td>248</td>
<td>199</td>
<td>110</td>
</tr>
<tr>
<td>940514</td>
<td>All</td>
<td>All</td>
<td>-2366</td>
<td>109</td>
<td>261</td>
<td>211</td>
<td>95</td>
</tr>
<tr>
<td>940515</td>
<td>All</td>
<td>All</td>
<td>-14655</td>
<td>218</td>
<td>262</td>
<td>214</td>
<td>98</td>
</tr>
</tbody>
</table>

Table 5–1: A view of the distribution information system (translated in English).

Table 5–1 shows a typical screen of the distribution system and needs a few comments. The columns used are “Total delay” (total truck delay), “Distr. City” (extra carrier operated districts) and “Late distr.” (delayed carrier districts).

“Total delay” is a key figure giving the total truck delay in minutes for all distribution centre deliveries. An example: A route covers three distribution centres. The truck operating the route is 35 minutes delayed at the first stop, 40 minutes delayed at the second stop, and 40 minutes delayed at the third stop. The key figure for this specific route is 35+40+40=115 minutes. “Total delay,” is the accumulated result for all routes on a specific day.
Table 5–2: Statistics regarding daily average figures of delayed truck departures and the number of delayed carrier districts.

The number of newspapers loaded on the trucks varies and a forty minute delay of a truck can, e.g., imply either 75 delayed carrier districts (large truck, 15000 newspapers) or 15 delayed carrier districts (small truck, 3000 newspapers). The average truck load, 6 000 copies, has been used in the calculations of the delay costs.

The reported figures from May 3 1994 (940503) show that the total truck delay is 4878 minutes. Furthermore 179 out of 237 drops were reported delayed. In order to achieve a more manageable key figure, the total truck delay per day has been divided by the number of daily truck deliveries reported. The resulting key figure gives the average truck delay in minutes per delivery.

Table 5–2 shows statistics regarding delayed truck departures and the number of delayed carrying districts during the observed period. The average transport was 22 minutes late and the standard deviation was relatively large, 17 minutes, which implies that the outcome varied greatly between different days.

The average number of delayed carrier districts over the period was 252 (11% of the districts) and the standard deviation was 173. In terms of newspaper copies an average of 50 000 were delivered too late every day. The standard deviation was 35 000.
In figure 5–2, the relationship between the transportation delay and the number of delayed carrier districts has been plotted in order to determine the correlation. The wide-spread scattering can be explained by the fact that the load of the trucks varied as well as by carrier absence.

Figure 5–3: The correlation between the average delay of the truck departures and the number of delayed carrier districts during weekends (planned distribution completed before 07.30 am).
A simple regression analysis was performed in order to show the correlation. The regression curve shows that even very small delays result in approximately 75–200 delayed carrier districts. These delays were mainly caused by absence.

The graph depicting the weekend distribution shows another relationship due to the fixed production and distribution plan but a later delivery deadline, 07.30 am. During weekends an average departure delay of 30 minutes caused 200 delayed carrier districts and an average departure delay of 60 minutes caused approximately 350 delayed carrier districts.

**A general distribution delay cost calculation model**

A general delay cost calculation model can be designed in order to estimate how production delays influence the distribution costs. Delayed production in the printing plants influences a number of subsequent distribution operations. Every route has a unique delay cost function. In the function a number of parameters must be included:

- Route specific delay cost compensation to the transportation company as a function of delay time.
- Route specific delay cost compensation to the carriers as a function of delay time.
- Delay cost compensation to other distribution related activities as a function of delay time.

Other distribution related activities can be, e.g., networked joint distribution operations where bundles are reloaded at a specific time and place for further transportation throughout the country. This happens when a truck carrying copies of different titles to a specific part of the country is forced to wait for one single delayed title.

As all routes are unique with respect to the number of carrier districts, drops, reload operations, and carriers – the price tags vary between different routes.

**An example of an applied distribution delay cost model**

In order to analyse the interaction between the production in the printing plants, the loading operation, and the distribution – nine days with different outcome from the production were studied in detail. Six of the days covered the production in the plants, all truck departures and detailed calculations of the delay costs. The remaining three days were analysed more briefly – truck departures were identified and delay costs were calculated. The objective of the analysis was
to identify how the production in the printing plants influences the truck departures, the number of delayed carrier districts and the delay costs. The number of analysed days was limited due to the extensive manual work required. The following steps were carried out:

- The number of delayed carrier districts was plotted as a function of the transportation delay for each day.
- Nine days with different characteristics with respect to the average truck delay and the number of delayed carrier districts were chosen.
- The accumulated output from Plant 1 and Plant 2 was compared to the accumulated output on the departing trucks. All departure times and the loads on each truck were compiled.
- A model for calculation of the delay cost as a function of the departure time was constructed.
- A model for calculation of the delay cost as a function of the total transportation delay was constructed.

The difference between the observed days was mainly that the number of delayed carrier districts varied as well as the relationship between the total transportation delay and the number of delayed carrier districts.

The developed model for delay cost calculation, is based on a mixture of facts and assumptions. The facts originate from the reported departure times, agreements with transportation companies, and agreements with the transport unions.

An assumption was made that 200 copies – the average number – were delivered in every carrier district. This means that a delayed truck carrying 5000 copies implies 25 late carrier districts. Delay costs were assumed to occur as soon as a truck was more than 30 minutes late in leaving the plants. This assumption is not completely correct. Compensation for delay is only paid out if the carrier has actually been waiting for the delayed truck, and delay compensation is not paid until after 02.20 am. But the number of trucks delivering before 02.20 is very small.

Information regarding the arrival times of the trucks has not been used. An analysis shows that the departure time from the plants is a good indicator – the times used for transport and unloading were relatively constant during the observed period. A truck leaving the printing plant 15 minutes late was, in general, 15 minutes late at the distribution centres operated on the route.

Increased costs in printing plants and publishing houses, reduced advertisement volume and subscriber income as well as costs for goodwill losses related to delays have not been treated in the model or observed in the study. These aspects
ought to be considered if a total evaluation of the influence of delays is attempted. When it comes to severe delays, the total economic influence from non-distribution related factors can be assumed to be considerable.

The model presented for delay cost calculation should not be seen as precise, but it will support the estimation of the delay costs caused by deviations from the production and distribution plan.

In general, the working hours of the carriers imply that delay compensation is paid when a truck departs 30 minutes or more after the scheduled departure time. In practice, departures 25 minutes too late from the plants could imply no delay costs, but a general delay of the first transports to all distribution centres of 30 minutes could cause delay costs of $60 \times 225$ SEK (transportation companies) plus $1 \,350 \times 20$ SEK (compensation for one period regarding the corresponding carrier districts) – a total delay cost of approximately 40000 SEK for minute 30 to minute 39.

In addition to the compensation for delays, more extensive disturbances caused a shortage of carriers. If the delivery to the distribution centre is more than 1.5 hours late the carriers have the right to leave without losing their basic salary. If the carrier district is handed over to an extra carrier, an extra cost of 420 SEK is incurred. In the delay cost model, the number of carrier districts operated by extra carriers under normal conditions (no production delays) were assumed to be 80 and use of more than 80 extra carriers have been assumed caused by production delays.

Every night 2.3 trucks operated an average distribution centre. Distant situated distribution centres were often just operated by one truck, but the city distribution centres were operated by 3 or 4 trucks every night.

The values calculated in the detailed analysis of the delay costs have been plotted in a diagram showing the distribution delay cost as a function of the average departure delay. A regression analysis resulted in a function for delay cost calculation. The validity of the function was tested. The mean value of the departure delays for all days during the observed period was used in the function and the total delay cost for the period was calculated. A manual approximation was made for days with an average departure delay exceeding 60 minutes.

The regression analysis shows that even small average delays generate delay costs. An average departure delay of 15 minutes results in delay costs of approximately 20 000 SEK. Detailed observations have shown that the underlying delays varied. Some trucks left on time or ahead of schedule, and other trucks left 30 to 45 minutes to late and generated delay costs.
The validation calculations resulted in estimated delay costs reaching approximately 9 million SEK for the observed period, or 27 million SEK per year. The estimated values were compared to the real delay costs for the period. During the first 6 months of 1994, the accounts showed delay costs of 9.5 million SEK corresponding to 19 million SEK per year. But some costs handled by the model could not be traced in the economy system. One of these was the use of extra carriers. The 8 million difference between the theoretical delay cost and the outcome from the records, corresponds to 50 carrier districts daily operated by extra carriers. The reports show that an average of 30 extra carrier districts were related to delays. The model for estimation of delay costs seems to be rather accurate.

5.4.5 An enquiry to the distribution centre foremen

In order to identify the need for information at the distribution centres, especially status information from the printing plants, a questionnaire was sent to all distribution foremen in May 1994. The questionnaire contained questions regarding the information system used at the distribution centres and the occurrence of carrier shortage due to delays. Furthermore, the foremen were asked if an improved real time information exchange could reduce the number of delayed carrier districts.
The questionnaire consisted of 25 questions, 19 with four different answering alternatives and another 6 questions to be answered in words and figures. The results have been completely reported in [Stenberg 1994a].

The frequency of reply was 67% – 70 persons of 104 possible answered the questionnaire. The average distribution centre contains 22 carrier districts and delivers 4 400 newspapers.

If the distribution foremen were better and earlier informed regarding delays and got estimates of the truck arrival time to the distribution centres, 74% of the foremen thought that the carrier operation almost always would be more easily operated compared to the present situation. Another 13% thought that the carrier operation would be more easily operated quite often.

If estimates regarding the need for extra carrier could be performed as soon as deviations from the production and distribution plan occurred, 67% of the carriers thought that the number of delayed newspapers could be reduced. The 67% were divided in two categories – 44% thought that the number of late deliveries almost always could be improved and the remaining 23% thought that the delivery could be improved quite often.

A 60 minute delay implies that 1–2 extra carriers per distribution centre are needed, at a delay of 90 minutes 2–3 extra carriers are needed and a delay of 120 minutes leads to a need for 4–6 extra carriers. The need for extra carriers due to delays is quite different between the different distribution centres.

5.4.6 Summary

The newspaper distribution is a strictly planned and optimised network of operations. The conditions in most Swedish newspapers imply that the printing and distribution operations are performed in parallel – mainly between 12 pm and 6 am in the early morning. A large number of professional newspaper carriers deliver the newspapers to the readers. Delayed production implies that hundreds, or even thousands of carriers are waiting for the newspapers. In general, the carriers will get economic compensation for any delay.

The organisations, routines and systems surrounding the distribution operations are closely linked and mutually dependent. Delayed press starts in the printing plants, deviations from the calculated production speed and interruptions during the production, immediately cause disturbances in the distribution operation. There is a complex interaction between the product planning, the prepress work at the newspaper, the operations in the printing plant and the distribution organisation.
The outcome from the production process in the printing plants varies within a wide range. In this case study, no analysis has been performed in order to identify why the disturbances and delays occur, but a reflection made is that days of more complex production (higher page counts, inserting operations, and increased number of bundles) seem to have problems more often.

In this case, the production and distribution plans are fixed, and based on a production that starts on time and on a pre-defined constant production speed in the printing presses. Deviations from the production plan, caused by delayed production starts, production speeds below the planned production speed and unplanned stops, immediately cause delay costs and late delivery to the customers.

The simplified model for delay cost calculation presented here, uses the truck departure from the plant as a parameter for delay cost calculation. The time needed for transportation, unloading, and carrier operations turns out to be quite constant. The delay cost calculations show that even small average truck departure delays cause considerable delay costs.

The newspaper product and the newspaper publishing process are far from static phenomena, and the distribution operation must to a certain extent manage the dynamics. The ideal conditions assumed in the optimised distribution plan of this case occur very seldom. Great efforts should be made in order to achieve more reliable production starts and improve the process runnability in the printing plants. In parallel to this work, there seems to be a need for more fault tolerant distribution plans and plans that better match the variations in outcome from the production process.

The results of the questionnaire show that the distribution organisation, including the carrier foremen, needs to be better informed regarding delayed production starts and the occurrence and length of production stops. The carrier foremen believe that estimates regarding the time for the truck deliveries will facilitate the planning of the carrying operation and reduce the number of delayed copies.
5.5 Case study E

5.5.1 Introduction

The production processes of newspaper printing and mailroom operations have traditionally been quite straightforward. The printing presses, until the 1970’s often using letterpress technology, had the ability to mass produce newspapers in one colour and the operations in the mailroom were often restricted to manual counting of copies and strapping of bundles [Petersen 1985].

The changing market situation and the development of new technology have, especially since the end of the 1980’s, led to more complex and heterogeneous products and production processes. Today, the market demands and technology permits a targeted production with multiple editions and extensive use of four-colour pages and preprinted inserts [Fuchs 1990], [Fuchs 1995a], [Fuchs 1995b].

A modern production plant can use a number of different methods in order to prepare the newspaper product. In Europe, the possibilities of printing colour pages are constantly increasing. Fifteen years ago, the average was three inking units per web equal to an average of 2+1 colours. Today, the average is five inking units per web which corresponds to 4+1 colours per web [N.N. 1994e]. In order to provide flexibility in the positioning of the colour pages in the product, the individual webs in the printing press can be splitted, moved or turned [Nicholson 1975], [N.N. 1994c], [N.N. 1994d].

Despite the development of larger and more flexible printing presses, it is no longer obvious that the product will be finished in the printing press. The development of equipment and control systems in the mailroom means new conditions for newspaper publishing. Parts of the product can be printed in advance and later inserted into the main product. The method can also be used in order to obtain targeted products by varying the preprinted products inserted into the main product [Fuchs 1995b].

The number of pages and the occurrence of inserts often show great variations from one day to another. In addition, several possible production methods can often be used for a specific number of pages. The production in the printing plants has become diversified.

But newspaper production and distribution is a time critical operation, especially in the Nordic countries and in other countries where newspapers are practising home delivery early in the morning (often before 6 am). In these cases, the distribution operation is often carried out by trucks and newspaper carriers.
Delays may cause great damage to the newspaper – both in terms of goodwill losses, reduced income and increased costs. Despite the diversified production, the timetables used are often the same from day to day. The deadline of the press start is seldom changed in order to better manage complicated production conditions.

5.5.2 Objectives
A large case study was carried out during 1995–96, in which more than 300 production runs in two Swedish newspaper printing plants, printing the same morning newspaper, have been analysed. The main interest has been the relationship between product, production method and production output. Special attention has been paid to the possibility of predicting the production output for a given product with a certain probability.

