INTEGRATED PRODUCTION SYSTEMS FOR THE GRAPHIC ARTS INDUSTRY

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Keywords: Analysis, Case, Integrated, Production, Work flow.

Abstract: During the eighties, extensive investments in new technology have been made by the graphic arts industry, but the investments have not always given the expected productivity and quality enhancement. The expensive equipment must be used effectively if it is to become both technically and economically profitable.

If the different systems of which a modern production plant consists can be linked together, a more homogeneous production environment is obtained. Within the manufacturing industry the development of the CIM-concept (Computer Integrated Manufacturing) has resulted in ISO-standards and well functioning production plants.

The results presented are based upon literature studies, participation in conferences, supplier contacts, study visits and studies of one gravure printer and two newspapers which in addition to their own paper prints other newspapers and commercial jobs.

Company visits and field studies have shown that different company characteristics give rise to different needs of integration. Newspapers which have a tight schedule, need to be quickly notified about delays to be able to re-plan. Newspapers should first invest in automatic production reporting. Gravure printers with a long printing forme manufacture time, have to avoid remakes of the cylinders. Quality assurance is the primary goal, thereafter is electronic transmission of material from prepress to gravure equipment the most important measure.

The paper is concluded with a discussion about the general conditions of integrating a company.

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INTRODUCTION

Background

The graphic arts industry has changed in a short time from being a manual and handicraft industry in a direction towards becoming a high-technology process industry. Many companies have made extensive investments in new equipment, e.g. systems for image processing, phototype-setting, printing forme manufacture, printing and postpress production. Each of these subsystems represents a high-technology process but the intermediate links are missing. The subsystems are not homogeneous but in turn consist of several more or less isolated systems, each having specific solutions with regard to user interface, operative system, network and database functions. Control and monitoring functions are built into each subsystem without any coordination with the surrounding world.

This is one of the reasons why the investments have not always brought the expected productivity and quality improvements. Many companies have however become aware that the capital-intensive process equipment also makes great demands on efficient usage if it is to become technically and economically profitable. Production control and resource-efficient production are key concepts at a time when many companies are experiencing increasing competition. One way towards a more resource-efficient production is an increased integration of the subprocesses. This has been discussed for several years from different viewpoints (Fuchs 1986, Quervel 1991). In Finland two groups are studying CIM-concepts for the graphic arts industry (Juhola 1992, Sulonen 1992). Today, limited amounts of information are as a rule transferred between the different process stages and the degree of automation between these is low. The production is optimised within each subprocess without any overall concept.

Parallel to the development in the graphic arts industry, a transition is taking place within the computer industry towards open computer systems and efficient network solutions (Jonason 1989). This means that it is now becoming possible to link together the different subsystems relatively easily and to obtain a more uniform production environment (Nordqvist 1992). These integrated fifth wave systems will make it possible to create efficient information systems and to automate parts of the planning, control and reporting work (Karttunen 1992). By integrating the subsystems, a more solid foundation for decisions can be developed. Important decisions can be made from a total viewpoint.

A production system in which different subsystems communicate with each other can in principle be built up in two different ways. An expensive solution is to replace all existing equipment and invest in new systems which meet high requirements with regard to openness and communicability (Punnonen 91). Another possibility is to allow programmers to make special adaptations to existing systems so that they can exchange information. This is also an expensive and inflexible alternative. It is inflexible because the company becomes restricted to the existing equipment.

The ambition must be to achieve a supplier-independent production environment in which equipment and systems can exchange information in a standardised way. If those

types of material and information flows which should be controlled or automated in the first place are identified, conclusions can be drawn as to which subsystems should first be connected, in which way this should take place and which parameters should be exchanged. It is not however desirable to have a centralised control and management system; the subprocesses should still be controlled locally.

By systematically studying and analysing the production with regard to material and information flows, technology, economy and organisation and by taking into consideration external technical factors, models and strategies for system integration can be developed.

The project: Integrated Production Systems for the Graphic Arts Industry

Within the framework of the activities carried out at the Swedish Graphic Arts Research Laboratory and at the Department for Graphic Arts Technology at the Royal Institute of Technology in Stockholm, a project was started during the autumn of 1992 within the field of integrated production systems for the graphic arts industry. Three Swedish graphic arts companies also participate in the project. Criteria for the choice of these have been the size, type, proximity and good relations with the company.

