IFRATRACK 2.0 AND ITS FUTURE EXTENSIONS THE GLUE FOR INTEGRATION IN BUSINESS-WIDE WORKFLOW MANAGEMENT SYSTEMS

Stig Nordqvist*, Fredrik Fällström** and Nils Enlund**

Keywords: Production, Management, Systems, Model.

Abstract: Production processes in the graphic arts industry are becoming more complex, time-critical and physically integrated. In a digital world this put new demands on management and creates new possibilities of intersystem integration. The necessary IT infrastructure is available today, but the mechanisms for interchange of management information are not standardised.

This paper presents the IFRAtrack recommendation, a tracking information interchange mechanism for integrating production management systems in the graphic arts industry. IFRAtrack was developed jointly by representatives of newspapers, system manufacturers and research organisations. The current version, IFRAtrack 2.0 is presented and future extensions are discussed.

In prototype applications, IFRAtrack has proven to be an excellent vehicle for integrating heterogeneous multivendor systems in the newspaper and the catalogue industry. Our aim is to show that further extensions can be included to handle the wide range of businesses and systems that the industry contains. Industry restructuring will require the management of networked virtual enterprise production processes.

---

* GP, Göteborgs-Posten, Göteborg, Sweden (stig.nordqvist@gp.se).

** KTH/GT, Royal Institute of Technology, Media Technology and Graphic Arts, 100 44 Stockholm, Sweden (fredrikf@gt.kth.se, nilse@gt.kth.se).

Increased information repurposing will require the management of parallel production of printed and digital products. IFRAtrack is a powerful mechanism that through simple extensions can handle very complex processes.

INTRODUCTION

Production management and IFRAtrack 2.0

The modernisation of newspaper companies with computerised pre-press departments and highly automated printing presses and mailrooms is today one of the biggest revolutions in the newspaper industry. However, total production management using computer-based tracking and active process control is still almost absent from newspaper production. In the future, pre-press, press, mailroom and distribution control systems will be linked to form an integrated newspaper production management system focusing on customer-to-customer satisfaction.

Today is the time for newspapers to involve themselves in and implement business wide computer-based management systems. To secure the investment and to guarantee an open system, we need to agree on a standard interchange mechanism for status and management information. We need a standard – a "PostScript" for management systems. We propose the use of IFRAtrack [Nordqvist 1997].

The new version of IFRAtrack provides more functionality as well as easier implementation for both the newspaper and the system vendor. IFRAtrack has already been implemented at newspapers and commercial companies.

This paper explains the background and scope of the work with IFRAtrack 2.0 and also the potential ways to further develop IFRAtrack to meet future demands. This paper is a product of work done by a working group with the participation of the authors. A more extensive publication version of the work is available in the IFRA Special Reports 6.21.1 [Nordqvist 1997] and 6.21.2 [Fällström 1997]. This is a development of the IFRAtrack 1.0 and IFRAtrack 1.1 specifications described in [Thoyer 1995] and [Nordqvist 1996].

Background

One of the important aspects in newspaper production is the fact that the product is not completely defined when production starts. Outside

events can change the contents and structure of the product radically at a very late point in time; in addition, every day the product is different. Still, production schedules have to be kept and a complete newspaper has to be delivered to the reader on time.

The newspaper production process consists of two distinct and very different production processes:

- The aim of the first process is to make an original. It is the creative process of putting together the newspaper pages with their mixed content of editorial and advertising matter. Each newspaper has two main pre-press departments doing a parallel production of originals. The ad department sells page space and collects as well as produces advertisements corresponding to that space. The editorial department collects information and through a complex process of selection, creation and editing, fills the pages in a structured way.
- This is followed by the rapid mass production and distribution of copies of this original. The manufacturing of copies is a linear production process. The main production steps are platemaking, printing, insertion of pre-prints, addressing of mailed copies, stacking, bundling, transportation and delivery. This is a traditional manufacturing process and it can be managed, controlled and optimised through the use of established resource management methods and systems.

