E-paper Production Workflow – Adapting Production Workflow Processes for Digital Newsprint

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Abstract: This study focuses on production flow for publishing in generic digital newsprint editions, such as e-paper, PDAs or on-line editions, by analyzing and mapping existing production workflow at three Swedish newspaper publishing companies covering the most common organizational types in the newspaper publishing industry today.

Most newspaper publishing companies produce a range of electronic editions, all part of the digital newsprint family. In general, there exists two types of organizational production workflows – the integrated multiple channel workflow, and the separated, where the printed and the electronic workflows are detached, sometimes in totally separate organizations.

Using scenarios, the aim is to propose a model for the production workflow of the electronic paper editions in newspaper publishing. The results indicate several possibilities for automation in the workflow. Furthermore, the study points out stages as challenges in the workflow where changes have to be done in order to introduce e-paper as a publishing channel for news publishing. We will as an introduction, along with the workflow scenarios in this paper, also present a brief overview of the existing techniques for displaying content on electronic paper terminals.

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INTRODUCTION

Background

Many newspaper companies produce, in addition to the printed edition, a number of different types of electronic editions, in this paper denoted as digital newsprint. The past few years, many newspaper companies have successfully introduced multiple channel publishing, integrated or separated from the publishing workflow for the printed edition of the newspaper (Sabelström Möller, 2001). As developments in technology are introducing new publishing channels, new business models can be established at the newspaper companies.

In the middle of the 1990:ies, many newspapers ventured into parallell publishing (Sabelström Möller, 2001). Web editions of the newspapers were created and published in parallel with the primary product, the printed edition. As the years have passed, a wide range of different editions from the newspaper companies are now reaching the readers (Figure 1).

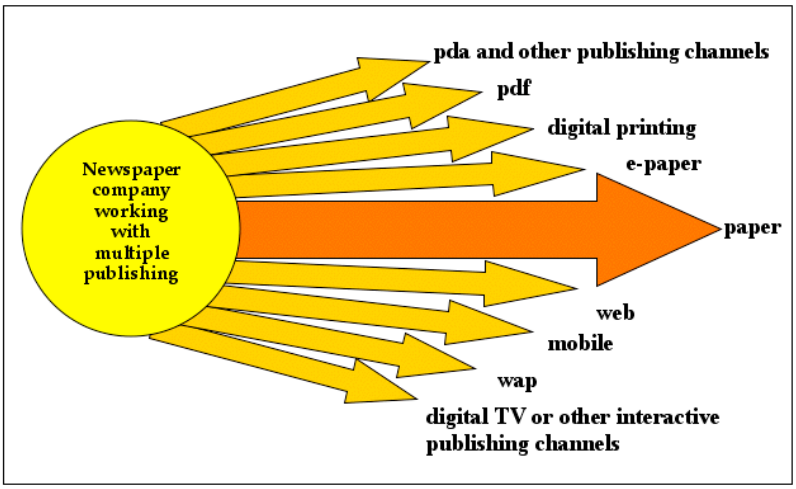

Figure 1: Some examples of the many publishing channels in a multiple channel publishing newspaper company in the year 2004.

To cut costs, it is preferable that the publishing workflow for the new publishing channels are as automated as possible. This paper aims to find efficient solutions for future newspaper production focusing on digital newsprint, such as an electronic paper edition.

To illustrate possible ways for newspaper companies to produce an edition displayed in an electronic paper terminal we will in this paper present three future scenarios, combined with examples from case studies carried out at three Swedish newspapers.

Definitions of terminology

Digital Newsprint

Digital newsprint is in this paper regarded as a form of digital content distribution of content originally suited for the printed edition. The concept digital newsprint is frequently used by the international newspaper organization, Ifra. The information can be presented using terminals such as PDAs (Portable Document Assistant), e-papers, or most commonly, for digital print with the computer to plate technology (Ifra Special Report 3.36).

The dominating file format on the market for ready-to-print pages sent to the printing plant, today is PDF (Portable Document Format). Since its introduction several years ago, PDF has become the foundation format for digital production workflow management and is increasingly relevant for content management (Löffler, 2003). However, it is not nescessary to use this particular format for digital newsprint.

E-paper – an extension of traditional paper

The purpose of electronic paper is to achieve the same characteristics as paper, such as high flexibility, contrast and reflectivity and with the possibility to update the presented content (Ritter, 2003).

Electronic paper, as seen from a newspaper company's point of view, is conceptually a crossbreed between the traditional paper edition and the online edition. It will visually be a paper with the online qualities hidden under the surface. Some prefer to call some of the technologies rewritable paper (Kipphan, 2001) rather than electronic paper, since the content in this type of paper is not consistent over time.

E-paper can be regarded as one kind of digital newsprint, due to the way the content is produced and displayed on the e-paper terminal. The file that has been sent from the newspaper company to the printing plant for print, can be displayed on an e-paper terminal without any changes to the file, provided that the terminals are built in a sufficient size equivalent to the printed edition. The printed version of the newspaper then comes in a digital newsprint format when presented on an e-paper terminal.

There are currently a few different types of e-paper terminals under development in the world. The terminals are portable and designed to consume a minimum amount of electrical power. Some are foldable, while others are in a rigid format, much resembling a cover for a compact disc. In the beginning the e-paper terminals were not designed to display color. Today the most recent terminals support colour as well as moving images. There is a range of different technologies behind the terminals and these technologies will be further discussed in the section called E-paper today.

The services suitable for an e-paper terminal is in this paper referred to as e-paper services or e-paper editions. We will in this paper focus on e-paper services as extensions of printed newspaper editions. However, there is a range of other services suitable to be displayed on an e-paper terminal, such as content from the newspaper's on-line editions, moving images, e-books, calendar-functions, abilities to take notes and store material, possibilities to play sound-files as text-to-speech, to name a few.

As some of the e-paper-terminals support the same kind of services as a PDA, it would technically be possible to display the same kind of functions as of a PDA on an e-paper terminal. Some of the services today presented in mobile phones could also be possible to display on an e-paper terminal.

The users for an e-paper terminal are from the newspaper publisher's point of view the same as the readers of their printed newspaper. The target group for e-paper services will be further discussed in the section called Target groups for e-paper editions.

Production workflow

A production workflow at a newspaper company is in this paper a term for the tasks involved in producing the editions and products in a newspaper company. The production workflow, as described in this paper, starts with the planning of the product and ends with the distribution to the readers.

Recently, when electronic as well as printed editions in some cases have been extended with interactive services, the production workflow can be regarded rather as a loop than a linear flow. However, in this paper, the workflow will not handle interactive aspects and can therefore be regared as a linear flow, starting in the advertising department and ending in the distribution process.

The production workflows at newspaper companies in the Scandinavian countries are today in most cases fully digital. Leckner (2004), discusses the importance of knowing the limitations of digital technology and its possibilities, in order to grasp the production workflow efficiently. In her opinion, the increasing digitalization creates a demand for knowledge among the employees working in the production workflow in order to produce qualitative output. This is important to consider when expanding the existing workflow at a newspaper company, with yet another digital publishing channel, such as an e-paper edition.