The need for integrating different subsystems or subtasks in newspaper and certain types of commercial printing will be investigated. The investigation will be carried out with regard to what can be attained with integration, e.g. improved productivity, greater flexibility, better foundations for decisions and better working environment. The results from the preliminary study will provide a basis for a larger project which will be directed towards developing models and strategies for integrated graphic arts production systems.

This paper constitutes the first official report from the project. It is based on literature studies, supplier contacts and a mapping and analysis of the production in three companies. The scientific methodology used in the mapping of the production is presented here together with the results of the three case-studies and the subsequent analysis.

PROCEDURE

To start with, an inventory was carried out of those production systems which exist on the market. The inventory was carried out in the form of literature studies, trade fair visits and company visits.

The production in those graphic arts companies which have participated in the project has been mapped. The mapping meant that the project workers carried out extensive interviews with personnel involved in technology, administration and production planning. The project workers were also present during production and in connection with this interviewed operative personnel, carried out a problem inventory and complemented the mapping. In order to illustrate the activity graphically, i.e. functions and flows, parts of the so-called ISAC-method were used. The method is described briefly in the following

section. The so-called activity graphs which represent the result are a good tool for grasping and sorting out all the flows which enter into and exit from different functions.

Activity graphs were produced with the help of the GraphDoc software and, together with the problem inventory, provided the basis for the analysis and the results presented in this paper.

METHOD

The task has been to analyse material and information flows in prepress, printing and postpress production in the graphic arts industry.

By using a structured method we are forced to map the companies' activities according to a defined set of symbols and rules. The kind of production sets some basic conditions for the method we choose. These demands are that it:

- Has the ability to describe multi-flow-oriented production.
- Has the ability to describe activities both graphically and verbally.
- Has the ability to consider both the material and information flows.
- Is well tested and documented.
- Is supported by software tools, because of the complexity of the production.
- Is understandable to both fellow researchers and production personnel.

The method we chose to analyse production is called Systematic Description of Activities (SDA) and is defined in the project ISAC, Information Systems work and Analysis of Changes (Lundeberg, 1978). This method describes the activity and information behaviour of an organisation. The method satisfies the demands for a uniform tool to map the production of typical graphic arts companies. The method has been chosen on the basis of literature studies and contact with systems experts at the University of Stockholm. The detailed process of choosing an adequate method is described by Nordqvist (1993), whose work is presented at TAGA '93.

Systematic Description of Activities (SDA)

SDA uses a graphical description technique that is called activity-graphs (A-graphs). A-graphs are combined with a verbal description, text pages and attribute tables that present interesting data about certain elements in the A-graphs. These can be frequencies, amounts or sizes. The method defines a collection of symbols and rules of design and interpretation. Physical connections between activities in A-graphs are described by physical flows, communication is described by information flows (Boström, 1986). The method is mature and developed from a project during the seventies called ISAC (Lundeberg, 1978). The method has been developed at the Royal Institute of Technology and the University of Stockholm, Sweden. It is relatively widely used by some large companies, both Swedish and international (ABB, SCA, Ericsson and financial companies).

Symbols defined by the method

It is important to follow the rules and guidelines defined by the method. The symbols shown in figure 1 are the set given by SDA. All connections and flows are assumed to be from top left. If a flow is in any other direction it must be shown with an arrow. In-flows goes in to the top of the frame and out-flows emits from the bottom. The A-graph should represent a given period of time, activity of "now" (N0), and in a separate set it should display the future (F0). For examples of A-graphs, see figure 2 and 3.

Rules for the user

The rules define the numbering of graphs, sets and flows (Boström, 1986). The first graph is numbered N0 and deeper in the activity a hierarchical numbering follows. Activities within N0 are numbered. A deeper map of e.g. activity number 4 will generate subactivities 41 – 49. Material and information flows are named after their activity. For example, a flow from subactivity 46 is named 46A-Z. The interpretation of an A-graph is helped by a thorough verbal description. It also assumes that the observer knows the symbols and the basic rules for SDA.