When making a newspaper, one problem is to make sure that the production process is running according to the schedules and to the budget. Today, production in most newspapers is managed by information residing in the minds of a few persons, responsible for getting the newspaper out on deadlines.

But, especially in the pre-press area, the technology is making this kind of production management more and more problematic. The emergence of low cost, high performance text, image and page processing software for standard platform computers has made possible the digital production of newspaper pages. Organisational structures have adapted to technical and functional realities. The flow of material in digital form will have to be managed by electronic means, since no physical material exists that could be tracked mechanically or manually.

The tracking of events and objects in the newspaper production process is today, when present at all, handled by function based, local tracking systems. Separate solutions from different manufacturers exist for

mailroom management, press control, page output and printing plate tracking. In the pre-press area, production tracking, outside ad tracking, has only recently been addressed by system manufacturers. The idea of automatically tracking newspaper production is relatively new in the newspaper industry. In other industry branches, there are well developed production management systems aiming at optimising the production. When business has been going well in the newspaper industry, there has been no need for production tracking. The current economic situation has increased the interest in efficient monitoring and management of the entire newspaper production process, just like any other industrial production. There is a need for a better production control.

To be able to follow the progress of a page from page make-up through imaging and platemaking to press mounting, there is a need to exchange status and management information between local systems.

In order to make this possible, some mechanisms have to be developed to enable for example the press management system to communicate with the mailroom system. More important, this mechanism will also enable the creation of a company-wide production management layer (a Global Production Management System) that can be used by the management and employees to follow what is planned and what is happening in the whole process.

There is a need in newspapers for extending production tracking and management to cover the entire manufacturing process, from news gathering and ad marketing to the delivery of printed copies. A global production management system has to serve the needs of business management and should provide the tools for extracting high level planning and decision information from the different local systems. It should also serve as a distributor of information between the different areas of responsibility within the newspaper production process.

THE STRUCTURE OF IFRATRACK 2.0

Scope and purpose of the specification

Several production management systems are available today from different manufacturers and many new solutions are under development. Each of these systems takes its own approach to solving a locally defined tracking problem. There is no reason for an attempt to standardise these approaches – this could hamper innovation in a rapidly developing sector. Instead, ways and methods to be used by

local production tracking systems to communicate with other systems should be defined in a structured manner [Nordqvist 1997].

The primary objective of the IFRAtrack specification is to define a way of exchanging status and management information between local and global systems. The proposed mechanism makes possible the creation of global newspaper production tracking systems that can collect the information from the various local systems.

The specification of version 2.0 is focused on production tracking and basic management functionality. Production control is not part of this specification but could be the scope of a future work. For technical information about the 2.0 specification we refer to "IFRA Special Report 6.21.2" which describes the IFRAtrack 2.0 specification in detail [Fällström 1997].

Any proposed standard method should be kept as simple as possible. The format has to be flexible enough to handle all the necessary status and management information on various levels of details. The newspaper production process can be planned, observed and tracked at different levels of detail. On a very high level, we can observe the process as consisting of four main functions: pre-press, press, mailroom and distribution. Looking closer at the pre-press department, we can distinguish between: editorial, advertising, composingroom, repro and platemaking. And going even further, we can for example observe the different steps necessary to produce advertisements. These views represent different levels of detail.

The level of detail is important when it comes to production tracking and management. Local production management systems work internally at a certain level of detail and they would communicate with other systems on another level. For example, an ad system is concerned with bookings, texts, images, layouts and complete ads. A plate management system is concerned with pages, paste-ups, films, printing plates, register punches, benders and plate transports. Another system might only be concerned with plates, presses, copies, bundles and vans. Still, all these systems need to exchange information. Any recommendation for the exchange of information between systems should be able to work at these different levels of detail. This means that the recommendation should be built as an extensible architecture. On the other hand, global management cannot be made on a too detailed level. The consequence would be too heavy traffic on the network with thousands of messages being sent when events occur at every level of the production process. It is also important to build a

general but strict method that can be used in many different areas, for example in the commercial printing industry.

