# Improved Workflow for Print-Ready, Variable Data Material

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Abstract: During the journey from analogue production of printed products to today's digital production, many steps in the manufacturing process have been eliminated as well as the way printed products are produced.

Thanks to open networks and standardized file formats, such as PDF, new print workflows may successfully be engineered. This paper presents the development of such a workflow, where the traditional design activity has been divided into two separate activities: design and adaptation.

The design activity is done using graphic software to create a specified layout. The adaptation activity makes it possible to use the layout to produce print ready files with variable content, without graphic software and skills in graphic arts.

In the workflow from design to a print ready file several steps can be automated and sped up if layout and content (i.e. variable data such as name and address) are stored separately. Variable data can be merged with a predefined layout through which multiple print ready files can be produced automatically.

This has some major benefits:

- Variable data can be changed without a layout/design program.
- A change in layout does not affect the variable data.
- Variable data can be used on arbitrary layouts.
- The graphic profile is kept intact.
- The merged data is not predefined to any file format.

This technique has mainly been applied on printed products such as business cards, letterheads, envelopes, product sheets and stickers, where the user data often is personal information and addresses. We will show how this workflow increases the productivity on the products above. Other benefits are less printing errors and making print products available to order on all networked computers. The same technique can be used to increase the efficiency on many types of print products that are repetitive but with changes in the content.

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## Introduction

During the journey from analogue production of printed products to today's digital production, many steps in the manufacturing process have been eliminated as well as the way printed products are produced.

Along with the technology shift from analogue to digital production, we see three other clear trends driven mainly by customers to the printing industry (Kihlberg and Lindgren, 1998):

- More color, images and illustrations in printed products. A way to get attention.
- We also see that product live cycles get shorter, which give printed products a shorter lifetime. This makes the editions smaller.
- With the lifetime of information being shorter, we will also need shorter lead-times from an idea to a delivered end product.

With an open standard for communication and industry standards for design and layout software, possibilities to change the existing workflow of print production have emerged.

This paper will discuss such an improved workflow, named the Printon workflow (PO Workflow). The PO Workflow takes advantage of the available technologies to transform the traditional workflow to a more efficient one (with certain limitations).

The PO Workflow has been implemented through a web based software system (PO System). The PO System encapsulates the whole workflow, including the communication points between printers, designers and customers.

The PO System has been under development since 1999, and the current version (v. 3) is the one presented in this paper.

## Definitions

| | |
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| Adaptation | The process of applying content on a layout. |
| Atomic elements | The smallest possible part of a product. Comes in different types and flavors. |
| Content | Changeable data which is to be placed on a specific layout. |

| | |
|---|---|
| Creation | The whole process from idea to a finished product and the activity to produce a printed product. The activity incorporates design, adaptation, specification and the actual printing of a product. |
| Design | Is a part in the creation of a printed product. Here the parts and their layout is specified, as well as material. Rules for how the repetitive printed products can be adapted is also specified. This is the encapsulation of the Product Layout Definition. |
| Graphic profile | General design rules that apply to a set of different products. |
| Order | From the PO System's point of view, an order is the concrete representation of a product. |
| Original | Consists of layout, text, logos, graphics and images in a wide range of formats. |
| PO System | A web based software system implementing the PO Workflow. |
| PO Workflow | The PO Workflow (Printon Workflow) takes advantage of the available technologies to transform the traditional workflow into a more efficient one by automating several steps of the creation and adaptation processes. |
| Prepress | The operations where a page original is adapted to the specifications of the output media before copy production (Enlund and Nordqvist, 1995). |
| Process | "Set of inter-related resources and activities which transforms inputs into outputs" [SS-ISO-8402]. |
| Product | A product is the definition of how a specific orderable print material is represented in the PO System. |
| Product Layout Definition | A description of a product containing information about all aspects of the printable end product. |

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|---|---|
| Repetitive printed products | A printed product which is reprinted. In the PO Workflow it is a product which has been sufficiently specified and designed so that it can be adapted. |
| Workflow | A chain of activities through which there is a flow of material or information. A process can have several workflows. |

## Hypothesis

On many printed products, the layout is fixed in the design process and every repetitive print order with change of content does not need to be redesigned. By eliminating the design step for consecutive orders and only applying user data on a fixed layout, the process of creating repetitive print orders is sped up. The design elimination will also keep the graphic profile intact.

## Limitations

This paper has its focus on creating a workflow that will be efficient for repetitive printed products, with limited changes in layout and design. This will lead to restrictions in the number of graphical products that are suitable to produce with this workflow.