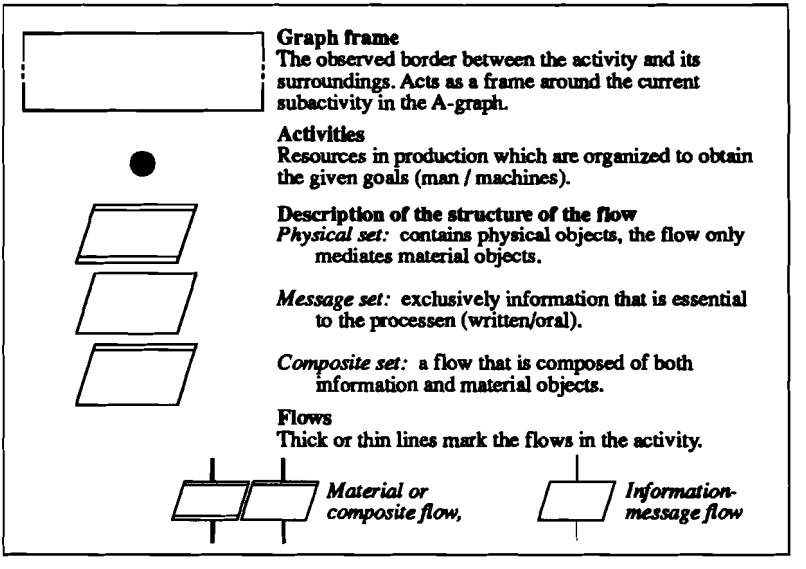

Figure 1. *Symbols defined by A-graphs.*

Software tool for SDA

GraphDoc is a tool for simplifying the mapping of the activity and keep it updated. The tool supports the method fully and keeps the graphs consistent. The tool also supports a method called "I-graphs" (information graphs). The software was developed in 1983 - 1985 on DOS-PC (N.N. 1989).

Advantages	Drawbacks
Easy to break down to complex activities into less complex subactivites without losing data and control.	The graphs can become confusing since the simplicity of the method invites to "overdo" it. It is important to limit the task to those activities which it is of interest to map.
Graphic and verbal description, hierarchical structure.	Functions and flows do not have an intuitive numbering.
Compact group of symbols.	The method does not support time-related issues.
Graphics are easy to understand, even for newcomers to the method.	The method is not integrated with a systems development model.
Separates material and information flows in the production.	The software is developed in an old system environment (commando-oriented). It does not allow export or import of data. The graphics are bit-map-oriented.
Adjacent methods that allow deeper analysis of the production are available	
Software, that supports the method, is available.	

***Table 1.** The following advantages and drawbacks have been observed when using SDA.*

CASE 1 — GRAVURE PRINTING

This company is a gravure printer producing primarily magazines, with editions of more than 100 000 copies. The amount of incoming orders is good. Printing forme manufacture and printing is carried out 24 hours a day and binding for 16 hours a day. All departments are in production six days a week. The reproduction work is done by other external companies and is not included in this analysis.

The incoming film is copied to opaque film to facilitate reading for the cylinder engraving. The film is fitted by hand on the reading drum. The cylinder is engraved, washed, chromium plated, polished and proof-printed before it is ready to be moved to the printing hall and fitted into the appropriate printing unit. After printing, the folded sheets are rolled up on PrintRolls (Müller Martini) before the bindery takes over. The bindery plans its work independently according to the nature of the products and how they are to be processed.

Information is transmitted between personnel mainly verbally and via the work orders and reports. The order is passed from the salesmen to the order foremen. Work supervisors take their work orders from the production control system GD2000 (GrafiData) and morning meetings are held with planners and order foremen. The work supervisors then pass on the information to the operative personnel. Reporting back is done by the different work units in the form of written shift reports, material reports and error reports which are then fed into the GD2000. This provides the basis of the production follow-up.

Computer systems in the company

Approximately three years ago, the company invested in the GD2000 production control system. This includes calculation, planning, storage and production follow-up and handles a large part of the information flow within the company. The planning part of the system is not however used to the full extent. The detailed planning is instead done in the Lotus 1-2-3 software. Only the utilisation of the press is planned. It is possible to simulate the production in GD2000. Consideration is given to all the production stages but not to the fact that the make-ready time varies depending on the order of the jobs. GD2000's simulation function is not used. Bar-code equipment exists but is not used.