In this paper, the e-paper edition is regarded as one kind of digital newsprint. In the concept of digital newsprint lies that the content is based on the printed edition or uses content from the printed edition as a starting point. The newspaper companies interviewed in this paper demand that the workflow for an e-paper edition should be as automated as possible and be based on the printed edition. The production of an e-paper edition is similar to any digital publishing

channel at the newspaper companies, with the distiction that this edition is going to be based on the printed edition to a greater extent than the other digital editions.

A specific e-paper production workflow would then be specific in the sense that it is not identical to any of the production workflows of the other publishing channels, and in the fully automated case, there is no content exclusively made for this publishing channel.

PDF retailers

There are a number of companies all around the world providing PDF editions of newspapers on websites or in special automates, functioning as automated vending units for newspapers printed on-the-fly. These companies can be described as retailers functioning as a middleman between the newspaper company and the customers specializing in selling copies of newspapers at airports, hotels or on the internet at special newsstand sites. The target group for the newspaper editions provided by the retailers consists mainly of business travellers and people living abroad.

The retailers providing newspaper to be printed out in automates, have several demands toward the newspaper companies, such as size of the PDF-file, number of pages and delivery time from the newspaper. If the PDF file is to large, the retailers cannot offer their customers a short printing time.

For the newspaper companies sending their files to the printing plant in the PDF format, the PDF file to the retailers is often generated automatically as the PDF file for the printed edition is created and transmitted to the printing plant.

Methods

To establish a historical view on e-paper and investigate the meaning of the concept, literature studies have been carried out.

Newspapers are important players in the converging media industry. In this study, we have therefore to a great extent focused on the newspaper industry. To single out synergetic effects between printed newspapers and other publishing channels in the publishing workflow, interviews based on case study models (Yin, 1994) have been carried out at three newspaper companies. The three newspaper companies selected in the study were regional mid-sized newspapers with previous experience from working with PDF editions.

With the aid of scenarios three proposed models for future e-paper content production have been created, based on results from the workflow mappings carried out in the case studies of the production workflow at the newspaper companies. Based on these three

scenarios, a ”most likely-scenario” is presented for a future e-paper production workflow.

E-PAPER - A MARKET VIEW

E-paper technologies today

Many of the e-paper terminal solutions of today consists of a screen with electronic ink wrapped in a covering shell. The covers on the prototypes of today can be either bendable or rigid. Furthermore the terminals will contain some sort of computer, memory, batteries and one or several recievers for updating the terminal with content.

There are several solutions for e-paper terminals on the market. However, some of these solutions are based on somewhat the same technologies and originates from three main solutions. All the solutions consist of some sort of grid with tiny cells, forming pixels on a display. The cells are based on different designs depending on the solution and manufacturer.

The solution with tiny capsules containing charged particles

The first solution consists of a flexible, plastic electronic display entirely made with a process similar to traditional ink-on-paper printing technology. The two american companies behind the solution, Lucent’s Bell Labs and E-Ink, claim that their solution uses technology combining the flexibility and portability of paper with the changing display capabilities of a computer screen.

This solution’s prototypes of e-paper terminals consists of electronic ink and printed plastic circuits. The transistors in these circuits are mechanically flexible, rugged and leight weight compared to traditional silicon thin film transistors, and allows updating via computer link.

The electronic ink contains tiny capsules reacting to electrical signals by showing either dark or light pigment. The ink is printed onto a sheet of plastic film, laminated to a layer of circuitry (E-ink, 2002). The grid of plastic transistors forms a pattern of pixels and creates electronic fields causing the electronic ink to change colour and thereby create images (Lucent Technologies, 2000). As seen in figure 2, each microcapsule contains fluid with positively charged white particles and negatively charged black particles. The top of the capsules are visible to the person looking at the display. The image is created when the terminal is charged, then the white particles move to the top and the black particles move to the bottom of the capsule where the electric field is negative. Where the positive field is applied the opposite reaction occurs.

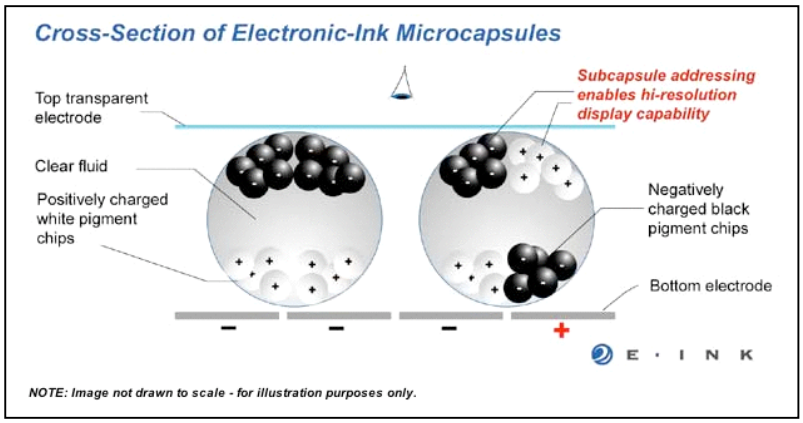

Figure 2: Description of E-Ink's Electronic-Ink Microcapsules, Copyright E-Ink (2002).

The electronic ink enables brightness, viewing from all angles, low power consumption and plastic film constructions. The contrast ratio between white and black of the prototypes are according to a press release from Lucent Technologies (2000) approximately 10 to 1, compared to that of traditional newspaper with to 8 to 1.

This solution only needs power during each switching cylce as a new image is displayed, and Lucent Technologies claim that the first presented prototype draws one-tenth to one thousandth of the power of an LCD of equivalent size.

Another solution involving E Ink is a joint solution between Philips, Sony, Toppan Printing and E Ink (Figure 3) and is by E Ink described as the world's first electronic paper display in Sony's e-Book reader. It will be launched in Japan in April 2004, and is said to offer a reading experience with contrast that is the same as newsprint (E Ink, 2004). The device has a resolution of approximately 170 pixels per inch, wich according to E ink is the same resolution as for a traditional newspaper.

Figure 3: Sony LIBRIé e-Book Reader

Similar to the Lucent/E Ink product discussed previously in this chapter, E Ink supplies electronic ink for this product. Toppan Printing process the ink into a thin optical film and Philips adds the driving electronics component. The solution has then been adopted in the Sony e-Book reader "LIBRIé".

This reader device has the same size and design as a paperback book and displays four shades of grey (E Ink, 2004). The solution is however rigid and therefore not paper-like, due to the glass backings and cannot therefore be bent (Walker, 2004).

The two-colored beads solution

The second solution to be discussed in this paper has been invented by the american company Gyricon and is called SmartPaper. The solution consists of two sheets of thin plastic where tiny bichromal beads are embedded in between (Gyricon, 2004).

According to Gyri-con, one side of each bead is negatively charged while the other is positively charged. The posi-tive side have a different color than the negative side and under the influence of voltage applied to the surface, they rotate depending on the charge of the electric field, thus presenting an image to the viewer (Figure 4). When a positive charge is applied, the bead turns to display the black half. The white side comes up when a negative charge is applied (Sidener, 2004).