The results of this paper are mainly based on the productivity gains of the PO Workflow. This paper does not compare the PO Workflow with other automated workflows.

## Method

The primary sources used for developing the PO Workflow have been interviews of users and potential users, which have been using early versions and prototypes of the PO System.

Through continuous interviews and observations, further knowledge has been gained. The workflow was invented by the authors and then tested on users. PO System v.1 was tested on 100 users, v.2 on 500 users and v.3 on 850 users.

The users were a good source of evaluating the presented workflow, but not a good source of new and innovative ideas. The panels had difficulties in suggesting ideas that were not closely related to the material they were introduced to.

To confirm that the PO Workflow is more suited for creating repeated print ready material than the traditional workflow, we have focused on measuring the time it takes to complete a print order. The measurements of ordering time in the PO System have been incorporated by automatic time triggers.

The traditional workflow's ordering time has been measured by interviews. The time measuring started when an order was received by phone, fax or email. It was stopped when the order was sent to print. The time spent waiting on customer approval was excluded.

The secondary sources used have been the evaluation of existing digital workflows in the graphic arts industry in Europe and the US to gain knowledge of what exists and what needs to be improved. This was done using the Internet, on print exhibitions and interviews with software companies and trade press.

During this research, many systems for different types of printed products and with variety of automation were found. An observation was that they were either developed to simplify ordering for customers, or developed to handle the internal workflow in the print house. We saw a need for a system which would handle the whole workflow, from the customer to the printer.

## Redefining the first activities in the print workflow

In general print workflows, the initial activity is to design the product which is to be printed. When the designer has a design that is print-ready, it can be sent to a printer with the required order information.

Often, the first time you print a layout it needs to be proof printed and accepted by the designer before the order is processed. This task requires specific skills from both the designer and printer. If the result is accepted, a repetitive order without any changes to the content is simple and will not require any specified skills.

However, on many printed products, the content needs to be updated without changing the layout. Today, this activity still requires the skills and tools of the graphic arts industry. The design activity has been divided into two separate activities, were the first activity requires a number of skills that are not necessary in the second activity:

1. Design. The first time a printed product is ordered, it is designed separating the product's changeable content from the other data layout.
2. Adaptation. The second time you order the product, it will only need some adaptation of the user data.

The separation of the two activities has been identified as a base for large productivity gains on repetitive printed products that require a certain amount of adaptation for each order.

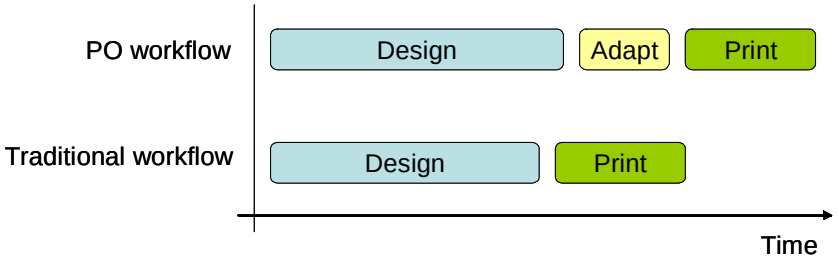


*Figure 1. First order of new design with the PO Workflow and the traditional one.*

The productivity gains are exemplified by Figure 1, which illustrates the traditional print workflow contra the PO Workflow. The time spent on design in the PO Workflow may be larger than in the traditional one.

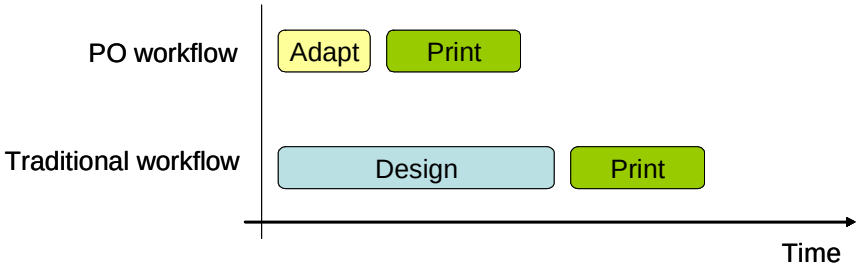


*Figure 2. All consecutive orders (repeat orders) with the possibility to correct and adapt user data in the PO Workflow and the traditional one.*

Figure 2 illustrates the gains of the PO Workflow. On all consecutive orders, it is possible to adapt and reuse the previous order's content and product definitions. The time spent on the repetitive orders will be less. The gains in efficiencies increase with the number of repetitive orders.