For the press there are two systems, one press control system which pre-sets ink, register and parts of the folding unit, records the errors which have arisen in the press and counts the total number of revolutions. The other system handles ink and register adjustments during printing and counts approved sheets before the folding unit.

In the cylinder preparation, there is a system which records the position and status of the cylinders. This system also controls the traverses which handle the moving of the cylinders. The cylinder engraving has computer equipment which controls reading and engraving.

In the bindery, there is a planning and production system which also controls some of the machines.

Problems in production

Planning

The planning and simulation possibilities of the GD2000 are not utilised. This depends on low motivation and a low level of knowledge among the personnel and on the fact that the management does not give priority to the use of the GD2000. Since the system was purchased, the company has undergone large structural alterations and the management has been changed. Since the users do not have sufficient training on the system, the information is not always fed in correctly. This in turn generates errors in later stages.

Re-planning in the production is the rule rather than the exception. The planners do not have direct access to information about which cylinders are available and ready for engraving. The delays are considerable if cylinders with the right circumference have not been prepared. Planners are only available on the dayshift, which means that the detailed planning rapidly becomes out of date.

Printing forme manufacturing

The main problem in the production is that the printing cylinders must be remade in about 10% of the cases and are thus not ready in time. This, in combination with the fact that the prepress material often is delayed, causes delays throughout the subsequent process. The remakes can be necessary for mechanical reasons but more often they

depend on errors in/inadequate control of the incoming repro-material and on errors arising internally when preparing the cylinders.

Printing & Binding

Because of delays in the cylinder preparation department, the presses and parts of the bindery are sometimes temporarily shut down.

The press cannot run if no empty PrintRolls are available. Problems can arise when the bindery is closed if there are unexpected production changes (thicker or multi-sheet products or overtime on the press).

Reporting

Many reports are in circulation, such as shift reports, error reports and machine reports. Because of complicated routines, these may give rise to both double and triple work. Error reports are incomplete, the errors are noted but not always their causes and effects. Bar-code equipment is available and ready to operate at the company, but it is not yet in use because it has not been given priority in the development of the company.

Analysis / Case 1

Planning

The planning is today only very general. In order to be able to plan/re-plan more accurately and in an optimal manner, the GD2000 should be used to the full extent with the possibilities of simulation which exist. By placing similar jobs after each other, the make-ready times in both the engraving shop and the press can be reduced. It is also desirable to be able directly to see which cylinders are available, and to be able to determine whether the number of PrintRolls will be sufficient. If the GD2000 is used, the planning becomes automatic not only for the press but also for the other operations. If a person who understands GD2000 is available on all shifts, re-planning can take place in the best way (1:$,F). The indices in the text refer to Table 2.

Printing forme manufacturing

A careful control of the incoming repro-material would be a great benefit since errors in the repro usually lead not only to one but to several cylinders having to be remade. It is true that the prepress functions are today debited for their errors, but the remakes lead to time delays and to other costs which are not debited such as re-planning and stand-still time in the press. (Such costs have however begun to be debited since the completion of this study.)

A number of internal errors could be avoided if the engraving equipment had better verification functions in order to discover incorrect settings (2:$,Q).

The material from prepress could be delivered digitally and all impositions be stored digitally together with the pre-settings. The engraving machine could then be loaded with these data and errors depending on film, misfitting, incorrect sorting and wrong pre-setting be eliminated (3:$,Q,F). An additional effect is that messenger costs are reduced and that the costs of the film and engraving departments can be reduced (4:$).

By introducing cylinder history, recurring individual cylinder errors can also simply be found and corrected (5:$,Q).

Printing & Binding

With more efficient planning, possibilities of simulation, and more PrintRolls in order to accumulate sufficient work, the resources of the press-room and bindery can be used more efficiently (6:$,F).

It should be possible to pre-adjust the viscosity of the ink for each job since the ink/ toluene ratio depends primarily on the paper. This would lead to shorter make-ready times and reduced waste (7:$,F).