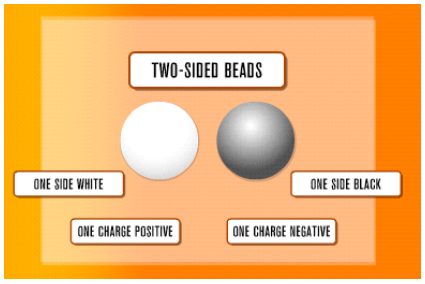

Figure 4: Gyricon's two sided beads (Gyricon, 2004)

Similar to the earlier presented solutions, this image remains until a new voltage is applied. The terminal can be updated via wireless radio signals or from a computer (Walker, 2004).

The oil and water solution

The third solution is based on the electro-wetting technology. The technology uses oil and water in tiny cells, forming a surface. When an electric charge is applied, the oil is temporarily pushed away by the water and the background colour is thus displayed.

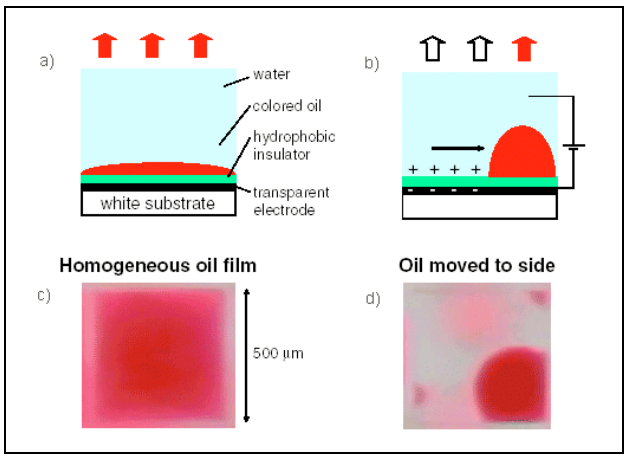

Figure 5: Electrowetting display principle, Philips (2004).

As seen in figure 5, when no charge is applied across an hydrophobic insulator, oil covers the surface and nothing is displayed of the white substrate. The lowest energy in the system is achieved when water is in contact with the insulator. As a charge is applied, the surface becomes temporarily possible to wet, and the water therefore pushes the oil to the side (Philips, 2004).

The electro-wetting technology enables use of color when combined with two independently controllable colored oil films and a color filter. The colors used are cyan, magenta and yellow (The Hindu, 2003). However, this solution is still in an early laboratory stage.

Other solutions

There are other solutions for electronic paper terminals as well, for example from IBM and Acreo. These two solutions are bendable with color displays and will not be discussed here in detail.

The Swedish based company Acreo has developed an e-paper solution called Paella. It consists of color-changeable inks included in thin or thick film, combined with electronic devices on paper (Acreo, 2004). The electronic ink produced by Acreo needs according to the company, less power than the competing solutions by E Ink (Larsson, 2000). The solution by IBM is a bendable computer display resembling traditional paper. Rival technologies by SiPix, Fujitsu, Siemens and Ntera are under development. All these solutions are based on the concept of fluid crystals (Perkin, 2004).

Updating e-paper terminals

Since the technologies for e-paper are under development there are currently several solutions for updating the terminal. The terminals could be updated via various IP services, via 3G, DVB (Digital Video Broadcasting) or as suggested in the DigiNews project (Bouffioux, 2003), via DAB (Digital Audio Broadcasting) or W-LAN hotspots. IP services, W-LAN hotspots and in some cases DVB as well as the 3G technology make interactive services possible in the e-paper terminals. DAB broadcast channels are mainly used for broadcasting radio signals for digital radio receivers, and have additional frequency space for data, such as a future transmission of e-paper editions.

DAB is not an interactive distribution form, but covers large regions and can reach a large number of users with low transmission costs. W-LAN hotspots can offer additional interactive services. The DigiNews project suggest combined use of of different technologies for e-newspaper distribution.

An e-paper terminal could compared to other mobile digital terminals be similar to a PDA in terms of mobility. In the beginning the terminals will be small, not larger than a A5 page (148x210 mm).

The first prototypes was made in the european ISO standard A5 format and smaller, but the size is promised by the manufacturers to increase with the development of the terminals.

User reactions to e-paper terminals

How the general public will react to an e-paper edition and the terminal is hard to predict. According to market research conducted by the e-paper terminal manufacturer Philips, and the Swedish newspaper Sydsvenska Dagbladet, carried out during November 2003, the general opinion was positive.

The results however indicate that the users regard an e-paper terminal with possibilities to read the newspaper as yet another gadget with not much new to offer. On the bright side, the Swedish users considered the low power usage in e-paper terminal to be almost too good to be true, and wish that the reader would have a large storage capacity so that it will be possible to download several different newspapers throughout the day. They also found it useful when travelling abroad. The downloading process was something the Swedish users was concerned about.

Compared to traditional newspapers, the users thought that an e-paper edition would imply new ways of reading the newspaper. Compared to a laptop, the e-paper terminal would be more portable, and compared to a PDA, the reading experience would be better on an e-paper terminal. (Liljestrand, 2003)

E-PAPER AS A NEW PUBLISHING CHANNEL

Scenarios

We will in this paper present three possible ways for newspaper companies to work with an e-paper edition. These suggested solutions are presented in the form of scenarios and are followed by examples from the case studies carried out at three Swedish newspaper companies in the autumn of 2003. They could also be valid for other types of digital publishing channels.

The first scenario illustrates a fully automated workflow. Secondly, we will give the other extreme with editors working full time with an e-paper edition and creating a new edition from scratch, every day. In the third scenario, the e-paper edition is created on the fly, whenever the reader sends a request for it.

The scenarios are created with respect to existing technology and editorial systems at the newspaper companies. In the best of worlds the entire collection, storage, and refinement of the editorial and

advertising material would be stored in standard formats and tagged with metadata. Thus, the editorial as well as advertising material, would be compatible and possible to publish in all digital publishing channels at the newspaper companies. Unfortunately, as of today this is not entirely the case.

Case studies

The studied newspaper companies were Göteborgs-Posten (GP), Östgöta Correspondenten (Corren) and Nerikes Allehanda (NA).

Göteborgs-Posten (GP) is the second largest morning newspaper in Sweden (TS, 2004). The strategy at this western Swedish newspaper is to use the web as a complimentary publishing channel supporting the printed edition. The aim is to make GP the natural information channel for the people living in the western part of Sweden, regardless of the desired publishing channel. The strategy for a future e-paper edition is to use this publishing channel for subscribers living in sparsely populated areas or abroad. A future e-paper edition at GP would be identical to the printed edition regarding published material.

Östgöta Correspondenten (Corren) is the largest newspaper in the area of Östergötland and the forth largest regional daily newspaper in Sweden (TS, 2004). The strategy of Corren, is freely translated: ”to collect, refine and distribute media content with the aim to influence, make life easier and add brilliance to the people living and working in Östergötland and to assure the advertisers that they can reach their market and make a result” (Annual Report Corren, 2002). Corren is working closely with the University of Linköping and has initiated several research projects where the newspaper company functions as a test bed for the projects. The strategy for a future e-paper edition could be to especially include material suitable for the format, such as pictures of new born babies and interactive advertisments.