The products and production methods have been described in terms of a number of parameters:

- Number of pages in the main product.
- Number of webs and the individual web-leads during the printing of the main product.
- Occurrence of inserts and the number of pages, physical format and paper type used in the inserts.
- Total number of pages in the product.

One productivity related key figure has been extensively used – the net production speed, measured in good copies per hour (cph). The net production speed is defined as the number of ordered copies divided by the production time from the first to the last good copy printed.

A minor study was devoted to the occurrence and length of unplanned stops. This additional study was carried out at the end of the project.

The project and its observations have been carried out on a global level. The underlying, probably physical and mechanical, reasons for the variations in production output have not been studied.

Focus
The focus of the study is on morning newspapers printed in double round – double width offset presses with satellite printing units. The number of pages in the
main products studied varied from 32 to 76 pages. In general, the main products consisted of three sections. Each section was glued, and due to the collect run, the page count in one of the sections must be equal to the sum of the page counts in the remaining sections.

In addition to the main product, different preprinted products were often automatically inserted in the mailroom. The maximum number of inserts added to any main product was three. The paper type and physical format of the inserts varied over a wide range – from broadsheet and tabloid products on newsprint via magazines printed on LWC-paper to paying-in forms.

A maximum of 80 pages can be printed in a collect run. The number of possible four-colour pages is 24, and 16 additional pages can be printed in two colours. One of the presses is drawn in figure 4–7. The number of ordered copies printed in each of the studied printing presses varied from approximately 50000 to 75 000 each night.

5.5.3 Methods of investigation

Case study

The study has been performed as a case study. All the observed productions dealt with the same newspaper product, a national newspaper printed on four presses at three locations. The product was a daily national morning newspaper in broadsheet format printed on 45 g/m² newsprint. The major part of the study covered all productions from 2 January until 31 May 1995. The two printing plants observed (Plant 1 and Plant 2) printed two separate editions of the same product during the period. In general, the editions were quite similar, although the page count was often slightly reduced in the edition printed in Plant 2.

Analysis of product parameters and production methods

A number of product and production related parameters were defined in collaboration with specialists at the newspaper and in the printing plants. Data regarding the chosen parameters were collected from printing orders and production reports. Data regarding the insert parameters (physical format, paper grade) were obtained by manual inspection of the inserts during the period.

In the first phase of the study, data from 289 editions and 289 production runs were collected. The material covered 100% of the production runs with this particular newspaper product in the period 2 January until 31 May 1995.
During the second phase of the project, production reports relating to 77 productions in the period 1 August 1995 until 30 April 1996 were studied. These studies focused on the number of pages in the main product and on the occurrence and length of disturbances.

Sources of errors

Many of the reports had been put together manually and some information was sometimes lacking. Reasonable assumptions have been made in such cases. Information manually compiled may be unreliable but, due to the large number of observations, the general conclusions should be valid.

The key figure used, the net production speed, may be misleading. The production speed in the printing presses may sometimes be restricted by external non-production-related factors. One example is a lack of distribution trucks due to an early press start. The occurrence of external disturbances is relatively rare and this probably influences the result only slightly.

The production equipment used is from the late 1980’s and is in general well functioning. The production staff is considered to be capable and familiar with the equipment.

A problem in the study is the great variety of products and production methods. Although a large number of products and productions have been observed, the occurrence of certain specific types of production runs can be limited.

Validity of the results

The results have been presented to and discussed with experts from different departments at the newspaper and in the printing plants. These representatives have approved the methods used and the results obtained.

5.5.4 Results

Average net production speed

The frequency of different net production speeds has been plotted. Initially, separate curves were constructed for the two printing plants. The shapes of the frequency distributions in the two plants were almost identical and a resulting curve was constructed, as shown in figure 5–5. Both in Plant 1 and in Plant 2, the average net production speed was close to the total average of 23300 copies per
hour per printing press. In Plant 1 the standard deviation was 2850 and in Plant 2 the standard deviation was 3200. The larger standard deviation may depend on the smaller number of printed copies in Plant 2.

![Histogram showing the frequency distribution of the average net production speed in the 289 productions observed.](image)

The histogram covers a large interval – from approximately 13000 copies per hour to 31000 copies per hour. This means that the time needed for the production of 75000 good copies varied from 2.4 to 5.2 hours.

**Bay window assembly**

One web-lead related operation has been given particular attention – bay window assembly. A bay window attachment consists of a vertical stand of idler rollers mounted in the line of the press on the outside of the angle bar superstructure. It receives webs at one level and returns them at another, enabling the position of monochrome and colour pages from different webs to be interchanged in the signature [Nicholson 1975].

Interviews with the press crews and production managers in the observed plants as well as in other plants earlier observed, have indicated that bay window assembly is considered to be an unreliable production method, increasing the occurrence of web-breaks and reducing the production speed.

The first analysis is based on 59 productions – 23 productions using bay window assembly and 36 similar productions without the use of bay window assembly. Graphs, data and basic statistics are presented in figure 5–6.

The results in this analysis show that the average press speed using bay window assembly is approximately 1150 copies per hour less than when bay window was not used. For page counts below 48 pages and above 60 pages, the use of
bay window assembly seems to have no significant influence on the average press speed. A larger number of production runs is necessary to obtain a more reliable general result.

In the 48–60 page area, a difference in average net production speed is observed. 33 similar productions have been identified – 16 including bay window assembly and 17 without bay window assembly. The difference in average press speed in this segment is almost 2 000 cph.

Altogether the results regarding bay window assembly must be interpreted carefully as a multiple regression analysis (shown in table 5–3) using a larger amount of data does not indicate any significant reduction in net production when bay window assembly is used. Further and more extensive studies are necessary to get more reliable results.

Figure 5–6: Regression plots and statistics from the comparison between bay window and non-bay window productions.
Inserting

Insert operations are common in the studied plants. During the period of study, there were inserts in more than 40% of the observed productions. The most common inserts were preprinted tabloids of 8 to 24 pages. In addition to inserting of preprinted supplements [Thoyer 1995] – broadsheet and tabloid products on 45 to 60 g/m² newsprint – products previously printed outside the plant were also inserted in the mailroom.

The two plants use the same kind of mailroom equipment although some minor differences were observed in control systems and in the ability to separate the printing presses from the mailroom production.

The total number of productions observed was 222, 130 without inserting and 92 productions involving inserting operations. The curves in figure 5–7 represent 3rd order polynomial regression plots based on the average net production speed in Plant 1. The shapes and positions of the curves are similar for the two plants. In both plants, the insert operations reduce the average net production speed by approximately 2 000 cph for page counts ranging from 40 to 60 pages – approximately 80% of all products are found within this area. For products containing less than 40 and more than 60 pages, the difference in average net production speed is less clear, but the results must be interpreted with care due to the limited number of observations.

For productions without inserts, the average net production speed in Plant 1 was 24 731 cph and the standard deviation was 2 521. In Plant 2, the corresponding net production speed was 24 124 cph and the standard deviation was 3 140. The average net production speed for all the observations of inserting productions is 21 825 cph in Plant 1 and 21 912 in Plant 2. The standard deviation is 2961 in Plant 1 and 2 869 in Plant 2. A summary of the statistics is given in table 5–3.

A more detailed analysis shows that the insertion of tabloid and broadsheet products into the main product caused the greatest reductions in net production speed. In order to create a model to forecast the net production speed of main products with inserted tabloid or broadsheet products, the relationship between the net production speed and the total number of pages – main product plus inserts – was analysed.
Figure 5–7:  Statistics and regression plots of the relationship between page count and average net production speed in productions with and without inserting.
The page count regarding inserts was transformed to broadsheet pages – two tabloid pages equal one broadsheet page. Since the results of the analyses have shown similar results for the two plants, all production statistics have been plotted in one figure. Data from 92 productions have been compiled and the resulting plot is shown in figure 5–8.

The resulting regression plot shows that the net production speed curve decreases steadily when the total number of pages increases from 44 to 68. Above 68 pages, the loss in net production speed seems to accelerate when the total number of pages increases.

The influence of externally printed (non-newsprint) inserts was less clear, but it is difficult to draw conclusions covering all possible combinations of main products, supplements and inserts. The physical format, paper type and previous handling of the products may strongly influence the runnability in the mailroom. The number of observations in the study regarding externally printed inserts was small.

The equation for the regression plot is:

\[ y = -0.0883x^3 + 16.227x^2 - 1058.4x + 46898 \]

\[ R^2 = 0.2563 \]

**Figure 5–8:** Regression plot based on all productions in which tabloid and broadsheet products were inserted into the main section. The statistics from the two plants have been combined. The x-axis represents the total number of broadsheet pages in the main section and inserts.
A multiple regression analysis

In order to use the complete data material in parallel, a multiple regression analysis [Triola 1994] of which parameters that have the strongest impact on the average net production speed was performed. The result of this analysis is presented in table 5–3. The average net production speed is the dependent parameter and the influence from seven independent parameters have been validated. The independent parameters tested were the page count in the main section (Pages), bay window assembly (BW), occurrence of narrow (40 centimetres) webs in the superstructure (KNIFE), and the impact from one (Ins1), two (Ins2) and three (Ins3) inserts in parallel.

The p-values of Pages (p<0.001), Ins1 (p<0.001) and Ins3 (p=0.0633) suggests that the multiple regression equation has good overall significance and is usable for predictions. The result confirms that the page count and the occurrence of inserting operations reduces the average net production speed.

In this study the use of bay window assembly or the use of narrow webs in the superstructure do not play a major role in the reduction of the average net production speed – other parameters seem to have a stronger influence.

<table>
<thead>
<tr>
<th>Count</th>
<th>Intercept</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>Std. Coeff.</th>
<th>t-Value</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>289</td>
<td>30273,388</td>
<td>30273,388</td>
<td>0</td>
<td>-75,783</td>
<td>-34,567</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>R</td>
<td>0.489</td>
<td>-121,935</td>
<td>16,471</td>
<td>-391</td>
<td>-7,403</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>BW</td>
<td>319,382</td>
<td>401,144</td>
<td>.043</td>
<td>.796</td>
<td>.4266</td>
<td></td>
</tr>
<tr>
<td>KNIFE</td>
<td>233,189</td>
<td>460,315</td>
<td>.027</td>
<td>.507</td>
<td>.6128</td>
<td></td>
</tr>
<tr>
<td>Ins1</td>
<td>-87,071</td>
<td>16,088</td>
<td>.322</td>
<td>-5,412</td>
<td>&lt;.0001</td>
<td></td>
</tr>
<tr>
<td>Ins3</td>
<td>253,467</td>
<td>135,961</td>
<td>.111</td>
<td>1.864</td>
<td>.0633</td>
<td></td>
</tr>
</tbody>
</table>

Table 5–3: The result of a multiple regression analysis of the parameters having negative impact on the average net production speed.

The reduction in net production speed

The study of the frequency distribution of the net production speed shows that it varied over a wide range. Further analyses have shown that the net production speed is influenced by inserting operations.

Discussions with representatives of the printing plants have indicated that the production speed (cruising speed) normally varies in the interval 27000–31 000 cph. Complicated productions may lead to a reduction to approximately 25000
Production speeds below 25 000 cph are unusual. The observations show that the net production speed varies from 13 000 to 31 000 cph. The main reason for the differences between the cruising speed and the net production speed seems to be unplanned disturbances.

The disturbances may be caused by, e.g., web-breaks, technical problems related to the printing presses or mailroom equipment, or quality problems related to the products.

In order to evaluate roughly the occurrence of production stops, 50 randomly chosen productions with 3 webs (36–48 pages) and 27 productions with 5 webs (68–76 pages) were analysed in detail. The evaluation is based on data from Plant 2 during the period from August 1995 to April 1996. This period was chosen because of available data. The 3-web productions are randomly chosen and the 5-web productions represent all 5-web production runs during the period.

<table>
<thead>
<tr>
<th>Samples (no)</th>
<th>Average net prod. (copies per hour)</th>
<th>Standard deviation (copies per hour)</th>
<th>MTBM (hh:mm)</th>
<th>MDT (hh:mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 webs</td>
<td>50</td>
<td>23872</td>
<td>3.551</td>
<td>3.62 0.29</td>
</tr>
<tr>
<td>5 webs</td>
<td>27</td>
<td>20715</td>
<td>2.736</td>
<td>1.76 0.21</td>
</tr>
</tbody>
</table>

Table 5-4: The occurrence, MTBM – Mean Time Between Maintenance, and length, MDT – Mean Down Time, of unplanned productions stops in Plant 2.

Data regarding all production stops and the length of each stop were collected from production reports. Methods normally used in the context of quality assurance were used in order to identify relevant key figures – Mean Time Between Maintenance (MTBM) and Mean Down Time (MDT) [Bergman 1985]. All production methods were included, i.e. the evaluation did not distinguish between inserting and other production methods. The information regarding the occurrence of stops and the lengths of the stops was collected from manual reports. The reports did not cover minor stops (5 minutes or less).

The evaluation shows that stops were much more common in the 5-web productions. The MTBM was 1.75 hours compared to 3.62 hours in 3-web productions – see table 5-5. The MDT was 0.21 hours in the 5-web productions and 0.29 hours in the 3-web productions. The results indicate that the 5-web productions meet with problems more often, but that some of the additional problems can be handled quite rapidly.

If the number of copies printed daily in Plant 2 is taken into consideration, the results indicate that in 3-web productions approximately one 17 minute stop occurs every second day. In the 5-web case, an average of one 13 minute stop occurs every production run.
A 20 minute stop during a production of 50000 copies normally printed at a speed of 27 000 copies per hour means that the average net production speed drops from 27 000 cph to approximately 22 900 cph. This is probably the reason for the relatively large standard deviation in the observed productions.

The waste figures

Data regarding the amount of waste was collected from the two plants. The available waste figures did not completely cover all kinds of waste [IFRA 1983], [IFRA 1987b], [IFRA 1990], [Trollsås 1990]. Only waste occurring after the folders of the printing presses was included – start up waste, printed waste, and mailroom waste. Good copies printed in excess of the number of ordered copies have also been defined as waste and included in the analyses.

The number of ordered copies varied slightly from day to day and between the plants. In Plant 1, the number of ordered copies was approximately 85000 copies per production and press. In Plant 2, less copies were ordered – approximately 50 000 copies in the press observed.

The share of waste from the printing presses increased with the number of pages. The average share of waste started at approximately 3–4% (Plant 1, respectively Plant 2) in 36 page productions and the average increased slightly with the page count. A production of a 76 page product generated an average of approximately 6% waste. The standard deviation is large – approximately 2%. An observation related to the standard deviation in Plant 2 was that 48 and 64 pages products (only full width reels) were very stable with respect to waste figures.