Reporting

Reporting of both work carried out, errors and standstills could, in order to avoid double work and wrong entries, to a greater extent use existing systems and the bar-codes to which GD2000 is adapted (8:$,W). The reporting from cylinder preparation could take place with bar-codes and/or via the system which handles the engraving or the cylinder handling system. Reporting from the press could take place via the press control systems which record all standstills, the number of printed sheets and the waste figures. The reporting from the bindery could be done with the bar-code equipment. The advantage of using these methods of reporting is that the production could be followed in real time. If real-time reporting is used together with the GD2000, the production can be optimised (9:$,Q,F).

	$ Profitability	Q Quality	W Work content/ environment	F Flexibility
Planning	1			1
Printing forme	2,3,4,5	2,3,5		2,3
Printing	6,7			6,7
Reporting	8,9	7,9	8	7,9

Table 2. This table shows which subprocesses can be improved by integration. The criteria are profitability, quality, work content/environment and flexibility. The figures in the table can be found as references in the text.

CASES 2 & 3 — NEWSPAPER PRODUCTION

The mapping of the production at two Swedish newspaper printing houses is the basis of this section. Besides their own morning newspaper, both companies print both other newspapers and commercial products. The companies are characterised by a relatively high resource utilisation and very tight time limits. The study has been concerned only with the production of each company's main product. A description of the activities involved in newspaper production can be found in appendix A.

In order to achieve a good overview of the production and the factors which influence it, the whole planning and production procedure has been followed. For reasons of space, however, this report concentrates on the production from the finished original film to loaded addressed bundles of newspapers. Systems integration within the prepress area has been mapped and analysed by one of our colleagues (Nordqvist 1993).

Newspapers in Sweden

Most of the morning newspapers are distributed directly to the homes of subscribers. Newspapers from different newspaper publishers are often distributed jointly and, in the contracts which regulate the distribution of the newspapers, any company who causes a delay may be obliged to pay very severe damages. The daily newspapers work under a very severe time press.

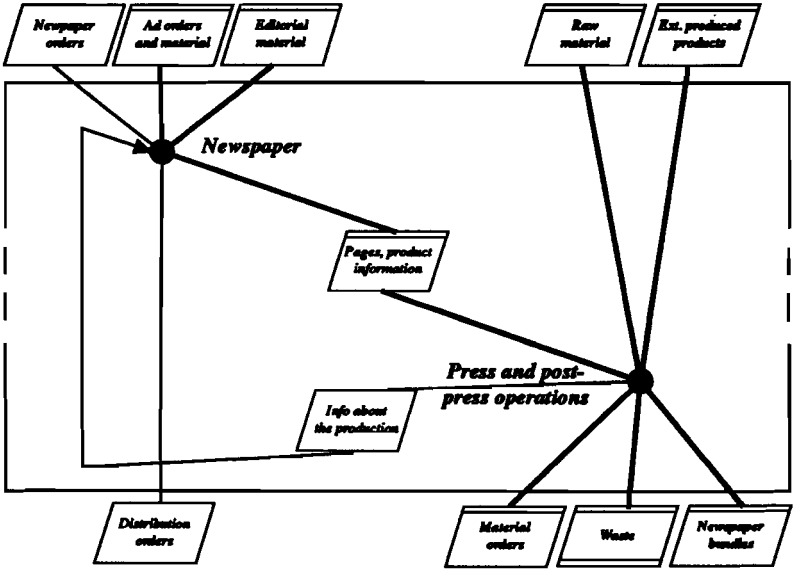

Figure 2. General description of the most significant global information and material flows in newspaper production.

The newspapers have a relatively large number of pages (32-64 pages are common) and consist to 40% of advertisements. The proportion of newspapers able to print in four colours is high. The colour potential is used primarily for advertisements. The print quality of these advertisement pages is very important and often determines whether or not the printing is approved.

Systems in the companies

The philosophy with regard to systems for monitoring the stocks differs between the two companies as far as the paper is concerned. In the one case, all transactions are recorded and the current stock balances are obtained directly from a computerised system for paper follow-up. In the other case, the stock routines are fully manual. It functions thanks to standardised paper grades and low storage levels which are taken stock of daily, paper being ordered 2-3 times/week. The routines for other types of stocked articles are manual.

The presses are equipped with systems for automatic pre-setting and control of the parameters which influence the printing. The systems show a very high degree of automation within a limited area. The control systems used are not able automatically to store information about what happens during the printing and the possibilities of obtaining automatic production reports are limited.