The third company, the regional daily newspaper Nerikes Allehanda (NA) is the third largest regional daily newspaper in Sweden (TS, 2004). However, it reaches 82 percent of the population living in the county of Örebro in the middle of southern Sweden (Annual Report NA, 2002). The strategy for a future e-paper edition is that it should be an extension of the on-line edition.

The production workflow at the studied newspapers

The two extremes of organizational production workflows are the integrated multiple channel workflow, and the separated, where the printed and the electronic editions are produced in totally separate

organizations. At the studied newspapers the organizational production workflows are somewhere in between the two extremes as the electronic editions are partly separated from the workflow of the primary product, the printed edition. At these newspaper companies, content from the printed edition is often published on the web after it has been published in print, while content made for the on-line edition is not as often published in the printed edition.

The selection of material for the desired publishing channel is made manually and the belief is that this step should always be manual.

The editorial department is responsible for ”pressing the button” to send the page to the printing plant, as soon as a page is ready for print. The pages are stored in a database and in the archive of the newspaper. As the pages passes the OPI (Open Prepress Interface), the postscript conversion to the PDF files and the RIP (Raster Image Processor) the responsibility belongs to the IT department. The pages ready for print are then sent to the printing plant as compressed files.

The advertising department uses a planning tool, often not compatible with the production system of the editorial department. In order to determine the number of pages of the printed edition, there is an ongoing dialogue between the advertising and the editorial department. For the electronic editions such as the online edition, the advertisement spaces are fixed and the number of advertisements usually does not vary.

A page shared between both departments is in general first layouted by the advertising department, stored as one unit and later assembled by the editorial department as if the advertisments were images. The department responsible for advertisments is also usually responsible for the transmission of full page advertisments to the printing plants. This transmission takes place during the day while the editorial pages of the newspaper are transmitted by the technical editors during the evening.

Many newspaper companies send the pages to the printing plants in the PDF format. Copies of these PDF pages are also stored and downscaled for later publication in a PDF-edition on the website of the newspaper or in other forms.

Scenario 1 – The automated production workflow for future e-paper editions

An e-paper edition is yet another edition to produce, requiring resources such as money and time for the newspaper companies. It is therefore preferable if the production workflow of the e-paper edition could be as automated as possible. In the automated scenario (Figure 6), after initial work to set up the workflow, no further manual editing will be needed. A prerequisite for this scenario is that the layout issues and valuation of news can be solved automatically.

The starting point for this scenario, as seen in figure 6, is the printed edition. The stored composite file is exported to XML format (eXtensive Markup Language). From the tagged data it is possible to extract information such as where the different elements are placed on the page, and the type and level of the material.

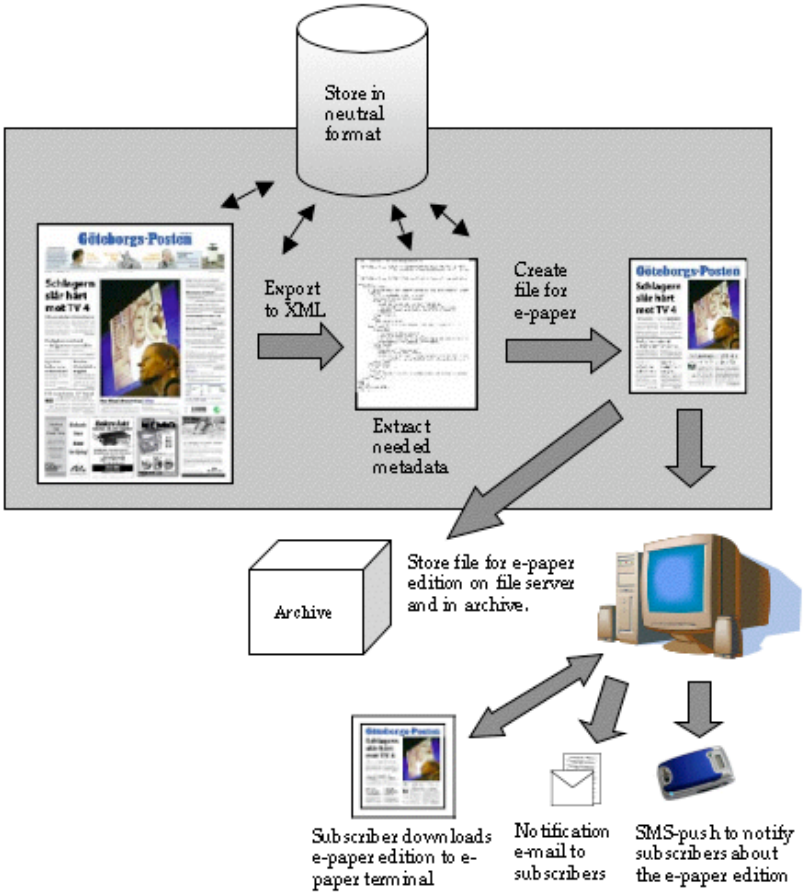

Figure 6: The automated e-paper production workflow.

This information is used to cathegorize the material and convert it through an automated scaling and re-editing process into material suited for the e-paper edition. The material is placed according to a template created for the e-paper edition and then saved as a file in a suitable format, such as PDF or JPEG (Joint Photographic Experts Group). The file is then stored on a file server and in the archive of the newspaper company.

The small arrows in figure 6, from the database to the different stages in the process, indicates that the material is referred to as links in the files. When the composite file is ready for publication, the links are replaced with the actual text, images and graphics. The file can then be stored on the file server for distribution to the readers.

When the file is ready for downloading, the readers are notified either via a text message to the reader's mobile phone or by e-mail. The readers can then start the downloading process of the e-paper edition to their e-paper terminals.

The two-way arrow between the file server and the e-paper terminal indicates that with a distribution form such as broadcast via DAB, the arrow is toward the terminal from the file server. If the edition is downloaded through IP services, the arrow needs to be two-way, since some sort of communication from the reader to the newspaper is needed in order to initiate the downloading process.

An e-paper edition could be compared to the PDF-editions available for download at the newspapers websites today. At Nerikes Allehanda, (NA) a PDF-edition of the morning newspaper is each day available at the website of NA. With the existing PDF-production workflow, it is possible to scale down the text, but not the images. This is a minor problem compared to scaling of advertisments that might be non scalable.

NA is not cooperating with any PDF-edition retailers. They do not believe in a retailer on the net functioning as a middleman, since they want to be the strongest channel of communication in their region.

Scenario 2 – The e-paper product as a new re-edited edition

The newspaper company has in this scenario chosen to dedicate resources to the e-paper edition and treat it as a stand-alone product, using re-edited material from the existing content newsflow at the newspaper company (Figure 7). The reason for chosing this scenario could be that the existing production workflow cannot easily be adapted to an automated process or as a strategic move for the future, if the e-paper edition is to become a successful edition.

In this scenario, an editor selects and re-edits material from the already printed edition. To save time and make the editing time more efficient, the editor uses a template especially made for the e-paper edition and creates a composite file, later converted to the chosen e-paper terminal format. The converted and ready to distribute file is then stored on a file server for downloading by the readers. A copy of the edition is also stored in the newspaper company's archive. Similar to the first scenario, the readers are notified by e-mail or SMS (Short Message Service on mobile telephones) when the e-paper edition is ready for downloading.