In production runs without inserts, the mailroom waste and occurrence of good copies printed in excess of the number of ordered copies seems to be quite constant independently of the number of pages. The average waste figures in these cases were 1.2% in Plant 1 and 2.2% in Plant 2. The standard deviation is very large in both cases – almost equal to the mean value in each plant.

In production runs involving inserting operations, the average mailroom waste and the number of excess copies, increased slightly with the page count. Small page numbers had an average of approximately 3%. The occurrence of waste increases with the page count, and 72–76 page products have average waste figures of 5–6%. The standard deviation for similar production runs were in most cases very large – often close to the mean values.
According to the previous results, the average total waste varies within the range 4–10% and the average standard deviation is 3–4%, depending on the production method and printing plant. Higher page counts and the occurrence of inserting increases the amount of waste. The trends in the two plants appear to be clear, but the waste figures and standard deviation are in general slightly larger in Plant 2, probably depending on a smaller circulation printed, causing a larger share of start-up waste.

Figure 5–9: The amount of waste from the printing press in Plant 1. The waste figures are compared to the number of pages in the main product printed.

Figure 5–10: The total waste in Plant 1 in productions including inserting operations in the mailroom.
5.5.5 The time schedules

From earlier studies of newspaper production, it is known that most Swedish newspaper production and distribution operations follow the same time schedules every day [Stenberg et al. 1995]. The available time span for the production and distribution processes is determined by a mix of editorial requirements, the available production capacity, and the organization of the distribution process.

In the two plants observed in this study, the time of press start is the same every night. In very special cases, the time span is increased – usually the press start is moved to an earlier time. The necessity of earlier press start is decided from time to time.

The scheduling of the distribution process is complicated. The distribution process usually involves a large number of trucks, vans and carriers. Often the distribution optimization is based on a certain press start time and a certain net production speed. Minor deviations from the production plans in the printing plants can be managed by the distribution plan, but more extensive deviations lead to serious problems in the distribution operations. Disturbances lead to considerably increased distribution costs and late delivery to the customers [Stenberg et al. 1995].

5.5.6 Discussion

The histogram of the observed average net production speed values shows that the frequency follows a normal distribution curve. The average net production speed for all observations was 23 300 cph and the standard deviation was 2 850 in Plant 1 and 3 200 in Plant 2. The cruising speed in the presses varied between 25 000 and 31 000 cph depending on the product and production method used.

A more detailed analysis makes it possible to identify a clear pattern. The net production speed was progressively reduced at higher page counts. The data for productions without inserting and the use of bay window assembly could be divided into three stages. In stage one, the average net production speed goes from 28 000 to 25 000 cph and covers page counts from 32 to 40 pages. In stage two, the average net production speed drops linearly from 25 000 to 22 000 cph for page counts from 40 to 64 pages. In stage three, the average net production speed drops more steeply from 22 000 to below 18 000 cph for page counts from 64 to 76 pages.
Figure 5–11: Percentile plot of two kind of products – complicated products with high page counts and inserting of preprinted tabloid supplements and easy non-inserted products with relatively low page counts.

The use of bay window assembly does not seem to influence the net speed in 3-web productions (less than 52 pages). For page counts ranging from 52 to 64 pages, the net speed was gradually reduced compared to productions without bay-window. The loss in net production speed increased with higher page counts. At 64 pages, the difference was approximately 2000 cph. No bay-window productions have been observed for page counts higher than 64 pages.

The influence of inserting operations is strong, especially for page counts ranging from 40 to 64 pages. The net production speed was reduced by approximately 2 000 cph compared to normal production. The insertion of tabloid and broadsheet products printed on newsprint seems to have the greatest negative influence. The total number of pages (main product and inserts) showed a linear reduction up to a total page count of 64 pages. Above a total page count of 64, the reduction in net production speed was greater. Products containing more than 80 broadsheet pages seem to have an extremely low process runnability in terms of average net production speed.

Because of the fixed press starts used today, the reliability of the production schedules varies over a wide range. The results of the study show that the probability of keeping up with the time schedule is approximately 90% when a 40 page product without any inserts is produced. The probability of keeping the production plan is, however, only approximately 30% when a 68–72 page product with a tabloid insert is produced.
5.5.7 Summary

The net production speed is strongly influenced by the products and the production methods used. The products and production methods used can be divided into a limited number of classes. The net production speed is decreasing with higher page counts. In addition, the use of bay window assembly under certain conditions results in an accelerated decrease. Inserting operations, especially of tabloid or broadsheet supplements in main products with high page counts, strongly reduce the net production speed. The standard deviation of the net production speed is larger for complicated products and production methods.

A general conclusion is, that the standard deviation for most kind of products and production methods observed varies from 2000 to 3 500 cph. The relatively large standard deviation is caused by differences in cruising speed and by the frequency and length of unpredictable disturbances. The productions observed lasted approximately 2 to 3 hours depending on the number of good copies ordered. This means that a web-break stopping the production for 20 minutes reduced the net production speed by approximately 2 800 to 4 000 cph.

A brief survey of the frequency and length of production stops shows that the production of main products containing 36–48 pages had a MTBM of 3.79 hours and a MDT of 0.29. Production of products containing 68–76 pages had a MTBM of 1.75 hours and a MDT of 0.21.

A completely dynamic scheduling is probably very hard to introduce, but scheduling more flexible than the present is possible. The flexible scheduling should be based on a classification of the products, production methods, and the estimated net production speed. The results from the study indicate that a more flexible management of the scheduling of the production and distribution processes would give many advantages.

The study is based on a limited number of empirical results but the trends appear to be valid. The figures describing net production speed and standard deviation will probably be much the same in many other plants, but differ a lot in others. However, the figures are not the most important contribution of this study. The most important result must be the conclusion that the net production speed varies within a wide range, but can be estimated with at a certain probability.

The results of the study are mainly based on one product and its production in two plants. But similar characteristics of products, production methods and equipment used in the plants, can be found in a large number of cases all over the world. All newspapers certainly do not produce the same variety of products.
as in the described cases, but many newspapers are mixing production with and without inserting and vary the number of pages in the main section and in the inserts from day to day. The occurrence of this kind of production will probably further increase as the general trend is toward increased editioning and targeting through the use of preprinted inserts.

Future work should address a number of areas related to the identified problems. An additional study covering a larger number of newspapers and production plants would result in more general models. To manage the problems observed, an initial move might be to develop tools supporting the planning of the product, the production and the distribution.

In the long term, the objective must be to increase the process runnability through development of the processes and the resources. This work must include analyses and development of routines, the production systems, and the material used in the production.
6. Expectations on future development

6.1 Introduction

The newspaper product is under competitive pressure from a number of other products. The objective of this chapter is to discuss the changing market conditions for the printed newspaper product in the coming five to ten years. As the development of new technology and competing products is now very fast, the discussion is mainly concentrated at the five year perspective. The market conditions and their impact on the printed product and its production will be in focus. The main question is if and how the printed product and its production will change.

Several reports have been published on the subject. This chapter is partly based on a number of the latest available reports discussing the present and future media landscape. Some of the articles have had a Nordic perspective. Furthermore, a number of scenario interviews have been carried out with executives of successful newspaper companies. Finally, the results from a questionnaire sent to 100 newspaper executives in Sweden are reported.

It is always difficult and sometimes dangerous to make predictions about the future – the final outcome is never known until afterwards. But these predictions will help to point to some likely directions of development and to support a discussion on whether the expected future developments will change the need for production management, especially on a global level.

6.2 Market trends

The publishing model of the newspaper has been developed and refined during centuries. The newspaper has many characteristics – content mix, navigational structure, social functions, etc. – that are difficult or impossible to transfer to an on-line, screen-based medium. Paper based newspaper publishing will therefore be with us for the foreseeable future. There will be a lot of changes, however [Enlund 1996].

In the three main publishing sectors – newspapers, magazines and books – the trends reveal a difficult future. In all three sectors declining revenues are clearly evident throughout Europe. The effects are manifest in a decline in the number of newspaper titles [Picard 1996].
If one considers the revenues of the newspaper sector, one finds that when advertising sales are viewed, a downward trend is occurring across Europe, with the exception of some Nordic countries that are moving upward. When circulation sales are considered, the newspaper sectors of most nations’ graphic arts industry are staying approximately even, but again some Nordic nations escape this trend and are raising [Picard 1996].

Newspapers and magazines produced in the form of ink on paper will continue to be very popular and heavily used mass media for many years to come. These media are still more inexpensive, more portable and easier to scan than any other media. They are still uniquely positioned to be significant players in this media age, because of their focus on content. Newspapers and magazines are better at collecting, processing and packaging information content. These strengths become even more important as the information explosion results in multimedia fragmentation of information channels [Lichtenberg 1996].

But newspapers and magazines all over the world have to face many problems: rising costs, falling revenues and changing habits of their readers. Given those problems, the future newspaper or magazine may prove to be too small a basis for the publishing company. Therefore, publishing companies rightly choose a complementary positioning to the other media: they get involved in audiovisual media and they experiment with new media [Lichtenberg 1996].


![Figure 6–1: The four main future scenarios described in the report “The newspaper of tomorrow” (The report is published in Swedish) [Tidningsutgivarna 1997].](image-url)
“Cyberworld 2000” means strong interest in digital services from the consumers and extensive use of high technology by the newspaper companies. The readers accept new technologies and devices developed by the computer and communication industry. The newspapers quickly adapt and use new technology for production and distribution.

“High Tech Production” means unwillingness from the consumers with respect to digital services and adaptation of new technology. The printed newspaper is the main media. The newspaper companies use the new technology in order to make the production of the printed newspaper more efficient.

“Wait and see” means strong interest in digital services from the consumers but scepticism toward new technologies from the newspaper companies. There is a demand for digital services but the newspapers do not offer the services.

“Business-as-usual” means unwillingness from the consumers with respect to digital services and adaptation of new technology. In addition, the business-as-usual scenario means scepticism toward new technologies from the newspaper companies. No big changes will occur. [Tidningsutgivarna 1997].

In the five year perspective, the “High Tech Production” scenario seems to be the most probable. The newspapers seem to be aware of the new threats and can afford the new technologies as these technologies are relatively inexpensive. Many newspapers have already set up Internet-based editions and different kind of other new products and services. But there will probably be no mass market in the near future due to lack of interest, knowledge and technology needed to make the digital products attractive on the mass market.

In order to study the newspaper product from a marketing perspective, the marketing theories presented by Kotler can be used as a basis for the further discussion.

Figure 6–2: Kotler’s demand-technology-product life cycles. The figure shows a succession of product-forms life cycles $P_1$, $P_2$, $P_3$, $P_4$ [Kotler 1994].
Kotler claims that marketing thinking should not begin with a product, or even a product class, but rather with a need. The product exists as one solution among many to meet a need [Kotler 1994]. Figure 6–2 shows Kotler’s view of product-forms life cycles, $P_1$, $P_2$, $P_3$, $P_4$.

If a rough parallel is made to newspaper publishing, the different stages of the product might represent different stages in the evolution of the newspaper products. Earlier evolutionary steps – e.g., the wide use of four-colour – have made it possible to strengthen the product on the market.

Kotler also illustrates the different stages in the product life cycle. The product life cycle portrays distinct stages in the sales history of a product. Corresponding to these stages are distinct opportunities and problems with respect to marketing strategy and profit potential [Kotler 1994]. The sales and profit life cycles according to Kotler are illustrated in figure 6–3.

If Kotler’s “Sales and profit life cycle-theory” is applied to the newspaper publishing market in Sweden, figure 6–4 can be used. The figure indicates that the newspaper circulation in Sweden is currently in the latter part of the mature phase.

Kotler states that if a company concentrates only on its own brand life cycle, it is missing the bigger picture of what is happening to the product life cycle. Companies must decide what demand technology to invest in and when to transit to a new demand technology [Kotler 1994].

If Kotler’s theories are used as a basis for the further discussion, a number of statements can be made:
• The newspaper product is a product that satisfies a demand for, e.g., information and entertainment.

• Demand technology for newspaper products and competing products develops very fast.

Newspaper companies have, in the historic context, been early users of new technology and seem to be aware of the hard competition on the media market.

![Graph: The development of the total newspaper circulation in Sweden 1850–1995](Engwall 1978), [Tidningsutgivarna 1996b]. The curve shows, according to Kotler, that the newspaper product in Sweden is mature [Kotler 1994].

A strong interest in digital services from the consumers implies that a number of technical problems must be solved in order for a digital product to be successful in the mass market:

• Devices that are easy to handle and make the digital products attractive.

• User friendly interfaces with respect to devices, services, and products.

• Infrastructure and bandwidth for digital distribution at acceptable speeds to the home of the consumers.

All these criteria will be satisfied in the future, but the exact point of time is uncertain. During the next five years the newspapers will probably continue to develop digital services and products in addition to the printed product, but the mass market will still be reached through the printed newspaper.
6.3 Predictions of future newspaper products, production, and distribution

6.3.1 Introduction

In the summer of 1995, interviews were carried out with three newspaper executives. The interviews were performed as relatively free conversations, guided by a set of questions defined in advance. The opinions expressed in the interviews are supported by the responses to a questionnaire distributed in April 1996.

The objective of the interviews and the questionnaire was to collect informed opinions on how a number of newspaper related factors will develop during the next five to ten years.

6.3.2 Methods

The interviews were guided by a specially designed questionnaire. Every interview was reported in a text document and approved by the person interviewed.

The questionnaire was sent to 100 newspaper executives in Sweden. An answerer profile had to be filled in as well as 22 questions, each of them with four different answering alternatives and with the possibility to make comments.

6.3.3 Sources of error

The number of interviews was limited and only 35% of the questionnaires were returned. However, most of the results from the interviews and the questionnaires indicate a clear direction of development.

6.3.4 Scenario interviews

The following persons were interviewed: A managing director from a national newspaper (circulation approximately 270000), a research and development manager from a national newspaper (circulation approximately 375000), and finally, a managing director for a regional newspaper (circulation approximately 70 000). The interviews are reported here as a summary of the most common opinions regarding the newspaper product and its future.

Two opinions are very clear in the interviews: The first opinion is that the printed newspaper product is very strong and will continue to keep a strong position for a long time. Secondly, some serious alternatives start to become available – competing digital products.
The printed newspaper product has, according to the interviews, a number of advantages:

- Compact and portable.
- Contains much information.
- Easy to overview.