In the mailroom, the systems adopted by the two companies are very different. In the one case, there is a system for programmed bundle production. Thereafter, all functions are manual. In the other case, insert equipment is used. The stacker lines and bundle control are fully automatic while the control of the inserting machines is to a certain extent manual. A more extensive list of subsystems is presented in appendix B.

Problems in production

Connections to large-scale systems for automatic status follow-up and reporting back are lacking. Delays in receiving information concerning hold-ups, changes, status and faults in both the prepress and adjacent departments makes the re-planning of the production difficult.

Many reports are hand-written. The personnel responsible for the reporting are often key persons who do not have time to document what has happened until afterwards. The reporting can be incorrect and the reports are often compiled manually after the production is completed.

The primary problem in the plate-making seems to be the mixture of systems which are used in the prepress departments. The pages are produced in a mixture of old and new systems which are not co-ordinated with the current organisation. Because of this, the page films supplied are not always complete. Page elements are included on several films of the same page or are lost completely. The consequences of this can be repeated copyings and errors which are not discovered until during the printing.

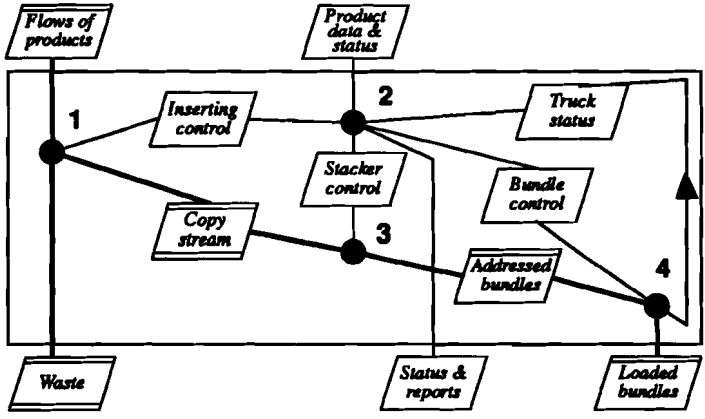

Figure 3. Activity graphs describing the flows of material and information in the postpress area. The activities are: 1- inserting, 2 semi-automated mailroom control of the production run, 3 - stacker lines, 4 - handling of bundles.

Communication between mailroom and pressroom is very important. Certain combinations of newspaper thickness and bundle size can make it difficult for the mailroom to keep up and it may thus be necessary to reduce the rate of production on the printing press. Mailrooms with many manual operations or unreliable automation solutions are often personnel-intensive and/or vulnerable. The function of the mailroom is often dependent on a small number of persons who know all the routines and understand the production. During manually controlled zoned inserting, great demands are made on coordination between the inserts and the bundle production.

Analysis / Case 2&3

Automatic data collection can reduce the work load, increase the speed and accuracy of the reporting and make it easy to adapt the information to the receiver. Production data which is collected and processed can be used both as a basis both for decisions in connection with production disturbances and as a basis for production reports.

Control routines to check whether the content of each page film is complete and correct should be introduced. This control can be carried out either in connection with the page-making or in connection with the plate preparation.

Mailrooms tend to become costly either through high waste figures or through an extensive staff if well functioning technical solutions do not exist. The mailrooms and their respective control systems can gain a lot by automation with regard to working environment, vulnerability and productivity. A rapid and well functioning exchange of information between the mailroom and the pressroom is very important to reduce the risk of production disturbances and to reduce the amount of waste.

CONCLUSIONS

The results presented here are based upon literature studies, participation in conferences, supplier contacts, study visits and studies of the three graphic arts companies described.

Many suppliers can deliver communicable systems. The **communicability** lies in the fact that the systems use standard solutions with regard to network and databases. Most of the large system suppliers can deliver systems based on standardised network solutions, communication protocols and database interfaces.

Few system suppliers go outside their traditional fields of technology. The total solutions which exist are in general **rigid and costly**. The suppliers who deliver open systems leave the responsibility for the integration to others.

Because of the limited time available, daily newspapers have a great need to be able quickly to **transfer** production information between different departments and to simplify and improve their reporting. Information feed-back relating to the production makes possible decision-making based on the status in the whole establishment. The production can be optimised and the establishment of co-operation throughout the whole process makes it possible to increase productivity. Manual reporting often means that the information is incomplete. Fully or partly automated feed-back reporting leads to a better working environment and more reliable reports. The introduction of automatic reporting requires that the personnel must be motivated and trained.