This scenario was tested at Göteborgs-Posten (GP) in the autumn of 2001. A two weeks experiment was performed, called mini-GP. The mini-GP was a re-edited edition of the printed edition in form of a PDF-file in A4 format with a 10 mm bounding border. It was tested on a group of 100 test users consisting of Swedes living abroad.

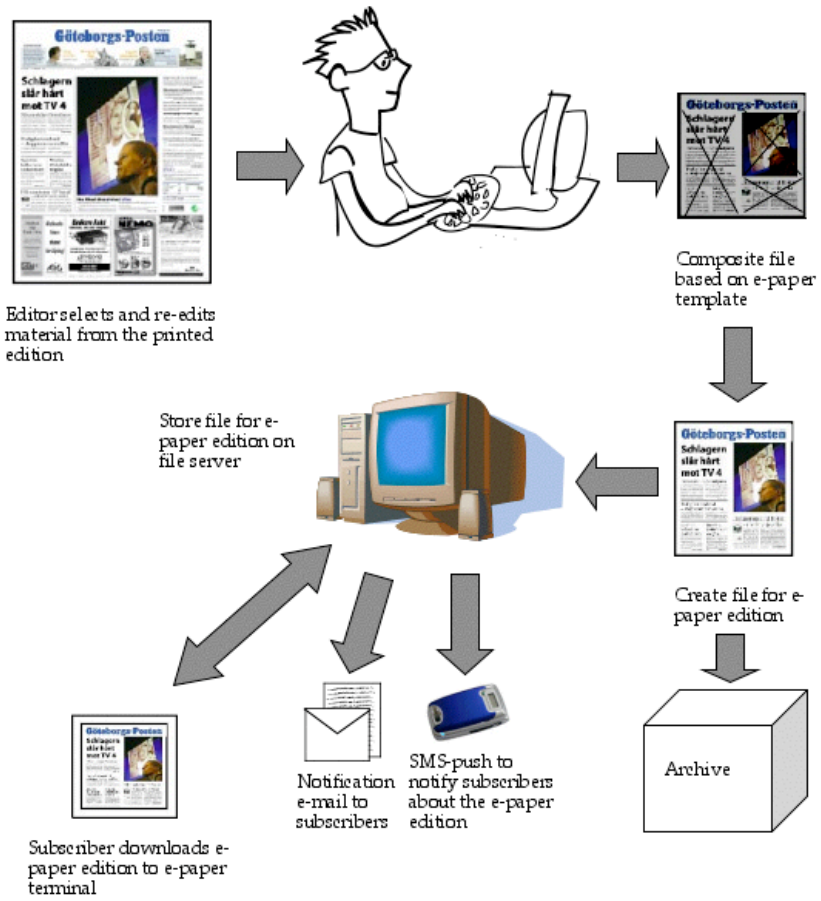

Figure 7: The e-paper product as a new re-edited edition.

In order to produce the mini-GP, two people were working full-time, re-editing the articles to fit the mini-GP layout. A full automation of the mini-GP would have been a difficult task to perform, mainly due to the existing editorial production system.

The mini-GP edition consisted of what was regarded to be the most important articles, mainly domestic news from the printed edition and news from the Swedish news agency, called TT news. Regional news and economy news where also included and there was a permanent space for the stock market and exchange rates. The last page had a weather section and selected news from the sports and culture sections of the printed edition.

All the pages were template-based, the images had to be in TIFF format (Tagged Image File Format) and graphics could not be larger than 2MB. The pages was made in Quark Xpress and converted into PDF pages with Acrobat Distiller 3.0. To reach the subscribers living abroad with the mini-GP, a personalized e-mail was sent out, with a link to the website where the mini-GP could be downloaded from.

A survey was carried out among the hundred test users of the mini-GP. Many of the answers were postitive, especially regarding the possibility of subscribing to the mini version of GP without subscribing to the printed editon. There were only a few minor problems in the production workflow for the mini-GP, such as resolution problems with the weather map.

The re-editing process requiring editors to work full-time was not economically viable for GP, due to the small market regarding target group and production costs for this kind of product.

Scenario 3 – The dynamically updated e-paper edition

In the third scenario, the e-paper edition is created on the fly, on request from the reader (Figure 8).

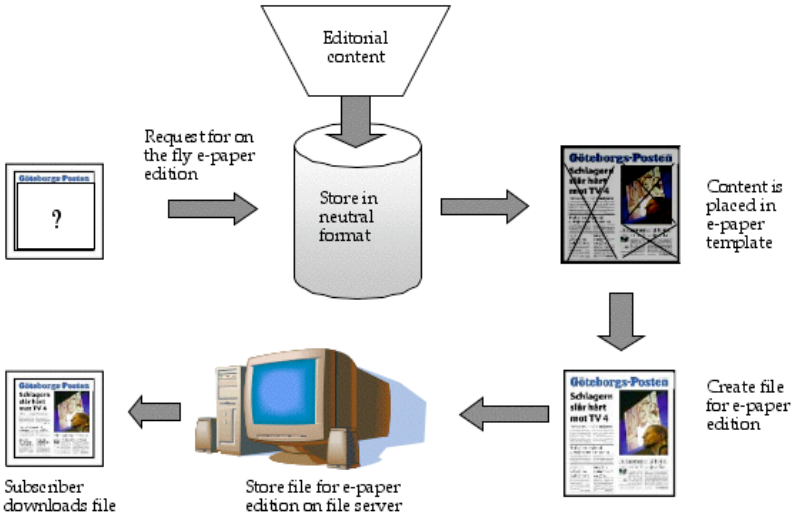

Figure 8: The dynamically updated e-paper edition

When the reader wishes to download the e-paper edition, a request is sent to the newspaper. The available content suitable for the e-paper edition is then selected through an automated process and the content is placed in an e-paper template. Unlike scenario one, the content is not bound to be taken from the already-printed edition. The composite file based on the template is converted into the e-paper format and saved on a file server before being distributed to the reader's e-paper terminal.

This scenario requires a large degree of automation. Furthermore, the material has to be stored in standard formats. The images, graphics

and other elements associated with the different articles, need to be linked to the article either through common document names or using metadata tags.

This scenario is somewhat more similar to publishing of an on-line edition of a newspaper than to publishing of the printed edition, since the e-paper edition in this case is updated continously throughout the day. This is in line with how NA sees a future e-paper product. According to NA, the e-paper edition should not be regarded as an extension of the printed edition, but as an extension of the on-line edition.

DISCUSSION

Advantages of an e-paper product

The significant difference between traditional paper and electronic paper is the electronic version's ability to be updated. Depending on the available distribution net, the electronic paper terminal could be updated whenever there is an important event in the news world, either automatically via the DAB (Digital Audio Broadcasting) net or on demand using IP (Internet Protocol) services, mobile telephone nets or digital TV.

For newspaper and magazine publishers, the transformation from mechanical printing presses and pulp paper to digital print media offers numerous opportunities to create and profit from a wealth of new product and services [Fidler, 1997]. A future e-paper terminal and service could, if the proper technology is built into the product, offer possibilities of interactive advertisements. The readers of the e-paper edition will most likely be registered users in the subscription database of the newspaper, and therefore known to the newspaper company. Thus, through the identification and downloading process, registrations and filling in forms with contact data in e-paper advertisements will already have been taken care of. This would make it easier to implement e-commerce applications and should be interesting for the advertisers.