Implementing a global management system would be relatively easy if all the tools used would be part of the same single vendor system. Production control could then be superimposed on a commondatabase system. This is not the case in the newspaper industry, where different systems from different manufacturers will have to communicate between each other. To be able to achieve it, a commonly accepted approach has to be taken.

The enforcement of standards in a rapidly developing environment is almost impossible. The IFRA initiative which started in 1994 does not aim at creating a restrictive standard [Enlund et al 1994]. Instead, a structured and open method for exchanging tracking information has been developed. During the development work, the aim has always been to make the final implementation as simple as possible [Enlund et al 1995].

A standard message format, version 2.0, has been defined by the IFRAtrack Working Group 2.0 [Fällström 1997]. Its members range from newspapers to systems suppliers for the pre-press, press and mailroom departments. The addition of IFRA recommendedIFRAtrack messages to existing and planned systems will be a simple task for the systems manu-facturers. The specification is independent from the system vendor and the platform used. For the newspapers, the fact that a local management system adheres to IFRAtrack message passing specification will be a guarantee that it will be able to communicate with other systems.

Production management — interaction between the production processes and the business processes

The production process of a newspaper and a global production management system, can be interconnected using IFRAtrack as discussed above. The two, in combination with the economical control mechanisms of the news-paper company can be expressed as in figure 1.

The economy of the newspaper is controlled by the demands on profit, or is based on publicistic goals [Nordqvist 1997] or, normally, a combination of both. The publicistic goals also require a healthy economic situation in the newspaper company. An economy system could be connected to the production process through the use of a global production management system (GPMS) which facilitates real time

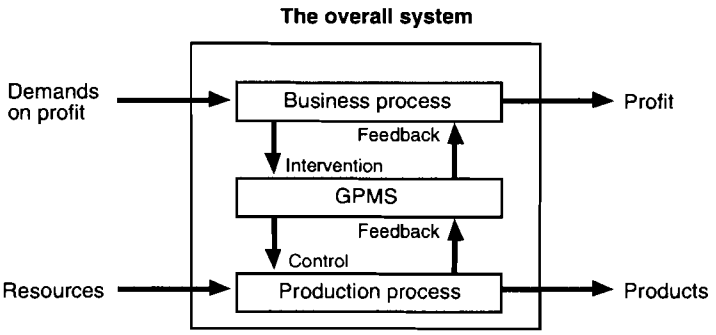

Figure 1: IFRAtrack could be the vendor independant interchange mechanism for information exchange between the production process – GPMS – business processes [Nordqvist 1997].

feedback. The production process needs resources, i.e. persons, material and machines, to be able to manufacture and deliver products. Figure 1 indicates that the GPMS can, from a company holistic point of view, be seen as a vital part of the newspaper, where both economical and production aspects play important roles.

The use of a GPMS that interacts with other systems through an open and standardised exchange format as IFRAtrack, promises the use of more flexible product structures and, at the same time, better utilisation of available processes and resources. At the bottom line, this will save time and money.

THE OBJECT CONCEPT IN IFRATRACK 2.0

Definitions

Production tracking is concerned with objects and their states. The objects are divided into different object classes. The state of an object is modified through processes. The changing of the state of an object is called an event. Production tracking consists on the registration of events. By associating the events with objects and their states, a tracking system can follow the progress of the production run.

The IFRAtrack specification defines a general tracking message exchange method. A "sender" is a system that generates a tracking message and a "receiver" is any system that can register and use this tracking message.

The specification is based on three main points:

- Semantics: the scope and content of the tracking data to be communicated is defined.
- Syntax: the method of describing and encoding the tracking messages is specified. The systems that send and receive messages have to be uniquely named. The objects concerned by the messages should also be identified. All this information has to be encoded, preferably in a human readable form.
- Message exchange mechanism: the method to exchange the tracking messages is also defined.