Also, an additional gain is that someone unskilled of graphical design tools can place and approve the order.

Defining the ordering process and points of communication

The traditional workflow goes through a number of points of contact between the customer, designer and printer before the order is ready to be printed. This is in many ways an analogue workflow applied on digital techniques.

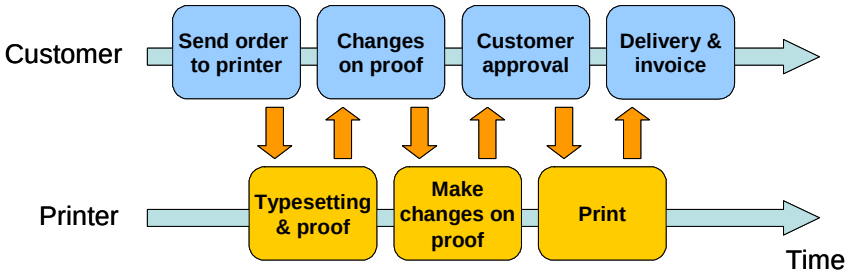


*Figure 3. Traditional print order workflow (Kihlberg and Lindgren, 1999)*

The main reason of the inefficiency, illustrated by figure 3, is the lack of a standardized communication of the product definition between the customer and the printer. This results in errors, which have an effect on quality costs.

A way of reducing this inefficiency is to automate parts of the process, minimizing the level of manual human interference (Cost, 2002). Automation of the communication process may be obtained if the layout and data is fixed to the highest degree possible, and the customer may only adapt the product at the ordering time using a guaranteed correct predefined layout. The adaptation will not violate any product design or information rules. A workflow using automated communication is illustrated by the following figure.

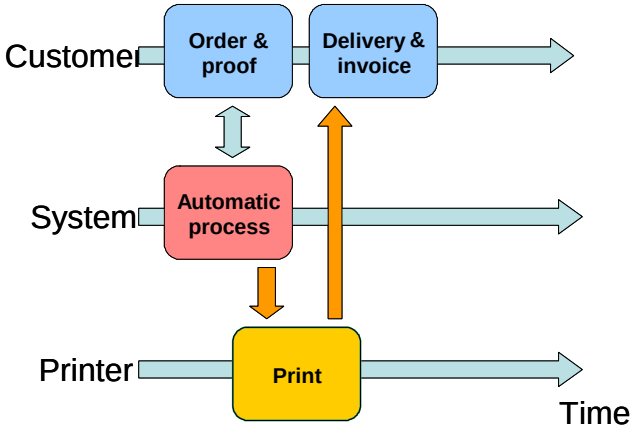


*Figure 4. PO Workflow*

The communication automation is handled by a system that exists as a tier between the printer and the customer, available through a network such as the Internet. The system allows product adaptation by separating the product layout, formatting and static data from the pure user specific data. This type of separation is ideal for products that are ordered repeatedly with minor changes.

The major benefit of the system is that it allows the customer to place its order and review, modify and accept the proof online in one single contact opportunity. The disadvantage is that not all kinds of creative work are applicable to this process.

### Adaptation of print material

The following sections will explain the bridge between the orders passed through the PO Workflow, and how they are represented in the PO System. From the PO System's point of view, an order is the concrete representation of a product. A product is the definition of how a specific orderable print material is represented in the PO System.

### Empirical experiences

In the PO System's early versions, the time needed to create and manage a set of products was significantly larger than the time spent on customer relations or order management. Also, as a customer's set of products increased in complexity and number, it became unsustainable managing each product as a separate entity. The majority of the products were variants of each other, with only small changes in each variant. To overcome the issues of complexity and time we set out to make the creation process simpler by separating the concept of a product into parts.

In the attempts to build a system that can facilitate ordering interactions of printing-matter, the definition of a product (i.e. a business card) has changed. The definition of a product has evolved from being a separate entity in itself to a complex composition of smaller shared parts.

### Dividing a product into smaller parts

As stated earlier, a majority of the created products have many parts in common. Taking advantage of this fact, a separation of a product reveals that it consists of four major parts.

These are:

- External resources (Such as fonts and images.)
- Variable elements (Defines any type of data that needs user input, for example the name and title on a business card.)
- Static elements (Any type of data that is not subject to change between orders.)
- Format elements (Defines how any variable or static part should be rendered and shown, i.e. font, font size and color.)