With an e-paper edition for a newspaper company, zoning could be possible as digital technology can achieve closer alignment of advertisements to reader profiles. Digital newsprint enhances the possibilities of advertising for remote applications, but such models are not yet developed (Löffler, 2003). Examples of how this could be achieved could be personalized advertisments in an e-paper edition, based on geographical location or dependent on the registred user's personal profile. Personalization of content could also be accomplished through active choices from the readers.

Parts of the newspaper content can in an e-paper edition consist of moving images. This gives the e-paper edition an enhanced way of presenting the news compared to the printed edition.

Newspaper companies have, with their printed edition, created a close relationship with their readers. In the online world, the readers are not as loyal to their newspaper. Through their online editions, the newspaper companies no longer have the priviliged relationship with readers, and thus with advertisers, that was the foundation of their success in the offline world [Sparks, 2000]. An e-paper edition could, however, be regarded as a crossbreed between an online edition and a printed edition, with the advantages of an electronic edition, the workflow much similar to the digital newsprint workflow, and at the same time with an exclusive relationship between reader and newspaper publisher.

Target groups for e-paper editions

An important aspect when sketching the outlines for a future e-paper edition is the target group for the product. From the interviews with newspaper companies carried out in the autumn of 2003, we can draw the conclusions that the target group for a Swedish e-paper edition might consist of several subgroups. They could be described as follows:

- Persons living abroad.
- People living in sparsely populated areas, difficult to reach with the existing distribution system for the printed edition of the newspaper.
- Roaming readers, such as businessmen and other people who travel extensively.
- People preferring to read an on-line edition of the newspaper, rather than the printed edition.

Swedes living abroad are frequent visitors to websites of their native hometown newspapers. This target group cannot be reached through the ordinary subscription system and a special service such as an e-paper edition could be a way to charge these readers for the content they are interested in. If offered a special version of the printed edition, tailored especially for them, the loyalty towards the newspaper among these readers might be increased.

Distribution of the printed edition to sparsely populated areas, such as woodland or archipelago areas are costly for the newspaper companies. According to Rehn (2001) the distribution process of the printed edition is a major expense for the newspaper companies. In some cases, it would be economically preferable to offer readers living in sparsely populated areas a subscription to a competing newspaper than to provide distribution covering these rural areas. An e-paper edition could offer an alternative for these customers; assuming that they are living in an area covered by the Internet broadband net or other digital distribution nets, it would be possible

to distribute the newspaper electronically. Unfortunately, rural areas in Sweden are often not reached by broadband today.

PDF-retailers around the world in combination with the newspaper's online editions reach a part of the roaming readers. An e-paper edition could compared to the on-line edition be a way for the newspaper companies to maintain control of the entire value chain, and in this manner, remain in contact with their readers by skipping the middleman or the anonymity of the readers for the online edition.

As discussed in Wesslau et al. (2002) readers may prefer to read news from the online edition of a newspaper rather than the printed edition. For certain target groups, the brand of the printed edition can for example be associated with political values, while the on-line edition is not. An e-paper edition might not be affected by these subjective values and could reach other target groups than that of the printed edition.

Challenges for e-paper content production

From discussions with the studied newspaper companies it has become clear that there are several functions in the current production workflows in need of adjustments before an e-paper edition could be introduced in the production workflow. The most important questions are:

- Selection of material suitable for the product
- Automated scaling of editorial and advertisment material
- Handling of high resolution graphics, such as advertisements or weather maps
- Pagination
- Copyright issues
- Editioned pages
- Layout aspects
- Human resources
- Distribution
- Promotion of the e-paper edition

Selection of material suitable for the product
The interviewed newspaper companies does not want to create unique content for an e-paper edition. At an early stage they prefer to use material from the already printed edition in combination with material from the online edition. The challenge is to automate the selection to a great extent.

Automated scaling of editorial and advertisment material

In order to handle scaling of images, text and advertisments it is important to store the material in a neutral file format with the aid of uniform metadata standards. A common standard for metadata tagging is XML. It is by Quinn (2002) described as the building blocks which makes convergence journalism possible. Convergence journalism would in this context mean that editorial material is collected and stored for later use in any of the publishing channels of the newspaper. The metadata should be applied to the material automatically in the collection and storing process in order to more easily keep track of different versions edited for the various editions within the newspaper company (Sabelström Möller, 2003).

Handling of high resolution graphics, such as advertisements or weather maps

Advertisements and high-resolution graphics such as weather maps may not be easy to adapt automatically to an e-paper edition. Further research in advertisement file format and planning is needed in order to determine how the handling of advertisements and graphics should be performed.

Pagination and copyright

Pagination could be a problem in a future e-paper edition. An example can be found in the case of the PDF edition at GP, which contains less pages than the printed edition, due to copyright regulations concerning certain parts of the newspaper, such as comics. The copyright issues have so far in the case of GP and their PDF-editions, been avoided by excluding the pages that might cause problems.

Editioned pages

If the newspaper company produces several geographically tailored editions, the most suitable edition for each target group needs to be selected for the e-paper edition. As of today this has to be done due to logistical and economical reasons. In PDF editions, the problem with different geographical editions is often avoided by excluding editioned pages.

Layout aspects

It might not be necessary to include the entire printed edition in an e-paper edition. What is included depends on the target group for the service. The placements of advertisments and editorial material could be pre-booked in the layout for the e-paper product. If the included materal in the pre-booked story does not fit in the assigned

area, a notice could be sent to the editor working on the e-paper edition, who then has to make changes such as shortening the story.

Many of the articles are connected to specific advertisements when it comes to layout and structure. If these connections are dissolved, the value of the advertisement could be lost.

Human resources
For the editorial staff, reorganizations take time to be accepted. Changes have to be introduced gradually to avoid turbulent reactions from the staff. Technology has to have a subordinate position in these changes and the editorial staff should not have to worry about the technical production workflow (Sabelström Möller, 2001).

Distribution
One problem is that a target groups such as people living in sparsely populated areas or Swedes living abroad might not be among the early adopters of technology and might not be reached by the broadband net.

If these problems were to be solved by for example the development of 3G (third generation wireless mobile technology) mobile or digital TV broadcasting nets, further research should investigate the readers willingness to read their morning newspaper in the suggested small sized e-paper terminal format.

Promotion of the e-paper edition
The advertising department at the newspaper company should not neglect a future e-paper edition. In the case of PDF editions, they are often hard to find on the website of the newspaper and few advertisements have been sold exclusively for the PDF-edition.

Business models and the future audience

E-paper editions could give rise to new business models and advertisement formats. They could, for example, include interactive advertisements. Registration issues in the advertisements could easily be solved since the newspaper already knows the user through the downloading process.

Most likely scenario

To conclude, the findings in this paper is here presented as a ”most likely” scenario (Figure 9), based on the above presented scenarios. A future e-paper edition of a newspaper, could be placed somewhere in between services made for mobile phones by the newspaper

companies and the printed edition. In the beginning, a new publishing channel will be expensive, especially in relation to the size of its audience. To cut costs it is preferable to use the same material in several publishing channels. Therefore the most preferable scenario would be the first presented scenario in this paper.