The IFRA Production Tracking Working Group has attempted to develop a basic model for newspaper production. This model gives some examples of trackable objects which go through the different production steps [Fällström 1997].

Object structure and classes

Objects used in newspaper production have a certain structure. For example:

- a page consists of stories and ads, which can themselves be made of texts, images and lineart.
- a newspaper issue on a certain day is made of different editions.

This structure means that some objects will be associated with other objects. For example, the elements composinga page will be linked to that particular page. Trackable objects are not necessarily physical objects, but can also be process objects, like for example, a printing job in the press department.

In its attempt to find a model for newspaper production, the Working Group had to name and define some basic trackable object classes. For each class a set of attributes is defined. Also links to other object classes are described. The definitions of the object classes can be found in [Fällström 1997]. The list of trackable objects defined by IFRAtrack 2.0 is not complete. Some other objects may be used by local systems working on a specific step of the newspaper production. It will be up to the newspaper companies to decide which objects are important for them to be tracked, especially on a global level. Therefore, according to specific needs, this object list can easily be extended.

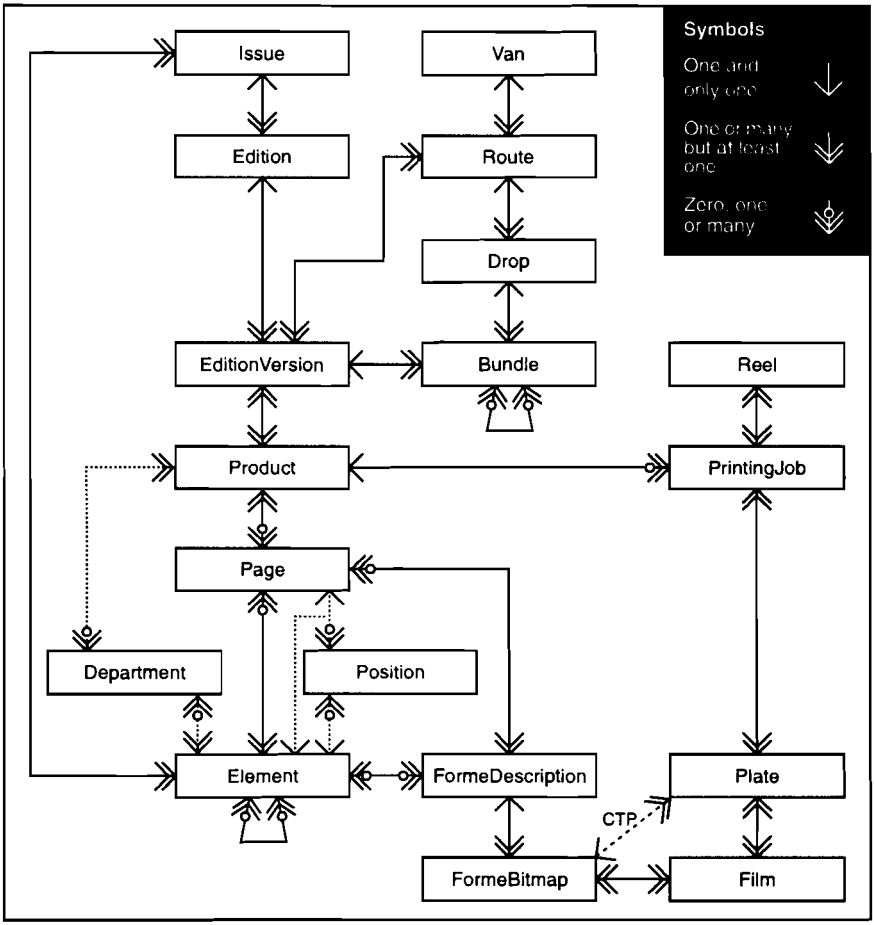

Figure 2: IFRAtrack 2.0 data model with the different object classes [Fällström 1997].