According to the interviews the modern society tends to create information stress among its citizens. Furthermore, the interviews pointed out that one important role of the newspaper is to serve the readers with a professional selection performed by the editorial department. The central task is to collect, process and publish information.

An important success factor is the newspapers’ ability to relate news to the local area of the readers. A method enabling this local touch is editioning. Today, some Swedish newspapers are printed in several editions. The editioning is mainly carried out through the changing of a limited number of pages between the different local editions. There is a large interest in editioning, but also risks associated with the more complicated production. Parallel editions lead to an increased need for production management with respect to ads, editorial contents, pages and plates.

Increased editioning in the printing plants means reduced productivity – the production takes longer time due to the production stops related to plate changes and the waste figures increase.

In the future, the following trends have been predicted throughout the interviews:

- The content will have a stronger local touch – increased editioning.
- Reduced number of pages due to reduced advertising and increased editioning. Stricter selection of the editorial content.
- Reduced number of printing plants. Production of several newspaper and commercial products in the remaining plants.
- Increased utilisation of the printing plants and of the distribution organisations through increased production and distribution of supplements and inserts.

A number of other ideas and comments can be added. A general conclusion is that the development is fast and dynamic and must be continuously observed and analysed.
6.3.5 A questionnaire to 100 newspaper executives

In April 1996, a questionnaire was sent to 100 Swedish newspaper executives. The questionnaire covered questions regarding future newspaper products, production and distribution. The target group was managing directors and technical directors working at newspapers and in newspaper printing plants.

As this study mainly concentrates on newspapers with a circulation larger than approximately 50 000 copies per publishing day, the questionnaire was sent to all of the managing and technical directors in this primary group (42 persons). In addition, the questionnaire was sent to 42% of the executives in companies publishing 15 000–49 999 newspapers per publishing day (38 persons) and finally to 30% of the executives in companies publishing 5000–15 000 newspapers at least three times per week (20 persons).

<table>
<thead>
<tr>
<th>Circulation per publishing day (copies)</th>
<th>Num of possible persons</th>
<th>Selected persons</th>
<th>Frequency of answers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>Num.</td>
</tr>
<tr>
<td>&gt;49999</td>
<td>42</td>
<td>100%</td>
<td>14</td>
</tr>
<tr>
<td>15001-49999</td>
<td>90</td>
<td>42%</td>
<td>18</td>
</tr>
<tr>
<td>5000-15000</td>
<td>66</td>
<td>30%</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>198</td>
<td>51%</td>
<td>35</td>
</tr>
</tbody>
</table>

Figure 6–5: The number of possible and selected persons in the target group as well as the answering frequency of the questionnaire.

The persons from the latter two categories were randomly chosen. The main reason for sending the questionnaire also to companies outside of the primary group was to investigate if the predictions of the smaller companies differed from predictions made by the larger companies.

Data regarding the number of possible persons in each category, the number of selected persons and the response rate is shown in figure 6–5. There were 99 Swedish newspapers that fulfilled the requirements – newspapers publishing at least three days per week and with a circulation exceeding 5000 copies per publishing day. Their total circulation was approximately 4.1 million copies per publishing day. 35 persons from 30 of these companies answered the questionnaire. The total circulation of the 30 companies that answered is 1.85 million copies per publishing day – 45% of the total circulation in Sweden.
The answered questionnaires originated from managing directors (40%), technical directors (43%) and others (17%). A majority of the persons were of the age 40 to 60 years.

The first group of questions covered future newspaper products. Future oriented questions were among others asked regarding the circulation, the number of pages in the newspaper, the number of editions as well as the occurrence of supplements. The answers to four of the questions are compiled in figure 6–6.

According to the answers, the circulation of future newspapers will decrease – only 3% predict a small increase. Furthermore, 73% predict a small decrease with respect to the number of pages in the newspaper and another 3% predict a large reduction of the number of pages. In contrast to the 76% predicting a decrease in the number of pages, 24% predict a small increase. These more optimistic answers were given by representatives from all three categories.

Increased editioning is predicted by 75%, out of these 25% predict a large increase in the number of editions. The persons predicting a large increase with respect to editioning came from all three categories. Finally, 85% predict an increased occurrence of supplements – 73% a small increase and 12% a large increase. The most optimistic persons were mainly representatives of companies in the primary group.

The production related questions covered the production processes from the completed electronic pages in the publishing houses to finished bundles in the mailroom of the printing plant. Eight questions were asked and results from four of the questions are reported in detail in figure 6–7.

A general conclusion drawn from the results is that there is a great need for improvements with respect to capacity. The need for higher capacity seems to be largest in the areas of page transmission, ripping, and output operations. 46% predicted a large increase in page transmission capacity and 40% predicted a large increase with respect to the operations from ripping to completed plates. Another 35% predicted a large need for reduced make-ready times in the printing presses. Finally, 29% predicted a large need for more automation and flexibility in the mailrooms.
How will the circulation of the newspapers change in the future?

- Small increase: 3%
- Large decrease: 3%
- Small decrease: 94%

How will the total number of pages in the newspapers change in the future?

- Small increase: 24%
- Large decrease: 3%
- Small decrease: 73%

How will the number of editions of a newspaper title change in the future?

- Small increase: 50%
- Large decrease: 25%
- Large increase: 25%

How will the occurrence of supplements change in the future?

- Small increase: 73%
- Large increase: 12%
- Small decrease: 15%

Figure 6–6: A number of product related questions and the corresponding distribution of the answers.

In addition to the results in figure 6–7, some other interesting predictions were made. For instance, 26% answered that the number of newspaper printing presses will be greatly reduced in Sweden. Another 71% predicted a small reduction in the number of newspaper printing presses in Sweden. A majority predicted that the utilisation of the remaining printing presses will increase (47% small increase, 21% large increase).

A number of questions related to the back-end of the process were asked. These questions covered future newspaper single addressing, loading of bundles and distribution. Clear trends pointed out were increased addressing of single copies, more complex loading operations in the plants (with respect to the completed products), and an increased number of products distributed by the newspaper carriers. Mainly the large companies predict a more complicated loading operation in the printing plants, probably due to an expected increase in editioning.
How will the need for page transmission capacity to the printing plants change in the future?
- Large increase 46%
- Small increase 51%
- Small decrease 3%

How will the need for capacity from ripping to finished printing plates change in the future?
- Large increase 40%
- Small increase 51%
- Small decrease 9%

How will the need for short make-ready times in the printing presses change in the future?
- Large increase 35%
- Small increase 65%

How will the need for flexible and automated mailrooms change in the future?
- Large increase 29%
- Small increase 71%

Figure 6–7: A number of production related questions and the corresponding distribution of the answers.

The results from the compilation of the answers to four of the final questions are found in figure 6–8.

According to the results of the questionnaire, a number of trends appear. Future newspapers will have to deal with:

- Declining circulation.
- A reduction of the number of pages.
- Increased editioning and increased occurrence of supplements and inserts.
- Reduced lead time for the production and reduced make-ready times in the printing plants.
- A reduction of the number of printing plants but an increased utilisation of the remaining plants.
How will the occurrence of individually addressed newspaper change in the future?

- Large increase: 18%
- Small increase: 67%
- Small decrease: 15%

How will the complexity with respect to the truck loading operation change in the future?

- Large increase: 19%
- Small increase: 72%
- Small decrease: 9%

How will the number of products distributed by the carriers change in the future?

- Large increase: 20%
- Small increase: 71%
- Small decrease: 9%

How will the share of distribution costs compared to the total costs change in the future?

- Large increase: 9%
- Small increase: 71%
- Small decrease: 20%

Figure 6–8: Four questions and the distribution of the corresponding answers. The questions covered the back-end of the process – addressing, loading and distribution.

- A need for increased automation and increased flexibility in the mailrooms.
- More complicated distribution due to increased customizing of the products and to more products being distributed by the distribution organisations.

The results of the questionnaire must be treated with care due to the limited number of returned questionnaire forms (35%). However, the results of the questionnaire are very clear within certain areas. In addition, they confirm many of the predictions that were made in the interviews.

### 6.4 Summary

The results of the literature study, the interviews and the questionnaire indicate that future newspapers will face hard competition. The circulation figures as well
as the revenues are expected to fall. The main threat pointed out is the emergence of new digital information and entertainment products, distributed through telecommunication networks.

But the printed newspaper is a strong product and the newspaper publishing companies have a number of advantages. The product is portable, demands no technology or special equipment to be consumed, contains much information and is easy to overview. Furthermore, the newspaper publishing companies are experts at collecting, selecting, refining and presenting information. The newspapers are also able to serve a number of different target groups with well known reading habits.

Creating a mass market for digital products requires, in addition to an interest from the consumers, that a number of technical problems are solved. Problems such as the creation of devices easy to handle, user-friendly interfaces for services and products, and an infrastructure for digital distribution at acceptable speeds. All these technical problems will be solved in the future, but the question is when.

The following main trends are expected in the near future according to the interviews and the questionnaire:

• Declining circulation but increased editioning. Reduced number of pages due to reduced advertising and increased editioning. Stricter selection of the editorial content but a newspaper content with a stronger local touch.

• Reduced number of printing plants. Increased utilisation of the remaining printing plants through increased production of supplements and inserts, production of several newspapers as well as of commercial products. Reduced lead time for the production and reduced make-ready times in the printing plants. A need for increased automation and increased flexibility in the mailrooms.

• More complicated distribution due to increased customizing of the products and more products distributed through the distribution organisations.

In a five year perspective, the new technologies will probably be used to experiment with new digital products. The printed product will remain strong and the newspaper companies will use new technology in order to make the production of printed newspaper more efficient.
7. Local and global production management

7.1 Introduction

In chapter 4, a number of technology related functions in newspaper publishing were defined. The objective of chapter 4 was to define functions and technology on a local level in order to create a foundation for a process description and analysis. In chapter 5, the processes of newspaper production and distribution were described and analysed. The analyses were mainly based on different case studies of specific sub-processes.

Chapter 7 is focused on production management in newspaper production. The objectives of this chapter are to introduce production management related definitions and to position the functions and processes described in chapters 4–5 in a global, i.e., company-wide perspective. One further objective is to describe existing models related to production management in newspaper production. This chapter is mainly based on literature studies.

7.2 Production management on local and global levels

In general terms, the role of production management is to effectively plan and control the actual use of resources in the manufacturing plant to meet the production requirements. The resources include, e.g., materials, machines, material handling equipment and people [South 1994].

In the manufacturing industry, a production management system (PMS) is seen as a mechanism that regulates the manufacturing system at the operational level. In general, production management systems have two objectives – planning and control of manufacturing operations [South 1994].

The use of computers in plant-wide production management in the manufacturing industry has been discussed for a long time. In 1965, Buffa analysed integrated data processing systems with respect to production management and concluded that at that time there was probably no complete integrated data processing system in use, but that parts of such systems existed. There was a trend toward fully integrated data processing systems [Buffa 1965].

In 1969, Hacker developed and evaluated a simulation model for analysis of selected newspaper production operations. A number of modules, each one representing a certain portion of a newspaper production plant, was developed and used in the simulation model. The simulation model made it possible to predict
the consequences of machine and personnel changes in the plant. Hacker also
discussed global production management in terms of plant-wide monitoring of
the flow of material through the plant. Hacker suggested that plant-wide moni-
toring could be used in order to regulate the progress of the material and to op-
timise machine and personnel utilisation [Hacker 1969].

Juhola concludes that the special character and the wide product range of the
graphic arts industry makes it difficult to apply CIM (Computer Integrated
Manufacturing) without analysing the business structure of the company. The
development of computer technology is proceeding toward open systems which
should give more freedom to integrate different systems [Juhola et al. 1992].

Enlund stated in 1994, with respect to the newspaper industry, that several lo-
cal production management systems were available from different manufactur-
ers and many new solutions were under development. Each of these systems took
its own approach to solving locally defined tracking problems [Karttunen
1993b], [Nordqvist 1993a], [Stenberg et al. 1993].

The ways and methods the local production tracking systems use for communi-
cating with external systems should be defined in a structured manner [Enlund
1994], [Enlund et al. 1994]. The objective of these efforts was to enable infor-
mation exchange between local and global systems in accordance with figure
7–1.

As the newspaper industry moves toward integrated production processes, the
need for tools to monitor and manage the manufacturing process becomes in-
creasingly obvious. The economic situation also increases the interest in efficient
monitoring and management of the entire newspaper production process [En-
lund 1994]. Monitoring through a global tracking system is the first step towards
company-wide production management systems.
The need to automate and integrate individual information systems has led to increased interest in process modelling and workflow management. Various systems supporting work processes in some specific environments, e.g., in software production or office automation, have emerged either as research prototypes or as commercial systems [Alho et al. 1995].

Karttunen has listed more than 80 vendors supplying the newspaper industry with production systems working on a local level and with various functionality and abilities with respect to local PMS. Every local subsystem has to be recognised as a data source and as a client, i.e., as the user of the monitored PMS data [Karttunen 1994].

Production control involves the active rescheduling of activities and the reassignment of resources due to deviations from a pre-defined production schedule. For active production control to be possible, the control system requires detailed information on the product to be produced, the activities involved, the resources available and the default production schedules. Production management involves the collection and analysis of data on production runs and production costs, covering the entire newspaper production process [Enlund 1994].

The newspaper industry lacks company-wide production management systems which provide overall production monitoring, planning, control, and management functionality. There exist no scientific models and no general approach to this problem today [Nordqvist 1996].

A global production management solution must serve as a standardised framework for integrating local PMSs – a glue, binding heterogeneous control systems together [Nordqvist et al. 1993b]. But primarily the global PMS – the GPMS – should provide tools for extracting refined high level planning and decision support information from different local PMSs. It should also serve as a distributor of production management information between the different areas of responsibility within the production process [Nordqvist 1996].

IFRA has presented a basic model of newspaper production [Thoyer 1995], [Thoyer 1996]. The model illustrates the newspaper production from a global point of view and covers the main production stages from ad sales to distribution. In the model five process stages are presented: production planning, prepress, page output and platemaking, press as well as mailroom and distribution. Within every process stage there is a number of production related activities. The activities generate output in terms of objects (ads, images, articles, physical pages, films, etc.).
Figure 7–2: A set of activities relevant in global production management in newspaper production and distribution. The figure is mainly based on the basic model of newspaper production presented by Thoyer [Thoyer 1995], [Thoyer 1996].
The model presented by IFRA does not include circulation management or distribution planning. As pointed out in section 5.2 and 5.4, the circulation determination and the distribution planning are closely linked to scheduling and production. In figure 7–2 a modified version of the basic model presented by IFRA is depicted. The top level process stage, “Production planning”, in the original model have been modified. Two activities – “Circulation activities” and “Distribution planning” has been added in order to get an even more global process view – see figures 7–2 and 7–3.