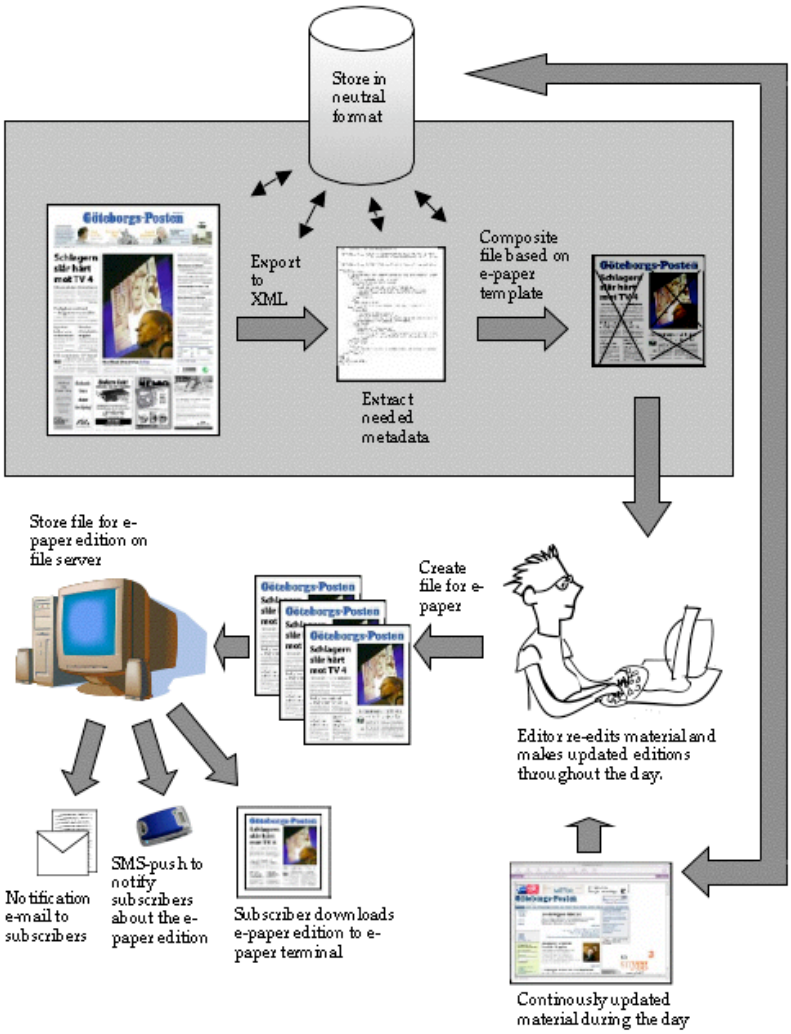

Figure 9: A "most-likely-scenario", both editing and automation

However, to automate the entire production workflow is a difficult task. The problem to automate the workflow is avoided in the second scenario, where an editor works fulltime with the e-paper edition. This scenario could be costly for the newspaper companies. The "most likely" scenario consists of a little of both, a certain amount of editing as well as automation.

Since the e-paper edition in this paper is regarded as a digital newsprint publishing channel with many similarities to a PDF-edition, the starting point for this scenario is the printed edition. As in the case of the first scenario, as much data as possible is extracted from the existing printed edition composite file and imported into a composite file based on an e-paper edition template.

Very few are the editors willing to allow an e-paper edition to be produced in a completely automated manner without any proof reading. In the "most-likely"-scenario, an editor works on the e-paper edition composite file, makes corrections, re-edits and updates the edition with the most recent news. The editor can also update the e-paper edition with news presented in the online edition.

The workflow is in this scenario automated to a great extent, but the final product is finalized by an editor. The editor creates new editions a few times during the day. The editions are stored on a file server and in the archive, and the readers are notified whenever a new edition is available for downloading. This scenario is also possible to extend with some of the qualities of the third scenario presented in this paper, such as on-demand possibilities to download the e-paper edition whenever a reader wishes to read the latest edited version in his or her e-paper terminal.

Will the e-paper edition replace the printed edition?

When the online edition was introduced as a new publishing channel at the newspaper companies, it was initially regarded as a threat to the printed edition. Maybe one of the biggest threats the newspaper companies ever have had to face (Fischerström, 2002).

New digital publishing channels as shown in figure 1, have succesfully been introduced at the newspaper companies. The competition in news publishing and in advertising becomes tougher with the increasing range of new distribution forms (Appelgren, 2003). Many of these new channels have initially been discussed as possible threats to the primary printed newspaper edition. When electronic editions were first introduced at newspaper companies, they where more often regarded as technological experiments than as new publishing channels and revenue sources (Sabelström Möller, 2003). Depending on the strategy, the different electronical editions have been presented as complements to the printed edition and thereby not been regarded as threatening.

According to Svensson (1998) in a larger perspective, people will however, abandon the printed edition. If a medium is faster, costs less to buy, and is possible to personalize it will win over other less developed media publishing channels.

We have in this paper presented some of the existing techniques for e-paper terminals today. Traditional paper might not have all the

characteristics of an electronic edition such as an e-paper edition or news presented on a PDA, but it has many characteristics that will be difficult for the creators of electronic paper or other electronic publishing channel terminals to achieve. E.g., paper does not need power, it is inexpensive and it is extremely portable. The e-paper terminal prototypes of today are still expensive and the power supply is a difficult issue. The portability can to some extent resemble that of traditional paper, but if the product is expensive, people will not use it in the same way as a paper product. According to market research carried out in Sweden in 2003, readers of traditional newspapers did not think that an e-paper edition could replace the printed newspaper. They considered it impossible to replace the feeling of reading from a traditional newspaper and found an e-paper edition impractical for a family, since it is not possible to share in the same way as a newspaper printed on paper (Liljestrand, 2003).

The scenarios presented in this paper are based on technology and organizational structures of today. This structure is here reflected in the ”most likely” scenario as a production workflow possible to implement in a Swedish newspaper organization, it might not however be the most efficient solution for production of an e-paper edition if the edition is made for a larger target group than that of citizens living abroad and readers living in sparsely populated areas. The third scenario, presented in this paper lies somewhat in the future and can be seen as the following step after an e-paper edition workflow has been successfully implemented and tested at a newspaper company.

Some of the challenges to overcome when introducing an e-paper edition have been presented in this paper. We have found that depending on the desired level of automation in the e-paper edition production workflow, the most difficult challenge is to solve the conversion and scaling of advertisments, regardless of their initial format. In order to produce an e-paper edition the challenges presented in this paper needs to be solved either in-house at the newspaper companies or by investing in one of the editorial systems supporting the production of e-paper editions.

Perkin (2004) suggests that e-paper will imply that publishers need to consider how e-paper, like all electronically transmitted media, opens up their market to competition, lowering the barriers to entry. For the media publishing companies it is preferable to obtain as much of the customers’ time as possible. In an increasingly competitive market, the struggle for customer attention is therefore high (Appelgren, 2003). If a large number of readers adopted e-paper, news publishers would be even more reliant on their editorial quality, brand and reader loyalty than they are now. Furthermore, there will be huge ramifications for how newspaper production is organized especially considering the potential that e-paper in a longer time perspective could replace print (Perkin, 2004).