Changes in object attributes are also important tracking information and need to be communicated. Therefore, some basic attributes for each object class had to be defined. Objects can also be linked to other objects. The links have to be transmitted to fix the object path. It is possible to add, remove and change links between objects.

It is difficult to think of all the attributes that will prove necessary on different occasions. Therefore, it is highly probable that different implementations will come up with additional attributes. Undefined attributes (not defined in the specification) are accepted as long as they

conformwith the IFRAtrack syntax. Different implementations could add attributes that they find necessary in an easy and flexible way. Valid and interesting attributes would need to be registered with IFRA for future versions of the specification of IFRAtrack.

Object states and workflow states

The main reason to send tracking messages is the change of object states. By associating events with objects and their states, a tracking system can follow the progress of the production. An object can have a great number of state values. If we take the example of an ad in the pre-press department, the state values can be: "registered", "booked", "planned", "positioned", "assembled", "approved by the customer", "proofed", "instances placed on a page", "all instances placed", "cancelled", "credit ok", "invoiced", "paid", "archived". A list of object states would need to be defined for each object class, which would be a difficult task. In order to keep the definition as simple as possible, the Working Group has agreed upon a state structure that does not go into a great deal of detail, but allows for the communication of essential tracking information between systems.

To extend the functionality of the IFRAtrack specification, any process state of an object can be associated with a deadline, specifying when the process state should have reached a specific value. If the value have not been reached by time of the deadline, the corresponding schedule state will be set to "late" (or to "warning" depending on the deadline statement). This means an object not only contains information about its current state, but may also contain schedule information.

Two object classes in the model can be considered to be resources, "Van" and "Reel", but a genuine resource model is not included in the IFRAtrack specification. However, to allow some simple tracking of other resources, it is possible to associate resource names to any state change or when setting a deadline, to indicate that the resource was (or is planned to be, in the deadline case) involved in the event.

IFRAtrack message format — IMF

One of the first requirements for the tracking messages exchanged by different systems was that they should be as simple as possible. For that purpose, the Working Groupdecided that these messages should be simple text strings. It should be possible to read and analyse the messages that are sent and received.