Computerisation tends to become **an end in itself**. Simple solutions are overlooked in favour of complex ones which require computer support. Good manual routines can be more efficient than poorly computerised ones. The danger with manual routines and manual control is that the function is dependent on a few individuals and their decisions and specialised knowledge.

Integration of different systems should take place only when the subsystems function well in themselves. This is especially true of the gravure printing company where the cylinder preparation and make-ready require so much time. Everything must be done correctly from the beginning to avoid the necessity for repeating any of these processes. For many companies, much can be gained by developing good manual routines and well functioning subsystems before different systems are computerised and subsequently integrated.

Integration could to a certain extent be included in the quality work (ISO 9000) started in many graphic arts companies in Europe, but it is above all a means of simplifying the quality assurance work especially with respect to reporting and planning, by taking information directly from the bar-code equipment and control systems in the production. Integration also reduces the number of sources of error.

Integration is only a part of the improvement process in a company — organisation, quality and automation issues are other important components.

DISCUSSION

The degree of openness and the use of standard platforms has led to a situation of less vendor dependence in the prepress area. Today it is possible to combine equipment from different vendors without any specially designed hardware or software. This new situation leads to a less machine-oriented organisation. The new organisations are more know-how-based and the knowledge is build up within the organisation. Equipment can easily be changed from one day to another and the investments and costs of maintenance are much lower than they were during the machine-oriented past. The change from a machine-orientated towards a knowledge-based organisation in the prepress area is shown in figure 4. We believe that the trend in the press and postpress area will be the same in the future. There are some big differences between the prepress area and the area of more heavy production. In short are these differences:

- The costs and the share of hardware in systems are much lower in prepress.
- The lifetime of each installation is much shorter in prepress
- The number of installations worldwide is much higher in prepress

Especially the second and third points might affect the development towards standard solutions and openness in a negative way. Integrated productions systems are the systems of the future and sooner or later the openness will be totally accepted by all vendors. Strategies and models concerning organisation, technology and information handling in the graphic arts industry will therefore become increasingly necessary.

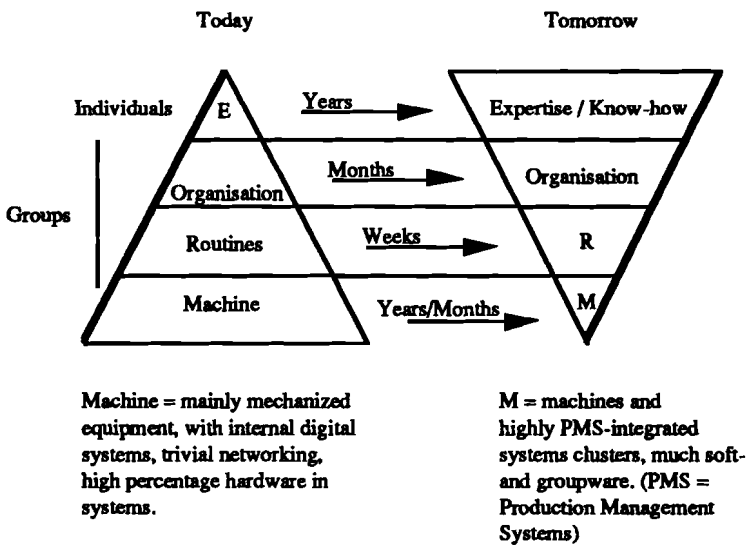

Figure 4. Changing new trend from machine-oriented to expertise-oriented production resources. Prices of machines/systems will be relatively lower. The investments in personnel and know-how will increase rapidly. Expertise becomes a critical resource.

The arrows between the triangles refer to the time needed for changes. Years under "Machine" refer to very long delivery times of big presses (up to 2-3 years) and months refer to normal hardware and systems. In the future systems, the routines and functions can be changed easily. Users produce a part of this systems customising. (Based on a discussion between Simo Karttunen and Johan Stenberg at KTH/GT Stockholm, April 1993.)