Figure 7–3: The circulation and distribution related activities added to the production planning process stage in the IFRAtrack basic newspaper production model.

The circulation, the location of subscribers and retailers as well as the organisation of the distribution operation, influence the production plans. More in detail, the plans partly depend on the structure of the circulation, the division of an issue into editions and edition versions, the structure of the bundles produced in the mailroom as well as the loading order of the trucks.

The original IFRA model was defined with the purpose of monitoring the production on a global level. The objective of the IFRA initiative – IFRAtrack – was to define the production process in order to facilitate the development of a mechanism supporting computer based production tracking. IFRA wanted to lay a foundation enabling the creation of Global Production Tracking Systems [Thoyer 1995].

### 7.3 The IFRAtrack recommendation

Section 7.3 is a summary of the most relevant parts of the IFRAtrack recommendation with respect to this study. An updated version of IFRAtrack, version 1.1, was established but not published during 1996. A manuscript with the changes has been studied [Thoyer 1996]. The complete IFRAtrack is presented in [Thoyer 1995] and [Thoyer 1996].

In the IFRAtrack recommendation, a number of newspaper production related object classes and states have been defined. The state of an object is modified through processes. The IFRAtrack recommendation includes object definitions, semantics, syntax, and suggested message exchange mechanisms.
The IFRA initiative did not aim at creating a restrictive standard. Instead, a structured and open model for exchanging tracking information has been developed.

The product structure of a newspaper is described in a hierarchical structure of objects. In figure 7–4, an example of the IFRAtrack object structure is illustrated.

![Diagram of IFRAtrack object structure]

**Figure 7–4**: The product structure of a newspaper described as a hierarchical structure of objects [Thoyer 1995].

Trackable objects – objects monitored throughout the process – are not necessarily physical objects but can also be process objects like, e.g., a printing job. Every object class listed by IFRA has a set of individual attributes and links to related object classes. An example of a data model proposed by IFRA is illustrated in figure 7–5. The data model is based on the IFRA objects described in the process model in figure 7–2.

The list of trackable objects is flexible – there might be a need to track other objects as well. A specific company can decide to add objects if there is a need – the object list can be easily extended.

A number of basic states have been defined in order to identify the status of the trackable objects. The number of states has been kept at a minimum in order to
achieve simplicity. There are process and scheduling states. The process states are “Not started”, “In progress”, “On hold”, “Completed” and “Aborted”. The scheduling states are “In time” and “Late” [Nordqvist 1996], [Thoyer 1996].

The sequence of activities that an object passes through defines the workflow of that object. Associated with the workflow steps are the workflow states of that object. The number of workflow states related to an object varies and depends on the operations performed on the object. For instance, a plate can have the workflow steps “Plate-making” and “Plate-mounting”.

The IFRAtrack messages that are exchanged consist of structured, relatively simple, and readable text strings. The messages contain information on object name, status change, workflow, attributes, links, time and comments [Thoyer 1995].

The proposed IFRAtrack recommendation facilitates standardised information exchange between systems originating from different suppliers. The global monitoring is the first step toward company-wide – global – production management systems (GPMS) in the newspaper industry.

Figure 7–5: A data model with different trackable object classes as defined in the IFRAtrack recommendation [Nordqvist 1996], [Thoyer 1996].
7.4 GPMS models

Alasuvanto has presented a process support system (PSS) for newspaper prepress production – a concept with similarities to a GPMS. The study focuses on the overall management of prepress workflow. The objective of the study was to add manageability to the work in the newspaper prepress and yet preserve its creative nature. The concept of a process support system is presented in figure 7–6. The PSS uses models of products, processes and resources. The kernel handles all requests coming through the interfaces. The agents represent resources executing activities. The trusted interface provides a more powerful functionality, e.g. centralised resource planning, for applications which are an integral part of the PSS.

Alasuvanto states that a strong set of concepts and a solid system architecture are needed to implement a process support system. The architecture should be able to incorporate existing and future applications. The system architecture described provides clear interfaces for external applications. The main objective of the concept presented by Alasuvanto was to secure good interconnectivity with a variety of production systems and environments [Alasuvanto et al. 1994].

Nordqvist has developed a GPMS model for newspaper production [Nordqvist 1996]. Nordqvist describes a model operating on an enterprise-wide level – from ordering and sales to the delivery of the final product. The structure of Nordqvist’s GPMS model is shown in figure 7–7. The process, the resources and the products are described as models in the GPMS.
Figure 7–7: A model of a global production management system (GPMS) [Nordqvist 1996].

The central functional components of the GPMS are tracking, scheduling, control, simulation and production management. The production is monitored by the tracking module. Overall production plans are scheduled and coordinated by the scheduling module. The schedules are then transferred to the production process by the control module [Nordqvist 1996].

Tracking is the function of collecting, in real time, status information on objects in the production process. The scheduling component includes the functionality of setting production time plans (deadlines), scheduling activities and allocating resources. Scheduling and resource allocation are the functions of assigning activities to the objects of the product model and resources to the activities. The production control component includes the functionality of issuing, in real time, a sequence of control commands, based on the production plan, to the appropriate, corresponding functions and their physical resources in the production process. The simulation component includes the functionality of simulating the effects of implementation of a production plan on a virtual production process. Simulation can be used as a tool for decision support. The production management component includes the functionality of gathering information from production data and statistics from other components of the GPMS. This information could serve as a basis for long and short term strategic planning [Nordqvist 1996].
7.5 Summary

Production management is a well-established term within the manufacturing industry. Computer-based production management systems (PMS) have been in use since the first half of the 1960’s [Buffa 1965]. In the newspaper industry, PMS in terms of prototype systems were developed in the late 1960’s.

In 1994, many suppliers to the newspaper industry offered local PMS solutions with varying functionality. The newspaper industry still lacks company-wide production management systems which provide tracking, scheduling and control on a global level (GPMS). The first conceptual models of GPMSs for the newspaper industry were presented in 1993 [Nordqvist et al. 1993b]. A step toward implementing GPMS is the IFRAtrack recommendation.

In the IFRAtrack recommendation, the global production process as well as a number of newspaper production-related objects and states have been defined with the objective to facilitate computer-based production tracking.

Models supporting prepress management and global production management for newspaper production have been presented by Alasuvanto and Nordqvist. Both concepts are developed in order to facilitate the construction of management systems that can communicate with a variety of production systems in different environments.

Juhola has analysed the graphic arts industry with respect to the use of CIM concepts. One of the conclusions in Juhola’s work was that the special character and wide product range of the graphic arts industry implies that the business structure must be taken into account when applying CIM [Juhola et al. 1992].

Juhola’s conclusion is valid also for the newspaper industry. The business structure and conditions for publishing, production and distribution vary between companies and countries and this must be taken into account when a GPMS is designed for a specific company. Even if a GPMS covers the entire production and distribution process, the main objectives of its use must be clear. Should the GPMS be used mainly in order to prevent delays? Should it mainly be used in order to support publishing of multiple editions in parallel or should it be used mainly in order to perform optimised scheduling and decision support?

Every company is unique and must identify its own needs. However, a number of general conclusions can be made – the time critical aspect of newspaper publishing makes functions preventing delays useful. How a GPMS can be used to support newspaper production will be discussed in chapter 8.
8. Coordination of products, processes and resources

8.1 Introduction

8.1.1 Objectives

Chapter 8 constitutes the synthesis of the work. The main objective of the synthesis is to discuss and analyse the need for coordination of products, processes and resources. Furthermore, to suggest methods for creating models of products, processes and resources supporting tracking, scheduling and control on a global level.

A brief summary of the contents of the different chapters is motivated. The synthesis is based on the description of the environment in which a newspaper publisher acts today (Chapter 3 and 4), definitions and analyses of the newspaper production and distribution process from a global point of view (Chapter 5), probable future changes (Chapter 6), and a global perspective of newspaper production management (Chapter 7).

8.1.2 Focus

The study is mainly focused on the production and distribution of morning newspapers in the Nordic countries, primarily in Sweden. Mainly newspapers ranging from regional newspapers to national newspapers have been considered (circulation exceeding 50 000 per publishing day). A number of significant facts have to be considered regarding the newspaper publishing industry in the Nordic countries:

- The reading of newspapers is among the highest in the world.
- A large share of the circulation is subscribed.
- An average of approximately 60% of the revenue originates from advertisements.
- The page count and advertisement volume in the products are relatively high.
- There is a wide use of colour in advertisements and editorial contents.
- The newspapers are produced in highly automated newspaper printing plants.
The mass production is followed by an efficient and strictly planned home delivery operation – performed by professional carriers. The publishers often guarantee delivery before 6 am.

Even though the Nordic countries have relatively small populations, the sizes of the newspaper companies seem to be representative in an international comparison. (1.3), (3.7.1).

8.2 The current state and the predicted direction of product and process development

8.2.1 The newspaper publishing industry

The history of the newspaper publishing industry shows that its development has been closely related both to the general development in society and to the development of new technology. Today, the newspaper product is mature in most parts of the western world. In Sweden, the circulation grew from the middle of the 19th century until the 1970’s. From the 1970’s, the circulation figures have been quite constant and during the last years the trend is slightly declining. (3.2), (4.1).

The newspaper industry differs to some extent from industries in general. In most newspaper publishing companies there are dualistic objectives – in addition to the profit objective there are publishing objectives. But, despite the somewhat different business concept, many publishing companies are very profitable. From an international perspective, a large number of media companies have newspaper publishing as one important part of their business. (3.4).

There are two categories of customers – readers and advertisers. The readers need information and entertainment – and a newspaper constitutes a channel sending information from the editorial department and messages from the advertisers of the newspaper. Competing channels are, e.g., other newspapers, other printed products, TV, radio, and Internet-services. Advertisers use the newspaper as a channel for distribution of messages to their target groups. The advertisers can also choose competing channels, e.g., commercial TV, commercial radio, or Internet as well as other printed products like billboards, magazines, or direct mail. (1.1), (3.5).

As the income originates from readers, approximately 40%, and advertisers, approximately 60%, the newspaper needs to serve two categories of customers with varying expectations. Late deadlines for news and advertisements are important as well as flexibility regarding the colour configuration. The quality of
the product must fulfil the expectations from readers and advertisers, but in parallel the lead-time for production and distribution must be short and reliable. (3.6.2).

**8.2.2 Production and distribution of newspapers**

The expenses related to newspaper publishing show that the total cost related to one distributed copy in 1995 was quite similar at the fourteen largest Swedish morning newspapers. A majority of the newspapers was positioned in the area 11 to 14 SEK per copy. The expenses related to production and distribution are approximately 50% of the total expenses. (3.6.3).

A modern printing plant for manufacturing of competitive newspaper products means heavy investments in highly automated equipment – investments that all newspapers cannot afford. Despite stable circulation figures and an increasing number of newspaper titles during the last 15 years, the number of newspaper printing plants has been greatly reduced in the Nordic countries. (3.6.3), (3.7.2), (4.2.5), (4.2.6).

The costs for platemaking, printing and mailroom operations in modern plants mainly consist of financial costs and costs for material. The financial costs per copy can be reduced by more efficient utilisation of the production resources. A higher utilisation of production resources will be facilitated by more reliable and better controlled production processes. The material costs, mainly newsprint, can also be reduced by more reliable production processes. (3.6.3), (5.5.4).

The resource consuming distribution operation of morning newspapers in general holds a share of 20-25% of the total costs. In addition, the distribution costs are strongly influenced by the outcome of the preceding production processes. Even small delays related to prepress work or to printing mean that the distribution costs increase. Delayed production starts combined with production speeds below the calculated production speeds means considerably increased distribution costs. (3.6.3), (5.4).

The process of creating, producing and distributing a profitable and unique quality product on an everyday basis is supported by an organisation covering many different areas. Due to the mixture of publishing and commercial objectives, many companies are operating under a leadership by two persons – the editor-in-chief and the managing director. (3.8.1), (4), (5).

Extensive use of computers in the prepress area has been predicted since the 1960’s and different organisational models supporting digital workflows have been presented during the years. The final breakthrough of the digital prepress
production came during the 1990’s. Today, the technology and regulations surrounding the job processes permit a small editorial group to perform writing, editing and page make-up. As a consequence, the existence of a separate prepress production department is not obvious. The physical flows of material have been replaced by digital workflows supported by databases and networks within the publishing house and between the publishing house and the printing plant. The production in the publishing houses has become invisible and harder to control. (3.8.1), (4), (5).

Today, the prepress production can be carried out in an integrated organisation, usually by an editorial department and a marketing department. The editorial department is, in addition to having the responsibility for the editorial content, also responsible for the prepress production in terms of text, image and graphics processing as well as page make-up and has the overall production responsibility for the pages. The marketing department is responsible for marketing, advertisement sales, and – in terms of prepress production – ad production and page make-up of the ad content. The ad production can also be performed outside the newspaper company, e.g., by an advertiser or by an ad agency. In these cases digital workflows from external companies occur. (3.8.1), (3.8.2), (4.2.4).

The use of open system architectures increases and implies standardised network hardware and protocols, open databases supporting queries from external applications and systems, and client-server systems philosophy. The client software often runs on standard personal computers. The trend is towards decentralised client-server systems in an open systems environment. (4.2.2), (4.2.4).

The circulation management is almost completely computerised and linked to printing and postpress production. The circulation systems of larger newspapers normally have the ability to handle customer addresses and order information, economy, sales, and support. The circulation system can also generate input to a separate marketing database, integrating data from circulation, advertising, and external databases in order to deliver specific advertising messages to small groups based on known data. (4.2.3), (5.2.2), (5.4).

In the printing plants, formerly manual operations have been replaced by remote control, closed-loop systems and automated systems. The print quality has been improved and the make ready times reduced. The possibility to print colour pages is constantly increasing in Western Europe and in 1994 the average number was five inking units per web in 16-page newspaper presses. The development of equipment and control systems in the mailroom means new conditions for inserting and bundle production. (4.2.5), (4.2.6), (5.1), (5.3.2), (5.5.1), (5.5.2).
The complexity in the production has increased and a great number of different products are produced at each plant. A variety of different production alternatives can often be chosen in the printing plants. The number of pages and the impositioning of the main product determines the number of webs, the web-leads, and operations performed in the superstructure of the press. In the mailroom, the number of supplements and inserts varies. In addition, the size, page count and paper type of the supplements and inserts vary. The maximum number of copies in a bundle depends on the total number of pages in the complete product, including supplements and inserts. (5.2.1), (5.2.2), (5.3.2), (5.4.2), (5.5).