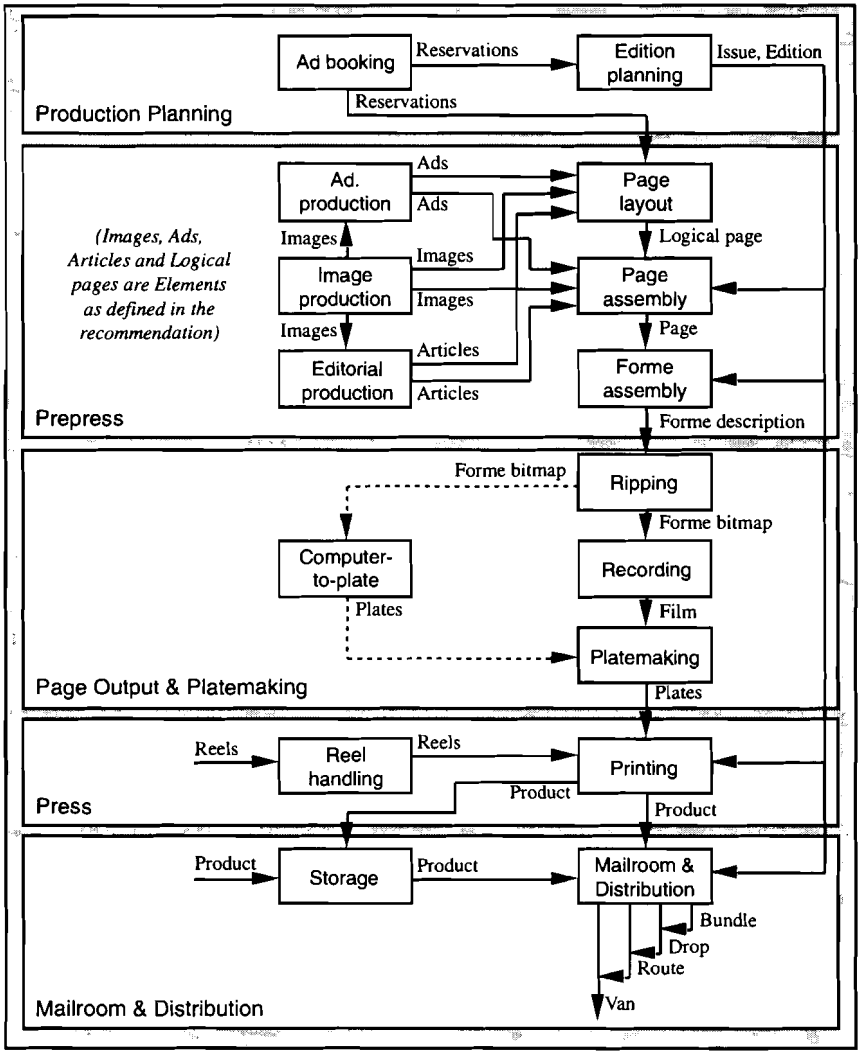

Figure 3: IFRAtrack 2.0 basic model of newspaper production. The boxes represent activities and objects are processed by these activities [Fällström 1997].

A tracking message should contain the following information:

- Time. The time when the message was generated.
- Message sender. Information about the system generating the message and about the supplier of that system.

- Object identifier. A unique identifier of the object concerned with the tracking message. The identifier must be either globally unique, or unique within a specified system. In the latter case the system together with the local identifier will function as the object identifier.
- Object data. The object information transmitted in the message. The object data may include status change, attributes, links, deadlines and resource information.

It has been proposed that the IFRAtrack specification should include a naming convention for the uniqueness of the object identification. A naming convention for the objects would be of help, especially when automatic identification techniques (like bar coding) are used. The task of defining naming conventions for the objects could be a future task for IFRA. For the time being, it is up to the system suppliers to uniquely identify the objects concerned by the tracking messages.

To exchange tracking information, tracking systems require an exchange mechanism. This mechanism should define how the message is delivered from the sender to the receiver(s). Since the approach is focused on simplicity, the exchange mechanism have to be easy to implement. It therefore required high level, well accepted, industry standard building blocks. At the same time the exchange mechanism had to be stateless to assure synchronisation between systems. There are several possibilities to implement an exchange mechanism meeting the requirements stated above. However, the IFRAtrack specification does not recommend any mechanism as the preferred solution. The reason for this lies in the fact that every possible mechanism has specific pros and cons depending on:

- network topology and preferred network software
- software already in use and installed systems
- other local preferences (databases, system architecture, LAN, etc.)

Nevertheless IFRAtrack specification contains a description of three pos-sible mechanisms for explanation purposes: a central relational database approach, a file exchange approach and a tcp/ip socket approach. Other possible exchange implementations are (list is not complete):

- e-mail
- tcp broadcast
- object request brokers.

FUTURE EXTENSIONS TO THE IFRATRACK SPECIFICATION

Scheduling and control

Efficient production tracking is only a first step in making newspaper production an industrial process that can be efficiently monitored and controlled in the same manner as other industrial processes. Tracking is a necessary basis to avoid or correct problems during the production. Newspapers will have to move toward adaptive production control and management.

Production control means the active rescheduling of worksteps and the reassignment of resources in case of a deviation from a schedule. A production control system should be able to solve problems in minimising delays and costs. In the case of a major rescheduling operation, the system would ask for approval and advice from an operator.

For active production control to be possible, the control system requires detailed information on the product to be produced, the worksteps involved, the resources available and the default production schedules. In a heterogeneous environment, involving systems from different manufacturers, this information has to be transmitted between the control systems in a structured and standardised manner. The definition of these mechanisms should be the objective of future initiatives and efforts.

Production management involves the collection and analysis of data on production runs and production costs, covering the entire newspaper production process. This information can be used by production and general management to support process improvement and strategic planning. In this area too, standardised means of exchanging information are required.