ACKNOWLEDGEMENTS

The authors wish to thank the companies involved and professor Simo Karttunen at the Royal Institute of Technology in Stockholm, Sweden.

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APPENDIX A

Activities involved in newspaper production

Newspaper production is a very complex chain of processes with a high degree of parallelism. Material and information flows between the newspaper publisher (marketing departments and editorial office) and the press room are similar from day to day and follow a carefully established timetable. This timetable is based on factors in both distribution and production technology and includes very little slack time. This appendix summarises the main features of the flows mapped at the two newspaper printers.

The advertising department and the editorial office can, on the basis of the expected advertisement volume and the sales orders, determine the format (number of pages and colour configuration) and size of the edition of the product. A format catalogue describes which formats it is possible to print. Parallel to the format determination, the subscription department up-dates its records of subscribers and orders from retailers. The information is thereafter transferred to the mailroom and is the basis for the production and addressing of the newspaper bundles.

The newspaper publisher delivers page films to the printer. In the companies studied, page facsimile, digital file transfer and messenger by car have been used. The page film contains information about the product to which it is related, the page number and the ink.

During newspaper production, materials such as paper and printing ink have high volume values and the paper in particular can be regarded as a critical component. In the type of production analysed, large quantities of paper of different grades and of different roll widths are consumed. At both companies, the average stock levels are low and great demands are made on the correctness of the calculations of material requirement and material orders.

Preliminary information about page number and colour configuration is sent to the plate-making during the afternoon. In certain cases, changes can be made, primarily with regard to the use of editorial colour. When the page film has been transferred to the printers, the plate copying starts.

Page film or finished plate are scanned to facilitate the pre-setting of the ink. The finished plate is fetched by personnel from the pressroom. The personnel on the plate line manually report times, the number of plates produced and any problems or remarks concerning the plate manufacture.

When the format of the newspaper has been determined, it is possible to plan the printing in detail. The format determines the consumption of different roll widths of paper in the printing. Paper can be ordered from the stockroom and the webs can be prepared. The control systems of the printing presses can be prepared with regard to those printing units which will be used and be prepared to read the pre-setting values from the plates/page films scanned. The printers write manual shift and paper reel reports.

The mailroom production is different at the two companies. In both cases, the bundles are made in a determined order and are directed to a pre-determined place. In one case, however, insert equipment is used while the flow and control in the second case become slightly more simple since the insert equipment is not used in this case. The information about which bundles shall be made and the addressee of each bundle is distributed to the stacker lines before the production starts. The bundles produced are addressed and are thereafter guided to the correct loading quay. Bundle addressing and control are done manually in one case while the functions in the other case have been automated.

The information flow in the mailroom is very extensive, especially in the case utilising insert equipment. In the company of interest, an automated control system for the insert equipment is lacking. This means that the personnel by the insert drum are always in contact with a co-ordinator in order to co-ordinate insert products to specific bundles. The rate of the printing press must also in certain cases be adapted to conform to this insert equipment. From the mailroom, production disturbances, starting and finishing times and departure times for different vans are reported manually.

APPENDIX B

Samples of subsystems

Subsystems	***Newspaper 1***	***Newspaper 2***
Page transmission	**Page-fax/car**	**Page-fax/car**
Plate-making	**Semi-automatic**	**Semi-automatic**
Plate reports	**Manual**	**Manual**
Plate film scanning	**Off-line**	**Off-line & on-line**
Plate transportation	**Manual**	**Manual**
Plate changing	**Manual**	**Manual**
Pre-setting	**Semi-automatic**	**Semi-automatic**
Press control	**Computerised**	**Computerised**
Press reports	**Manual**	**Manual**
Reelstands	**Manual**	**Manual**
Reelstand reports	**Manual**	**Manual**
Reel handling	**Semi-automated**	**Manual**
Inserter–bundle ctrl	**Manual**	–
Stackers	**Programmable**	**Programmable**
Bundle address	**Programmable**	**Manual**
Bundle control	**Automatic**	**Manual**
Bundle loading	**Semi-automatic**	**Semi-automatic**
Mailroom reports	**Manual**	**Manual**

Samples of vendors: *Allen Bradley, ABB, Data General, Data Oy, Denex, EAE, Ferag, Hell, IDAB-Wamac, PressTronic.*