8.2.3 A process view of newspaper production and distribution

All companies studied use fixed production and distribution plans, following the same timetable from day to day. The final page count and impositioning is determined in the afternoon the day before the publication day. The booking of certain kinds of advertisements is still in progress when the page count and impositioning is completed. The editing, page make-up and transfer of pages to the plants are guided by timetables defining deadlines for groups of pages through the different stages of production. The timetables are fixed, but the specific pages included in the different groups vary from day to day. (5.2.1), (5.3.4), (5.3.6), (5.4.3), (5.5.5).

Case D shows that the distribution operation is a strictly planned and optimised network of activities. Delayed production implies that hundreds of even thousands of carriers are waiting for the newspapers. The outcome of the production process in the printing plants varies within a wide range. Days of more complex production (higher page counts, inserting operations, and increased number of bundles) seem to meet with problems more often. (5.4.6).

The ideal conditions assumed in the optimised distribution plan in Case D occur very seldom. There is a need for fault tolerant distribution plans and plans that better match the variations in outcome from the production process. (5.4.6).

Case E shows that the average net production speed was similar in the two plants observed – approximately 23 300 good copies per hour with a standard deviation of 3 000 (5.5.4).

The net production speed is strongly influenced by the products and production methods used. The average net production speed is decreasing with higher page counts. In addition, the use of bay window assembly under certain conditions results in an accelerated decrease. Inserting operations, especially of tabloid and
broadsheet supplements in main products with high page counts, strongly reduce the net production speed. In general, the standard deviation is large and in addition it increases with the complexity of the products and the production methods. (5.5.7).

The reliability of the production schedules varies over a wide range because of the fixed press starts and the variety of products and production methods. In Case E, the probability of keeping up with the timetable is approximately 90% when a 40 page product without any inserts is produced. The probability of keeping the up with the timetable is approximately 30% when a 68–72 page product with a tabloid supplement inserted is produced. The waste figures and the occurrence of unplanned stops increase with the complexity of the product and the complexity of the production method (5.5.4), (5.5.6).

8.2.4 Development trends

The publishing, information, and communication industries are in a transition mode and seem, to some extent, to merge. The result can be an even harder competition for the time of the readers and the money of the advertisers. New competitors in terms of commercial TV-channels, free papers, and Internet-services offer information for free and the consumer willingness to pay for general news information might be reduced. The circulation figures of the morning newspapers are stable or even declining and according to the scenario interviews, the market reacts negatively to increased subscription rates. The circulation and the income related to the circulation will probably be stable or even slightly reduced in the near future. In the questionnaire, 97% answered that the future circulation will be reduced, but only 3% answered that the circulation will be strongly reduced. (3.5), (6.2), (6.3).

The increased competition regarding advertising channels makes the advertisers more selective in the choice of media – there is a growing interest in measuring the impact of the advertising. The newspapers must be able to serve the advertisers with demographic information regarding the readers in different distribution areas and in different demographic target groups. (3.5.1), (3.5.2), (4.2.3).

New interactive media might be more suitable for classified advertising and the occurrence of classified ads in printed morning newspapers can be reduced. The printed newspapers meet a future were the competition on the advertising market increases – parts of their traditional market might fade away – and the service level toward the advertisers in the remaining areas needs to be improved. (3.5.2).
The scenario interviews and the questionnaire indicate that newspapers plan to meet the competition by developing the newspaper product and by reducing the costs. The future newspaper products will probably be more customised with respect to editorial and advertising content. A strong connection to the local area of the reader is pointed out as one main objective in future morning newspaper publishing. This is achieved through an increased editioning of the products. (6.3.4).

The number of unique pages produced by the editorial and advertising departments will increase, but the number of pages in the main sections of the edition versions will be reduced. These results are confirmed by the questionnaire in which 75% of the newspaper management answered that the number of editions will increase. In addition, 76% answered that the number of pages in the main product will be reduced. (6.3.4), (6.3.5).

Inserted products and better utilisation of the distribution organisations are other future trends pointed out. In the questionnaire, 91% answered that the occurrence of inserts will increase and 85% answered that the occurrence of supplements will increase. The number of products distributed by the carriers will increase according to 91% of the answers. (6.3.5).

The printing processes do not seem to change in the near future. Web offset will remain the dominating printing process. A very clear trend is towards increased colour capabilities and the use of 4-high towers. The first shaft-less presses are just being installed [Stein 1995]. The shaft-less constructions will enable plate changes without stopping the entire press and some of the drawbacks of editioning can probably be reduced, e.g., make-ready time and start-up waste. (4.2.5).

In the questionnaire, 100% answered that they saw a need for improvements regarding the flexibility and the automation level in the mailroom. Of these, 29% answered that great improvements in flexibility and automation level are needed. The development of control systems and equipment in the mailroom is fast. Digital control systems controlling every single copy from the inserter through addressing, stacking and bundle addressing have just been introduced. (4.2.6), (6.3.5).

8.2.5 The future newspaper product and production processes

The development of technology used in the printing plants indicates that there in the future will be technical conditions for efficient production of more customised products.
A short survey of the predicted direction of future development of newspaper products and production processes indicates that the use of colour will increase as well as the occurrence of multiple editions. An increased editioning within the same production system implies a number of complications, among others:

- Coordination of subscribers, editions, supplements, and inserts in the circulation and distribution systems.
- Management of multiple editions in the advertising and the editorial departments and their systems.
- A more complex edition planning with respect to editions, pages, sections, impositioning, supplements, and inserts.
- An increased number of unique pages and a complex management of the relationship between the pages and the editions within the advertising and editorial departments. An increased number of page elements.
- An increased number of final edition deadlines in the publishing houses and in the printing plants.
- More complex production in the printing plants with respect to the coordination of main sections, supplements, inserts, and addressing of single copies as well as addressing and loading of bundles.

A number of new routines are necessary to plan and keep this kind of production under control. One way of solving the problem is to have staff dedicated to production management, but as the newspapers meet hard competition, this is not ideal. If these routines are to be carried out using the currently available resources, some kind of management system is needed to support the production management.

**8.2.6 Local and global production management**

Local production management systems (PMS), mainly for tracking purposes, are already in use. Separate solutions exist for page output and printing plate tracking, press control, and mailroom management. In the areas of editorial and advertising departments, the most extensive use of local tracking functions are often found in the advertising systems. The local production management systems do generally not support tracking, control and planning on a global level, but the case studies clearly show that there is a great need for information exchange and coordination between the different operations. (3.8.2), (4.2.4), (7.2).
One example is if ads are sold at a late stage. In this example, the ads generate extra income but also makes it necessary to increase the page count by four pages, choose a less reliable production run in the printing press as well as reduce the maximum number of copies per bundle. The income from the ad must be compared with the additional costs for newsprint and the increased risks of delays due to a more complicated production in the printing press and in the mailroom – the largest costs might occur in a delayed distribution process.

The implementation of global production management systems, GPMS, could be facilitated if all local systems would be supplied by the same vendor system and implemented in a common database system. But the production environment of a newspaper constitutes of a number of separate systems from different vendors. Standards and open system architectures facilitate the construction and maintenance of GPMS. A GPMS makes it possible to bridge the former system islands and supports intersystem communication. (7.2).

IFRA has defined IFRAtrack – a recommendation for interchange of status information between local and global tracking systems in newspaper production. IFRAtrack makes exchange of real-time tracking information (monitoring) possible. (7.3).

A complete, company-wide GPMS can include functions for tracking, scheduling, and control. The GPMS includes a simplified reflection of the newspaper production and distribution, and include models of products, processes, and resources. In order to perform scheduling, control, and simulation, the GPMS must also include rules. (7.4).

This study has concluded that there is a clear relationship between the product structure and the runnability of the production processes in the printing plants. The difference in runnability in its turn influences the resource consumption in the printing plants in terms of paper utilisation and allocation of production resources. Furthermore, the study has shown that the distribution operation is strictly planned but not fault tolerant – delays in the preceding processes can cause severe problems and increased costs in the distribution operation. (5.2), (5.3), (5.4), (5.5).

The next parts of the chapter will suggest how models of products, processes and resources can be developed and facilitate the coordination of products, processes and resources in newspaper production.
8.3 Coordination between product, production and distribution planning

8.3.1 A shift of paradigm

The present paradigm for newspaper production means that the newspaper is more or less mass produced in one or just a few quite similar editions. The production in the printing plants and the distribution operation are guided by fixed plans. Earlier shifts of paradigm can be found in the transition from manual and industrial prepress production into digital prepress production mainly performed in networked office environments.

A conclusion in this work is that newspaper publishing once again will be forced to a shift of paradigm. Similar to the earlier paradigm shifts, the publishing industry is strongly influenced by changes in society and by the basic technology used – both with respect to the creation of competing products and to the development of the newspaper product and its production and distribution process. The conditions for newspaper publishing and its production as well as distribution seem to change:

- Cost reductions in order to stay profitable despite harder competition.
- More control and coordination of the product, production, and distribution due to more complex products and increased editioning.
- Abilities to use tools that support dynamics with respect to products and to the processes of production and distribution.

The competition for readers and advertisers will be met through an increased customising using the available resources. The transition will be supported by new technology within the publishing houses and in the printing plants. New computer based tools operating on a local as well as a global level will provide possibilities to create the more customised products and in parallel facilitate an increased flexibility with respect to the production and distribution plans.

8.3.2 Considerations regarding production and distribution

This study has shown that there is a strong relationship between the product structure and the reliability and productivity in the production plants. Furthermore, the study has shown that the production and distribution processes must interact. Static product-, production- and distribution-planning means inefficient utilisation of the available resources.
A hypothetic example can be used in order to illustrate the reliability of a static production plan. If the same production and distribution plan is used when printing 100,000 copies of a 32-page product without inserting and when printing a 68-page product with multiple supplements inserted in the mailroom, the utilisation of the resources in at least one of the cases will be sub-optimised. In the first case, the printing and mailroom operations from first to last good copy might last for 3.2 to 4 hours. In the second case, the same operation might last from 4 to 7 hours.

If the production planning issues from a specific probability, e.g., 80%, of handling the production according to the production plan, the first case might be scheduled for 3.5 hours and the second case for 6.5 hours. According to the results in cases D and E, the production should be scheduled for approximately 5 hours in both cases.

This means that the printing in the first case, for instance, could have started 1.5 hours later. The editorial department could use another 1.5 hour and 1.5 hour could have been used for production of other products in the printing plants. In the second case, the publishing objectives might force the printing to start at a specific time. In this case, the distribution plan might be different and adapted to the lower production speed and the increased risks of production disturbances.

The expected customizing of the newspaper product will further increase the complexity in setting up reliable production and distribution plans. A variety of products and production alternatives will occur in parallel. The page count and impositioning of the product will, for practical reasons, probably remain relatively fixed between different editions printed in the same plant, but individual pages will be changed as well as the occurrence of inserting and the mix of supplements and inserts. If the printing presses have to stop and start between every edition shift, this means an increased risk of production stops.

**8.3.3 The coordinating function**

The coordination of the products and the production and distribution processes is essential already today, and will be even more important if the development will be as expected. A separate coordinating function would be of great use in many organisations already today. The function should be responsible for the coordination of products and plans for production and distribution on a tactical as well as an operative level. An important tool for the function would be a GPMS where many of the necessary support functions can be built in.
A number of objectives can be identified in terms of coordination and production management:

- Interaction between the product planning and the production and distribution planning.
- Flexible production and distribution plans.
- Global real-time control of the production and distribution processes in order to secure on time delivery in all stages – prepress, printing and mailroom operations and distribution.
- Decision support when deviations from the production and distributions occur due to unplanned changes.

The main objective of the coordinating function is to create a hub to facilitate coordination and support to the overall organisation. The coordinating function should collect all product specific information in one place and perform risk analysis as well as identify optimised production and distribution plans for the products in question.

Another important task is to perform real-time tracking of the production related flows of material and information within and between the publishing houses and plants in order to secure adherence to the production schedules. Also this work can be facilitated by a GPMS.

The decision support will help minimise the negative impact from delays and deviations from the production and distribution plan. The optimization should consider global aspects and a number of parameters can be used as control parameters, e.g., time, costs, and goodwill.

The organisational location of the coordinating function can be discussed – a separate department is not necessarily the best solution. The function can be incorporated in the work at already existing departments, e.g., the editorial department. The persons involved in the coordination work need tools to support their work and a great portion of knowledge of prepress work, possibilities and limitations in the printing presses and mailrooms as well as the conditions for the distribution. The work must be supported by a GPMS containing rules and proper models of products, processes and resources.
8.4 Models supporting PMS and GPMS

8.4.1 Introduction

Models and rules implemented in a PMS or GPMS in order to facilitate tracking, scheduling, control and simulation need to be simplified abstractions of reality. The granularity of the models will be different in different parts of the PMS/GPMS. This is determined by, e.g., the need for a detailed model, the abilities to create detailed models, and the need for performance in the system.

As pointed out earlier, the product models can be used in order to choose a proper production and distribution plan. In terms of GPMS, this means that an edition version containing certain products can be associated with a specific process model which in its turn requires certain resources. Due to the dynamics of the processes, the suggested resource consumption cannot be exactly defined with respect to time and associated costs.

An example. An edition version consists of a 60 page main product, a 16 page preprinted tabloid supplement, and 4 page insert in A4 format. This combination of products constitutes an edition version that is ordered in 50000 copies. The edition version requires a specific production process in order to be completed in the printing plant. The process model indicates that the production in the printing plant can be handled in 2.3 hours at an acceptable probability, e.g., 80%.

The selected production process model suggests a specific distribution process that will match the expected output and the reliability of the chosen process model. Furthermore, the consumption of resources is predicted. The suggested production process requires a certain amount of resources, e.g., personnel, newsprint, printing presses and mailroom equipment. The suggested distribution process model requires resources in terms of trucks and carriers.

The probability calculations performed on the process models can be linked to the resource models which makes it possible to perform estimates of the costs within certain limits.

8.4.2 A structured product description

The IFRAtrack object model [Thoyer 1996] suggests a number of object classes and attributes. Furthermore, the IFRAtrack model defines the relationships between the different objects. As IFRAtrack mainly is developed for tracking, it lacks some of the information necessary to manage scheduling and control.
But the product description is structured and developed in order to be used in computerised information systems. This makes the IFRAtrack model well suited for use in product modelling.