In version 2.0 of the IFRAtrack specification, some features have been added to prepare the specification for future extensions. A simple resource tracking mechanism has been included to encourage users of IFRAtrack to go beyond tracking. In this version there is not yet a resource model to go with the resource tracking mechanism, but this should be included in the future.

The tcp/ip socket approach for message exchange, which is introduced in this version of the specification, is another example. It could be used for two-way communication in a possible future control mechanism.

Integration to other standards

It is also necessary to look in to other standards and specifications, like XML, EDI [Gottberg 1995], CIP3 [Daun et al 1997], CGATS and pdf, to see how they could be used to enhance the use of the IFRAtrack specification.

Generalisation

During the work on the specification, the Working Group has had discussions about generalising and extending the model to other areas similar to traditional newspaper production. Interesting areas could be catalogue production and electronic publishing. Newspaper companies will most likely publish both printed and digital products in the future, and therefore need a tracking model capable of multichannel publishing. This is a challenge for a future version of IFRAtrack.

A truly object-oriented model

The current version of the object model does not include object inheritance, which makes the model simple to describe in an "entity-relationship"-like manner, but also quite limited. A truly object-oriented model is in many ways much more powerful, but will put higher demands on the users of the model. Before adding object-oriented features to IFRAtrack, the consequences in terms of simplicity should be thoroughly investigated.

Other standardised technologies, such as CORBA and various component architechtures, should also be considered for future versions of IFRAtrack.

Cost estimation

Another area that is not covered by the IFRAtrack specification is the exchange and gathering of cost information and cost estimates. This may include estimated costs for colours of prints, production costs of ads, estimated distribution costs due to a delay or a larger product and more.

This kind of information might be included within the IFRAtrack message as attributes to different objects, by separate cost objects or included in a format for IFRAtrack queries.

Version control

A mechanism for version control of objects is not included in this version of IFRAtrack. This would be needed to keep track of objects when handling more then one version of an object, for example when an article is updated.

An extended page element model

The Working Group has agreed that the handling of page elements currently is too limited in IFRAtrack. A single "Element" class is not enough to describe all kinds of page elements. The obvious way to solve this is by using object inheritance – a number of subclasses inheriting the behaviour of a basic element class.

IFRAtrack queries

When using multiple systems within the same newspaper, there sometimes is a need for an active communication between the different subsystems in the sense that one system may request information from another. To enhance this kind of communication, a standard for the syntax and content of queries is important and this may be an extension to the IFRA Message Format in the future.

A possible need for communication is for a later step in the workflow to ask previous system about specific information. The printing house may send a query to get an estimation on how much colour to use. For plate production, it might be interesting to ask for the status or time status of the pages to be placed on the plate.

Currently, IFRAtrack information is available to a system only by processing and parsing all IFRAtrack messages without selection.

DISCUSSION

The IFRAtrack specification is a useful tool within newspaper production departments to exchange topical tracking information. As already stated, this specification enables newspapers to create links between tracking systems in the various departments and also to install global production tracking systems. It also provides a new opportunity for system suppliers to offer global tracking systems that are compatible with existing systems. It is up to each supplier to offer the most user-friendly and efficient system.

As a result of the application of IFRAtrack, it is possible to achieve integrated tracking in newspaper production. This means better control of the entire process, the possibility to optimise production, and the possibility to significantly improve productivity. This, in turn, can lead to better economy and competitiveness for the newspapers.

The installations of IFRAtrack based GPMS's up to the end of 1997 are few but the experiences are overall positive. The first system was introduced at the Swedish daily newspaper Göteborgs-Posten in late 1995 and is in continuoususe. Other examples are to be found at the newspaper company Concentra in Belgium, Abendzeitung in Munich, and in catalogue production at IKEA Catalogue Services (world-wide).