It is likely that the e-paper editions will start off in the same way as the other electronic editions in the digital newsprint family. However, the e-paper products could in a near future, if not a threat to the printed edition, be a complement to traditional paper, displaying the content of the newspaper with the qualities of the printed edition together with the on-line specialties and functionalities.

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REFERENCES

Appelgren, E., Nordqvist S.
2003 "Evaluating Digital TV as a Publishing Channel for Newspapers" In Proceedings of the TAGA 55th Annual Technical Conference, April 2003, Montreal, Canada. *To be published.*

Bouffioux, A.
2003 "Full Project Proposal DigiNews- News for mobile e-paper terminals" ITEA 03015, September 2003

Fischerström, B.
2002 "Därför.", foreword in Hedin et al. (eds) Från lekstuga till affär. Dagstidningen och digitala medier. The Swedish Newspapers' Publishers Association, 2002.

Fidler, R.
1997 "Mediamorphosis in Understanding New Media." Pine Forge Press, Thousand Oaks, California, USA.

Kipphan, H.
2001 "Handbook of Print Media", Springer-Verlag Berlin Heidelberg New York. Pp. 1015.

Leckner S.
2004 "Soft proofing using Liquid Crystal Displays." Thesis for degree of Licentiate of Technology, 2004. KTH, Royal Institute of Technology, Stockholm Sweden.

Liljestrand, K.

2003 “E-reader findings from 2 Group discussions”, The Swedish Newspaper Publishers’ Association, 2003.

Löffler, H. ed.
2003 “Digital Newsprint, New Opportunities for Remote Business Development”, Ifra Special Report 3.36, Darmstadt, Germany.

Nerikes Allehanda
2002 “Annual Report 2002”, Örebro, Sweden.

Rehn, J.
2001 ”Information Flow and Physical Distribution Planning in Newspaper Delivery“,Thesis for degree of Licentiate of Technology, 2001. KTH, Royal Institute of Technology, Stockholm Sweden.

Ritter, H.
2003 ”E-Paper - a whim of convergence or a new business field?, E-Paper offers publishers, readers unique opportunities”, Ifra Newspaper Techniques, June 2003, Darmstadt, Germany.

Sabelström Möller, K.
2001 ”Information categories and editorial processes in multiple channel publishing.” Thesis for degree of Doctor of Technology, March 2001. KTH, Royal Institute of Technology, Stockholm Sweden.

Sabelström Möller, K. et al.
2003 “TAPP – Teknik och arbetsflöde i premediaproduktion”, Technology and workflow in pre media production, in Swedish.. TDM-RAPPORT Nr 7 – 2003, The Swedish Newspaper Publisher’s Association, Stockholm

Sparks, C.
2000 “From dead leaves to Live Wires” in Curran, J., Gurevitch, M., “Mass Media and Society.”, Third Edition, Arnold, London, Great Britain.

Svensson, B.
1998 “Fem dogmer för avveckling” in Lindskog et al., INTERNET som den FÖRLÄNGDA TIDNINGEN, The Swedish Newspaper Publisher’s Association, Stockholm

Tofani, M.
2003 “Elektroniskt Papper”, Electronic Paper, in Swedish, Tidningsutgivarna/Framkom, Stockholm.

Quinn, S.
2002 “Knowledge Management in the Digital Newsroom” Focal Press, Oxford, Great Britain.

Wesslau, K. et al.
2002 “Measuring Added Value in Electronic Newspaper Publishing”, in Stanford-Smits et al. (eds.) Challenges and Achievement in E-business and E-work”. IOS Press, 2002..

Yin, R. K.
1994 “Case Study Research, Design and Methods”, Second Edition. Applied Social Research Methods Series, Volume 5. Sage Publications, Thousand Oaks, California, USA.

Östgöta Correspondenten
2002 ”Annual Report 2002”, Linköping, Sweden.

On-line articles

Larsson, I.
2000 ”Genombrott för elektroniskt bläck”, ComputerSweden, 2000-11-20. http://nyheter.idg.se/display.pl?ID=001120-CS5

Perkins, J.
2004 ”Stop the presses! Roll out the e-papers”. Financial Times, IT Review, 2004-03-31. www.ft.comftit

Sidener, J.
2004 ”Retailers have tested e-paper gadgets; now consumers have their chance”. The San Diego Union-Tribune, January 5, 2004. www. signonsandiego.com/ news/computing/personaltech/20040105-9999_mz1b5pixel.html

Walker, L.
2004 ”Makers Scramble To Put Some Bend In ’Electric Paper’, TechNews.com, Thursday, February 12, 2004; Page E01, www.washingtonpost.com/wp-dyn/articles/A34553-2004Feb11.html

The Hindu,Technology for reflective full-colour display
2003 The Hindu, Online edition of India’s National Newspaper. Thursday, Oct 02, 2003.

Press releases:

Murray Hill, NJ. And Cambridge, Mass. Agreement with Lucent’s New Ventures Group will help E Ink develop ”Electronic Paper” for updatable books, newspapers and other media. Lucent Technologies licenses Bell Labs tehcnology to E Ink and makes cash investment, 13th of June, 2000.

Cambridge, MA USA and Tokyo, Japan, March 24th, 2004, PRESS RELEASE: E INK’s Electronic Paper Commercialized. Worlds’ First Production Shipment Commenced.

Tokyo, Japan, Amsterdam, The Netherlands, Cambridge, MA, USA, March 24th, 2004, PRESS RELEASE: First-generation electronic paper display from Philips, Sony and E Ink to be used in new electronic reading device.

Cambridge, MA USA and Tokyo, Japan, March 24th, 2004. PRESS RELEASE: E Ink’s electronic paper commercialized. World’s First Production Shipment Commenced.

Cambridge, Mass. and Murray Hill, NJ. Innovation marks significant milestone in the development of electronic paper. E Ink and Lucent Technologies demostrate world’s first flexible electronic ink display with plastic transistors, 20th of November, 2000.

Websites:

Göteborgs-Posten, www.gp.se 2004-03-26
Nerikes Allehanda, www.nerikes.se 2004-03-26
TS Tidningsstatistik AB, www.ts.se, 2004-03-26
Östgöta Correspondenten, www.corren.se 2004-03-26
Ifra, www.ifra.com, 2004-03-27
Lucent Technologies, http://www.lucent.com/pressroom/epaper.html, 2004-04-07
Gyricon, http://www.gyricon.com/technology.asp, 2004-04-07
E Ink, http://www.eink.com/technology/index.html, 2004-04-07
Philips Research, http://www.philips.com, 2004-04-08

Satellite Newspapers, http://www.satellitenewspapers.com, 2004-04-12

Interviews:

Göteborgs-Posten, 2003-11-11: Gunnar Springfeldt, Per-Arne Fernsund, Stefan Andreasson and Anders Aaroe, Gothenburg, Sweden.
Östgöta Correspondenten, 2003-11-17: Johan Hultman and Lars Johansson, Linköping, Sweden.
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