This work has shown that a number of parameters related to the products influence the runnability in the printing plants such as:

- The page count in the main product.
- The occurrence of inserting (supplements and inserts).
- The page count and paper type of the inserted products.
- The number of products added in the inserting operation.

I recommend further investigations with larger numbers of empirical observations in order to identify additional product-related parameters that might influence the runnability. Examples of such parameters could be the use of bay window assembly, the use of 40 cm webs in the superstructure, and other web-related operations. Also, the physical format of the supplements and inserts might influence the runnability.

The IFRAtrack model (see chapter 7) makes it possible to define an edition version (object class – EditionVersion) related to a number of specific products (object class – Product). In the object class EditionVersion, the attribute PlannedCopies can be used for planning purposes. For every product – main sections, supplements, and inserts – the number of pages, and product weight can be defined (attributes – Type, Weight, NoOfPages).

The physical formats can be identified through linking the object Product to the object PhysicalPage which in its turn can be linked to the object Logical Page where the attributes Width and Height can be used.

The paper type is more complicated to handle in the IFRAtrack model. For main products and supplements we can use the possibility to link the object Product to the object PrintingJob which can be linked to the object Reel. The Reel object has an attribute named PaperType with the type attributes “standard” and “special”. A reflection made is that “special” tells us very little about the paper type. In many cases a number of different paper types are used in addition to the standard newsprint. For externally produced inserts the paper type cannot easily be defined using the existing IFRAtrack object structure. This is a weakness within the model.

In order to link a specific main product to a specific configuration in the printing press, the colour information regarding the logical pages (object class – LogicalPage, attribute – Colours) can be used.
The object class Element makes it possible to classify pages according to their content. This opportunity can be useful in the area of prepress tracking, scheduling, and control. This study has not investigated the process runnability within the prepress area. But, it is known that especially the time needed in the ripping process depends on the elements associated with a specific page [Tribute 1995].

8.4.3 Modelling of the production and distribution processes and resources

From a system theoretical viewpoint, a process is viewed as a set of activities that transform an input to an output [Schoderbek et al. 1990]. In the SDA method, used in the case studies, the activity–process terminology can be seen as a hierarchical tree-structure. A limited number of activities constitutes the top level process. Every activity can be divided into a sub-process of activities which can be further divided. The granularity of the resulting tree-structure gradually increases.

Nordqvist [Nordqvist 1996] has broken down the overall newspaper process into five activities: content creation, original production, copy production, packaging and distribution. All these activities are then further broken down into finer detail in order to find activities corresponding to the actual process studied. When the granularity of the process models used on the global level is determined, the need for both accuracy and performance must be considered and harmonised with the objectives of the GPMS.

A resource model is a structured description of resources available for performing the activities in the process model on the objects described in the product model. The resources can be persons, workgroups, machines, trucks, etc. or combinations of these. With each resource is associated a set of capabilities, as well as information about the performance and cost in different types of activities [Nordqvist 1996]. The resource models are necessary in scheduling and decision support and make it possible to allocate resources and identify costs for a given product, production, and distribution process.

When creating prepress process models, the first step should be a systematic use of tracking data in order to identify process runnability in the prepress area. The borderline between the creative work and the production should be defined. In practice, strict modelling of creative editorial work might prove difficult. At least the main activities following the page make-up should be observed.
In Case E, the process runnability was, according to Nordqvist’s five main activities, measured for copy production (printing) and packaging (mailroom operations). A number of different sub-activities could be identified – printing, inserting, packaging, and loading, but not the performance of the associated resources as a function of the input. The activities in the printing press and in the mailroom were considered as one single process because the production reports analysed did not report the cruising speeds or the occurrence and the location of unplanned stops. This means that the process model could not be very detailed. There is a need for more detailed reporting from the production process if detailed models are to be used.

If better reports could be obtained, the process runnability can be identified for, e.g., the activities printing, inserting, packaging (stacking, bundle addressing, strapping), and loading. Reporting on this granularity level is suited for automation through the use of a PMS or GPMS. More detailed reports with respect to the different activities would also facilitate, e.g., identification of bottlenecks and the need for maintenance.

The specific product model described in 8.4.2 should be used as a basis in order to identify an associated production process model as a set of separate activities with a well-defined input and output. The associated resources and their performance as a function of the input and the operations performed should be taken into account.

But even with a rough model of the production process it should be possible to identify a number of separate process models with respect to the process runnability. The process models differ with respect to, e.g., the activities involved, the time needed for printing a given number of good copies at a specific probability, and the predicted consumption of newsprint.

An appropriate number of optimised distribution process models can be developed from the knowledge of the production process models. These models should consider the cruising speed and reliability of the production process. The distribution process models should include estimates of the optimum number of trucks loaded in parallel and how to manage delays and disturbances.

8.4.4 The linking mechanism between products, processes and resources

This thesis deals mainly with the production process performed in the printing plants and with the distribution activities. As pointed out, there is a correlation between the product structure and the process runnability in the printing plants.
Furthermore, there is a strong need for interaction between the production and distribution process in order to prevent delays and associated costs as well as goodwill losses.

A fixed production and distribution plan without coordination with the products and with the estimated process runnability will lead to inefficient utilisation of resources and great risks of delays associated with certain products. More flexible production and distribution plans would imply controlled and predictable risks. In addition, it will render increased utilisation of the production resources possible. The number of alternate production and distribution plans used by a newspaper company has not been discussed, but should be determined from case to case. A completely dynamic scheduling with respect to deadlines for pages, press starts and distribution operations would be complicated to handle and will probably not add much value in comparison with a more limited number of alternative plans. In addition, this would be difficult to introduce due to, e.g., the large number of different activities, organisations and persons involved in the newspaper publishing process.

A more suitable approach would be to use a strict definition of the complete product according to the product models suggested in 8.4.2 in order to identify the most suitable production and distribution plan among a limited number of alternative plans. The linking from the complete product definition to a specific production and distribution plan is carried out step-wise. The product model is used to identify an associated process model containing the necessary activities. The activities are linked to the resources through knowledge of the available resources and through rules telling how to connect resources to activities. Nordqvist has suggested the use of agents and roles as linking mechanism. A more elaborate scheme is proposed by Lassenius [Lassenius et al. 1995].

An agent is used to describe the demands of an activity – a set of capability requirements and their attributes. The agent specifies the required attributes of a machine and the skills and attributes required of a person, e.g. cost, performance, exclusivity, and availability. Roles are used to specify the possible functions the resources can have – a set of capabilities and their attributes [Nordqvist 1996].

A GPMS system should be able to provide the user with estimates of the performance and reliability of the chosen production process and to support with information that facilitates identification of the most suitable production and distribution plan. The identification should be supported by information on the probability of handling the production according to the different plans and the costs associated with the different levels of risk taking.
8.4.5 The maintenance of product, process and resource models

Since the entire production system – products, processes, and resources – changes dynamically over time, the models need to be kept up-to-date. Tracking data is very useful for determining the necessary parameter adjustments and can be collected automatically from PMS and GPMS. Nordqvist has described a tracking model for a GPMS and concludes that there are two significant topics to consider when designing a tracking model, firstly the real time tracking mechanism and secondly the question of how to logically save the collected data in a tracking history structure [Nordqvist 1996]. In this context, the IFRAtrack messages continuously giving the status of the different objects can be used as a source of data. The IFRAtrack messages need to be filtered in order to keep the amount of history data controllable. From this production history, useful tracking data has to be identified and analysed.

In addition, a certain amount of manual work will be necessary in order to support the models with data and rules. Long-term changes in the processes with respect the available resources and/or to their performance, reliability, and costs must be handled in the related models. Long-term changes due to, e.g., investments in new equipment might strongly influence the models and make the available production history obsolete. Many changes will make it necessary to manually set new starting values for the parameters.
9. Summary and conclusions

9.1 Global production management in newspaper production and distribution

In this thesis, a set of basic conditions for newspaper publishing in the Nordic countries have been analysed. Particular attention has been drawn to Swedish morning newspapers with a circulation exceeding approximately 50000 copies per publishing day. Despite the small populations in the Nordic countries, the newspapers companies, in terms of circulation figures, seem to be representative in an international comparison. In a global perspective, the Nordic countries have among the highest newspaper penetration in the world. The newspaper product holds a strong market position.

Efficient production is a key to maintaining the strong position of the newspapers. Late deadlines for news and advertisements are important as well as flexibility regarding the structure of the product. The lead-time for production and distribution must be short and the associated processes must be reliable.

A modern production plant for manufacturing of competitive newspaper products, requires heavy investments. Despite stable circulation figures and an increasing number of newspaper titles, the number of newspaper printing plants has been strongly reduced in the Nordic countries since the beginning of the 1980’s. Today, more than 2.3 newspaper titles are printed in an average newspaper printing plant in Finland and Sweden. In addition, the occurrence of distributed printing has increased – national newspapers are often printed in several locations. Many modern newspaper production plants also print magazines, and commercial products.

The utilisation of resources in the remaining printing plants increases both with respect to conventional newspaper production and production of commercial products. Also the complexity and variety of the products handled in the plants increases.

In terms of daily newspaper production, all companies studied use fixed production and distribution plans, following the same timetable from day to day. The editing, page make-up, and transfer of pages to the plants are guided by timetables defining deadlines for groups of pages through the different stages of production. These timetables are fixed, but the specific pages included in the different groups vary from day to day.
The distribution operation is a strictly planned and optimised network of operations – often based on a fixed press start and a specific production speed in the printing press. The organisations, routines and systems surrounding the distribution operations are closely linked and mutually dependent. Delayed press starts, deviations from the calculated production speed and interruptions during the production immediately cause disturbances in the distribution operation, delay costs, and goodwill losses.

Empirical results concerning the characteristics of newspaper production and distribution were obtained from five case studies, A through E. In Cases D and E, the average net production speed (good copies per hour) in the printing plants varies within a wide range from day to day. Case D mainly covers the distribution operation, but it has also been possible to conclude that days of more complex production in the printing plants (higher page count, inserting operations, and an increased number of bundles) seem to meet with problems more often.

Case E covers more than 300 production runs in two production plants printing the same national newspaper. The results of the study show that the time needed to produce 50,000 good copies of the newspaper varies from 1.6 to 3.7 hours. A histogram of the average net production speed for all productions observed shows that the frequency distribution follows a normal distribution curve. The average net production speed is 23,300 cph and the standard deviation 3,000. Both plants have the same average net production speed. In addition, the shapes of the normal distribution curves are similar for the two plants.

The average net production speed is progressively reduced at higher page counts. Inserting operations result in an accelerated reduction. In addition, the use of bay window assembly under certain conditions means lower average net production speed. In general, the standard deviation is relatively large for most kinds of productions. The standard deviation of the net production speed is larger for complicated products and production methods.

The difference in average net production speed between production runs including the same number of copies is mainly caused by product related differences in cruising speed and by unplanned stops caused by, e.g., web-breaks and technical problems. The frequency of the unplanned stops is dependent on the complexity of the production process.

Because of the fixed press starts used, the reliability of the production schedules varies over a wide range. The results of Case E show that the probability of keeping up with the time schedule is approximately 90% when producing a 40 page product without inserting. The probability of keeping the production plan is
approximately 30% when producing a 68-72 page product with a tabloid product inserted in the mailroom. The average net production speed varies within a wide range, but is strongly influenced by the product and the production method. The time needed to produce a specific product can be predicted at a certain probability.

In the future the conditions for newspaper production is expected to change. The publishing, information and communication industries are in a transition mode and seem, to some extent, to merge. The newspaper product is mature – the circulation figures of morning newspapers are stable or even slightly declining. In the advertising market the competition has increased due to new entrants and substitute products. Many newspapers plan to meet the competition by developing the newspaper product and by reducing the costs. Future newspaper products will be more customised with respect to editorial and advertising content. This is achieved through an increased editioning and inserting of preprinted supplements as well as inserts.

If these changes are carried out within the existing organisation and production system, it implies a number of complications, among others:

- Coordination of subscribers, editions, supplements, and inserts in the circulation and distribution systems.
- Management of multiple editions in the advertising and editorial departments and their systems.
- A more complex edition planning with respect to editions, pages, sections, impositioning, supplements, and inserts.
- An increased number of unique pages and a complex management of the relation between the pages and the editions within the advertising and editorial departments. An increased number of page elements.
- An increased number of final deadlines in the publishing houses and in the printing plants.
- More complex production in the printing plants with respect to the coordination of main sections, supplements, inserts, and addressing of single copies as well as addressing and loading of bundles.

A number of new routines are necessary to plan and keep this kind of production under control. If these routines are to be carried out using the currently available resources, some kind of computer system is needed to support the production management.
Local production management systems (PMS), are already in use, e.g., in the areas of page output and press control. The local PMSs do not generally support tracking, control and scheduling on a global level. But the case studies clearly show that there is a need for global information exchange and coordination between the different activities and systems.

One of the driving forces making systems integration possible is the use of standardised hardware and software components in production systems. Open system architectures imply the use of systems that facilitates intersystem communication. The new conditions for information exchange facilitate the implementation of global production management systems (GPMS). A GPMS makes it possible to bridge the former system islands and support intersystem communication. Some of the earlier obstacles making systems integration hard to introduce are gone, but there is still a need for standardisation. In order to standardise the information exchange between different systems, IFRA has defined IFRAtack. This method makes it possible to create global tracking systems.

A complete, company-wide GPMS can include functions for tracking, scheduling and control. The GPMS includes a simplified reflection of the newspaper production and distribution with models of products, processes and resources. In order to perform scheduling, control and simulation, the GPMS also includes a set of rules, reflecting the optimisation objectives of the company.

The coordination of products with the production and distribution processes is essential already today, and will be even more important if the development will continue as expected. In many organisations, a separate coordinating function, responsible for the coordination of products and plans for production and distribution, will be useful. The main objective of the coordinating function is to create a hub to facilitate coordination and support to the overall organisation. The coordinating function should collect all product specific information in one place and use the GPMS to perform risk analyses and to identify optimised production and distribution plans for the product in question.

Product models can be used in order to select a suitable production and distribution plan. The product model should be used as input in order to identify an associated production process model as a set of separate activities, each one with a well-defined input and output. In terms of IFRAtack and GPMS, this means that an edition version containing certain products can be associated with a specific process model which in turn can be associated with certain resources. The selected production process model can be linked to a specific distribution process model that will match the expected output and the reliability of the current production process.
The IFRAtrack object model suggests a number of object classes and attributes. Furthermore, the relationships between the different objects have been defined. The IFRAtrack product model is structured and developed in order to be used in computerised information systems. The product model is well suited for product modelling in a GPMS for newspapers.