An interesting case is the MWMsystem at the Swedish daily newspaper Östgöta-Correspondenten [Stenberg et al 1998]. The intranet based business-wide GPMS (MWM-system) is in daily use and covers almost the entire workflow, from product and production planning to newspaper distribution. The tracking information is also used for decision support in for example rescheduling of the order and deadlines of pages to be produced. Tracking is used as a basis for risk analyses, prognoses of delays, and cost estimating.

The industry needs defined interfaces that deal with and support a large set of functionalities. There will never be one single format or interface used for any specific functionality. In a newspaper of today we may use 100-400 different applications, several different databases, a number of IT platforms in local networks and PC-Macintoshes as clients. To be able to integrate them we need open standards.

For the exchange of management information between different systems, i.e. information for tracking, real-time status, planned deadlines, etc., we need a standardised mechanism — today, IFRAtrack fills that gap bet-ween other standards for other purposes. CIP3 is a neighbouring standard that does not overlap or replace IFRAtrack. Both IFRAtrack and CIP3 is needed. CIP3 was born from the needs of the commercial industry and IFRAtrack comes from the newspaper industry.

IFRAtrack has a promising future and there is a long list of additional functionality that can be included in future extensions to IFRAtrack. The list in this paper is a compiled list of functionality requested by users and vendors.

ACKNOWLEDGEMENTS

The authors wish to thank the members of IFRAtrack 2.0 working group; Annika Sardi (Astrakan AB), Collin Manning (CM Consulting), Tord Johansson (Göteborgs-Posten), Stig Forsberg (IFRA-NATS), Mattias Löfstrand (Mactive AB), Lennart Brolin (Mediamatic AB), Bob Corrick (Setanta), Leif Bergmark (Solna International), Simo Karttunen (VTT), for their hard work, valuable commentsand support. IFRAtrack 2.0 would never have happened without them. We also extend our gratitude to the whole IFRA organisation, and the companies actively working with IFRAtrack, especially Autologic, Data Engineering, and Denex.

LITERATURE CITED

Daun, S., Lucas, G. and Schönhut, J. 1997 "Specification of the CIP3 Print Production Format", Version 2.1, Fraunhofer Institute for Computer Graphics, Darmstadt, May, 61 p.

Enlund, N., Nordqvist, S., Alasuvanto, J. and Sulonen, R. 1994 "An Object Model for Integrating Production Management in News papers", Proceedings of the TAGA '94 Conference, Rochester, NY, pp. 498–510.

Enlund, N. and Maeght, P. 1995 "A Recommendation for the Interconnection of Production Tracking Systems in Newspaper Production", paper to be published in Advances in Printing Science and Technology, TAGA/ IARIGAI 95, Volume 23, Wiley & Sons, London.

Fällström, F. 1997 "IFRAtrack 2.0 - a specification for the interchange of status- and management information between local and global production management systems in newspaper production", IFRA Special Report 6.21.2, Darmstadt, October, 21 p.

Gottberg, H. v. 1995 "The EDIFRA message for ordering newspaper advertising by Electronic Data Interchange", IFRA Special Report 6.14.3, Darmstadt, August, 63 p.

Nordqvist, S. 1997 "IFRAtrack 2.0 Executive summary - A specification for the interchange of status and management information between local and global production management systems in newspaper production", IFRA Special Report 6.21.1, Darmstadt, October, 6 p.

Nordqvist, S. 1996 "A Model for Global Production Management Systems in Newspaper Production — Real Time Management of Time Critical and Heterogeneous Processes", thesis for the degree of Doctor of Technology, Royal Institute of Technology (KTH), Stockholm, 220 p.

Stenberg, J., Fällström, F. and Enlund, E. 1998 "Workflow management and decision support in a newspaper environment - implementation of an IFRAtrack-based system prototype", paper presented at TAGA '98 Conference, Chicago, IL, 26-29 April.

Thoyer, B. 1995 "IFRAtrack: a Recommendation for the Interchange of Status Information between Local and Global Tracking Systems in Newspaper Production", Version 1, IFRA, Darmstadt, 25 p.