Detailed modelling of the different activities demands detailed tracking and systematic use of the production history. A detailed activity modelling will make it possible to predict the capabilities of a certain activity in terms of production speed and reliability as a function of the input and the operations performed. This will facilitate modelling on a global level.

In Case E, the activities printing and mailroom operations were seen as one process because of lack of data. The input to the process was objects in terms of products (main sections, supplements and inserts) with certain attributes. The production reports did not support process modelling on a detailed level. Despite the rough model used in Case E, it was possible to identify a number of separate process models. The process models differ with respect to, e.g., the activities involved, the time needed for printing a given number of good copies at a specific probability as a function of the input, and the predicted consumption of newsprint.

A fixed production and distribution plan without coordination with the products and with the estimated process runnability will lead to inefficient utilisation of the resources and great risks of delays associated with certain products. More flexible production and distribution plans would imply controlled and predictable risks. In addition, they will render increased utilisation of the production resources possible. The number of alternate production and distribution plans has not been discussed, but should be determined from case to case.

A GPMS should be able to provide the user with estimates of the performance and reliability of the chosen production process and to support the user with information that facilitates identification of the most suitable production and distribution plan. The identification should be supported by information on the probability of handling the production according to the different plans and the costs associated with the different levels of risk taking.
9.2 Limitations

As this study has focused on the conditions for publishing of morning newspapers in the Nordic countries, some of the results might be of limited importance in countries were the newspapers operate under other conditions. Other parameters to consider in applying the results are the flexible approach to the product structure and its late determination, the advanced and expensive production plants as well as the home delivery and its need for a strictly planned distribution operations and real-time synchronisation with the production in plants.

The approach in this study has mainly been technology oriented. Possibilities and limitations with respect to technology have been primarily observed. No deep analyses with respect to market conditions or human aspects have been performed.

One open question is whether the products and production plants observed are representative – is it common to vary the page count and the occurrence of inserts and supplements within such a wide range and still use more or less fixed production and distribution plans? In Sweden, most national newspapers are operating under these conditions. In regional newspapers, the page count usually varies within a narrower range, but still the page count and the occurrence of inserting vary from day to day. Every individual company must analyse its own products, production and distribution processes in order to identify the need for alternative plans.

The analysis of the interaction between product structure and the runnability in the printing plants is based mainly on 366 production runs in two plants. The limited number of plants can be seen as a weak point in the study. But similar newspaper products, similar production equipment – mainly delivered from world leading press and mailroom manufacturers – and similar production methods are found in modern plants all over the world.

The two plants observed are among the most highly utilised in Sweden. The production equipment used is from the late 1980’s and is in general well functioning. The production staff is considered to be capable and familiar with the equipment. The results from the two plants, with respect to correlation between product and productivity, were almost identical. The results obtained were presented to and discussed with experts from the companies involved. These representatives have approved of the methods used and results obtained. The results have also been presented to experts from other companies who found the results re-
alistic. The results regarding correlations between product and productivity are general. But nevertheless, the figures presented are only valid under the conditions observed.

Only one distribution company has been studied, but the market situation and the general conditions for newspaper distribution in Sweden are very regulated and most distribution companies and distribution operations are organised in a similar way.

Great efforts have been made to identify the correlation between product and production. One legitimate question is whether the production process can be improved in order to improve the runnability in a general perspective and thus reduce the difference in runnability between different products. The topic has not been addressed here, but the question must be raised and analysed in every single case. The competence within the organisations, the routines, and the condition of the equipment are particularly important in this context. Quality assurance related activities are important in order to secure the production process and would probably help many newspapers in their efforts to obtain a reliable production, but the this topic has been left out of this work.

The part of the thesis that deals with models supporting PMS and GPMS should be seen as only a brief introduction. The objective of the discussion is to relate the previously presented results to computer based systems for production management. Much work is needed in order to develop process and resource models as well as rules supporting scheduling and control on a global level.

9.3 Generalisation

Many of the results presented are not exclusively applicable to morning newspaper production and distribution in the Nordic countries. Newspapers, particularly of approximately the same circulation and page count as the national and regional newspapers studied (circulation 50000–400 000), should gain by a better coordination between products and plans for production and distribution.

Furthermore, global production management will probably be useful in other businesses as well. Publishing of magazines and other printed products mainly produced in a digital environment and with complex flows of information and material are other closely related activities that should have use of tools and theories enabling increased flexibility, improved control, and decision support.
The graphic arts industry, and particularly the newspaper industry, has been early in adopting completely digital production environments. These digital environments make the production suitable for automated tracking which, in turn, generates the data necessary to extend the systems to include scheduling and control. The development of computer hardware and software as well as communication technologies accelerates and the occurrence of digital networked production environments will increase in other industries as well.

This study mainly focuses on two parameters – time and costs. These parameters are not unique to the newspaper industry. Reliable systems that support tracking, scheduling and control with respect to these parameters will be useful in many industries.

9.4 Future work

A prototype system of a GPMS partly based on the principles presented in this thesis is, as this is written, being developed in three stages by a research group at the Royal Institute of Technology in Sweden. A prototype system has been installed at a Swedish regional newspaper. The first two stages in the system development have been completed and a tracking system is tested in the production environment of the newspaper. An intersystem communication mechanism has been developed and a number of additional subsystems will be connected during 1997 [Hedin et al. 1997], [Fällström et al. 1997].

The next stage of the project is to complete the development of functions enabling dynamic process modelling and resource management. Tracking data from the production will be used in order to define some of the parameters in the models.

In addition to the prototype development, a number of areas can be pointed out as interesting fields of further research, among others:

- Identification and analysis of physical and mechanical parameters causing variations in production output in printing presses and mailrooms.
- The correlation between the process runnability and activities related to quality assurance and maintenance.
- Development of local PMS’s in the mailrooms that handle disturbances and that dynamically can optimise truck loading with respect to, e.g., time, cost, and goodwill.
• Development of a more fault tolerant organisation of the distribution operation.

These are just a few observations on possible future research areas identified during this study. Each topic has some kind of connection to the study and will hopefully help to push the development of newspaper production one step further ahead.
References

Adams, J.M., Faux, D.D., Rieber, L.J.

Alasuvanto, J., Enlund, N., Mäntyla, R., Sulonen, R., Vuorikoski, M.

Alexander, G., A.

Alho, K., Lassenius, C., Sulonen, R.

Andersson, J.

Andersson, J., Audell, B., Gieritz, E., Reitberger, G.

Antikainen, H.,

Bergman, B.

Blom, G.

Boström, B., Nilsson, A., Selldén, J.

Boström, B.

Bruna, M.
Buffa, E., S.  
1965  “Modern Production Management”, 2nd edition, 4th printing,  
John Wiley & Sons Inc, NY, USA, pp. 758.

Burkhardt, F.  
1992  “The pros and cons of a tailored newspaper”, IFRA, Darmstadt, Germany,  
pp. 24.

Bäck, A.  
1993  “Möjligheterna att effektivisera tidningsdistributionen”, in Swedish (translated  
from Finnish), Tidningarnas Förbund, Helsingfors, Finland.

Carlerud, O.  
1996  “Rapportering och underlag för planering inom tidningstryckerier”, in Swedish,  
thesis for the degree of Master of Science, The Royal Institute of Technology,  
Division of Graphic Arts Technology, Stockholm, Sweden, pp. 52.

Carlsson, G.E.  
1967  “Grafisk teknik”, in Swedish, Grafiska Forksningslaboratoriet, Stockholm,  
Sweden.

Christensen, L., B.  

Cole, D., M.  
1994  “Choose a circulation system – Distribution managers share their software  
criteria”, Presstime, VA, USA, October, pp. S3–S8.

Crouse, D.B., Schneider, R.J.  
(GATF), PA, USA, pp. 282.

Dalin, B.  
1986  “Tidningstryckets utveckling”, Det tryckta ordet, in Swedish, LTs forlag,  

Dalin, B.  
1994  “Rullrotationstryckning av tidningar och tidskrifter”, in Swedish, 2nd edition,  
Grafiska Yrkesnämnden, Stockholm, Sweden, pp. 105.

Diergardt, S.  
1989  “The changing world of prepress systems”, IFRA Special Report 2.3.1, IFRA,  
Darmstadt, Germany, pp. 14.

Edwards, S., E., Neelf, D., Rosello, R., Tribute, A.  

ENPA  
1996  “Europeans Read Newspapers”, The European Newspaper Publishers’  
Association, Brussels, Belgium, pp. 118.

Engwall, L.  
1978  “Newspapers as organizations”, Saxon House, Teakfield Limited, Westmead,  
Enlund, N.

Enlund, N.
1986 “Standardisation is the name of the game”, Newspaper techniques, IFRA, Darmstadt, Germany, December, pp. 22–26.

Enlund, N.

Enlund, N.

Enlund, N., Alasuvanto, J., Sulonen, R., Nordqvist, S.

Enlund, N.

FIEJ

Finansdepartementet

Foss, K.

Fredriksson, G., Strand, D., Hadenius, S., Gustafsson, K.-E.

Fuchs, B.

Fuchs, B.
1995a “How can the requirements for 4-over-4 printing be met”, IFRA Special Report 4.10, IFRA, Darmstadt, Germany, pp. 32.

Fuchs, B.
Fällström, F., Petersson, T.

Fällström, F., Nordqvist, S., Hedin, B., Ionesco, V.

Gustafsson, K.-E.

Güth, R.

Hacker, R. G.
1969 “A Simulation Model for the Analysis of Selected Newspaper Operations”, thesis for the degree of Doctor of Philosophy at the School of Journalism, Graduate College of The University of Iowa, USA, pp. 234.

Hadenius, S., Weibull, L.

Hedin, B., Fällström, F., Ionesco, V.

IFRA
1983 “Classification of paper and reel defects”, IFRA, Darmstadt, Germany.

IFRA
1986 “Automatic reel transport by means of AGVS”, IFRA, Darmstadt, Germany.

IFRA
1987a “Copy Stream Storage Systems”, IFRA, Darmstadt, Germany.

IFRA
1987b “The bar code on the reel wrapping – What possibilities does it offer to newspapers”, IFRA, Darmstadt, Germany.

IFRA
1988 “The use of bar codes in newspapers and in mailroom/distribution operations”, IFRA, Darmstadt, Germany.

IFRA
1989 “Inserting Machines”, IFRA, Darmstadt, Germany.

IFRA
1990 “New Developments in Newsprint Warehouses”, IFRA, Darmstadt, Germany.
IFRA 1992 “Copy counters and their application”, IFRA, Darmstadt, Germany.

IFRA 1994 “Possibilities and limits of CTP in newspaper printing”, IFRA, Darmstadt, Germany.


Jonason, N. 1989b “The changing world of prepress systems – Local Area Networks”, IFRA Special Report 2.3.3, IFRA, Darmstadt, Germany, pp. 34.


Jonsson, A. 1996 “Multichannel publishing and automated updating of online newspapers”, proceedings of the 48th annual TAGA-conference in Dallas, TAGA, Rochester, NY, USA, pre-print, pp. 17.


Monni, O.

Monni, O.

N.N.

N.N.

N.N.
1994c “Bild now printed in Munich on a KBA Commander press”, Newspaper techniques, IFRA, Darmstadt, Germany, April, pp. 40–42.

N.N.
1994d “Albert develops new concept for press superstructures”, Newspaper techniques, IFRA, Darmstadt, Germany, April, pp. 44–45.

N.N.

N.N.

NATS

NATS

NATS

NATS

NATS

NATS

NATS

NATS
NATS

Nicholson, M.R.

Nordqvist, S.

Nordqvist, S., Enlund, N.

Nordqvist, S., Karttunen, S., Stenberg, J.

Nordqvist, S.

Nordqvist, S., Enlund, N.

Nordqvist, S.

Nyman, M.

Nyman, M.

Petersen, E.
1985  “Systematics of Mailroom Functions”, IFRA, Darmstadt, Germany, pp. 36.
Picard, R., G.  
1996  

Porter, M., E.  
1985  

Prümmer, K., v.  
1994  
“PC networks in newspaper production call for the wide-ranging use of state-of-the-art technology”, Newspaper techniques, IFRA, Darmstadt, Germany, February, pp. 1–2.

Quervel, P.-L.  
1995  
“To reduce cost and expand colour – Nya Wermlands-Tidningen cross the Klarälven”, Newspaper techniques, IFRA, Darmstadt, Germany, December, pp. 62–67.

Rahkonen, T.  
1996  

Ralston, A. och Reilly, E.D.  
1993  

Ridderstad, P.S.  
1986  

Ring, S.  
1981  

Rock-Evans, R.  
1989  

1990  

Sigfridsson, J.  
1993  

Smith, A.  
1980  

Smith, G., B.  
1995  
“Honeywell’s Total Control concept in use at Dagbladunie in the Netherlands”, Newspaper techniques, IFRA, Darmstadt, Germany, October, pp. 72–76.
South, D. W.  

Statistiska Centralbyrån 

Stein, G.  
1995  “Shaft-less presses and PCU make flying plate changes possible”, Newspaper techniques, IFRA, Darmstadt, Germany, Juni, pp. 10–14.

Stenberg, J., Karttunen, S.  

Stenberg, J.  

Stenberg, J.  

Stenberg, J., Karttunen, S.  

Svedheim, B.  

Svenska Dagpress  

Södergård, C., Karttunen, S., Sirén, A., Yläkoski, I.  

Södergård, C.  

Thoyer, B  
Thoyer, B
1996 “IFRAtrack: a recommendation for the interchange of status information between local and global tracking systems in newspaper production”, manuscript of an IFRA Special Report, IFRAtrack version 1.1, IFRA, Darmstadt, Germany, pp. 32.

Tidningsutgivarna

Tidningsutgivarna

Tidningsutgivarna

Tidningsutgivarna

Tewlow, J.
1968 “Time-Sharing and the Newspaper of Tomorrow”, ANPA Research Institute Bulletin 951, ANPA Research Institute, NY, USA, April, pp. 93–110.

Tewlow, J., Marcus, R., S.
1970 “Computer terminals for newspapers: Applications and requirements”, ANPA Research Institute, NY, USA, pp. 207–212.

Tribute, A.

Tribute, A., Rosello, R., Jonér, U.

Triola, M. F.

Trollháss, P.-O.

Tuukkanen, A., Passoja, S., Enlund, N.

UNESCO