These parts can then be put together in what we call a Product Layout Definition; this is what constitutes a product. The variable, static and format elements are defined as atomic elements of a product. They are the smallest possible parts and may be shared among any number of products.

The format elements define how a static or variable element should be rendered. The static and variable elements contain actual text content. The term variable is defined by that user intervention is needed to specify the text value.

In the example below, two business cards from the same company are compared. They are very much alike, the only difference being that the bottom one has an extra row containing the person's cell phone number. By sharing the atomic elements, these two products are ensured to use the same graphic profile. Also, a change in for example the logo will automatically reflect on both products.

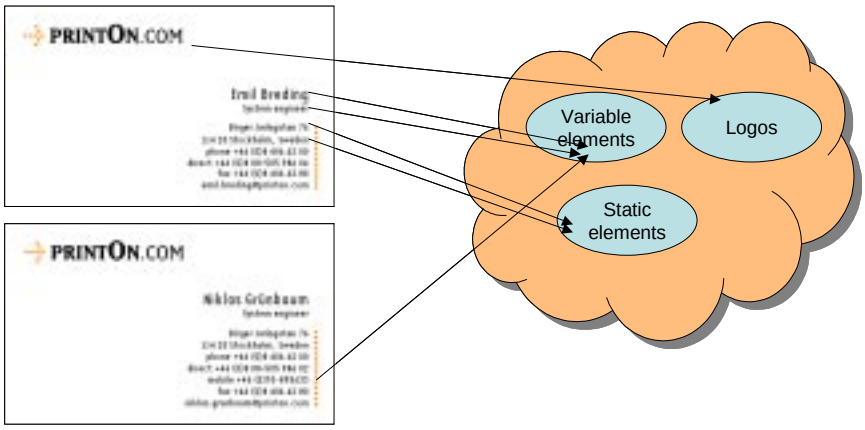


*Figure 5. Identification of logos, variable and static elements on a set of different products.*

Product Layout Definition

The Product Layout Definition defines how a set of atomic elements are grouped and placed on the product. A variable or static element is always combined with a format element and is placed on a page of the product via absolute coordinates. The Product Layout Definition also contains printing related parameters. These may be the type of paper, printing method and colors used.

By defining a product by the Product Layout Definition and its atomic parts, it becomes easier to maintain and manage a set of products.

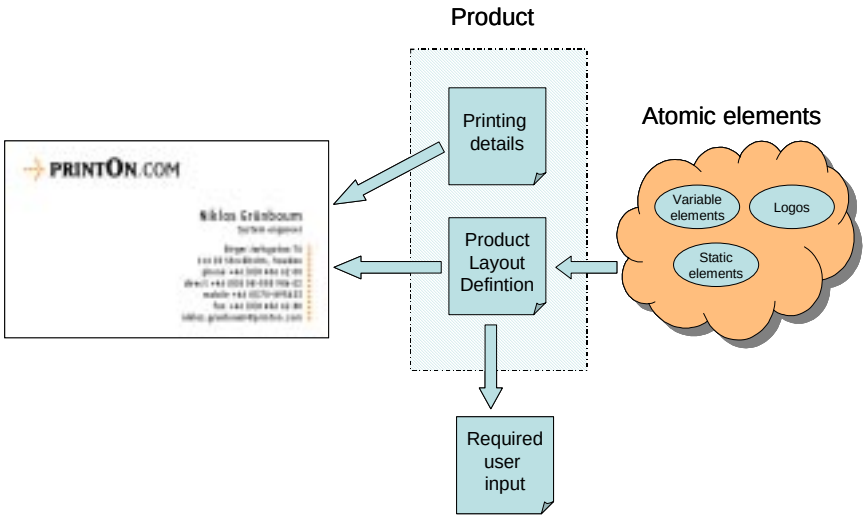


*Figure 6. Relationship between a Product Layout Definition, the atomic elements and the required user input.*

### Ordering

No technical knowledge of the printing business should be necessary to place an order through the PO System. It shouldn't be more complicated to order a business card than ordering a book or office supplies.

Because the system separates content (variable atomic elements) and the layout, a user's interaction during the order can be restricted to only manipulating the content. In other words all the user has to do is choose the type of product, update the content and the order is complete.

### Document rendering

Because the product has been abstracted into a composition of smaller parts it must be prepared before printing and manufacturing is possible. We call this process rendering. Before the actual rendering takes place, the user-data must be merged with the Product Layout Definition. In this stage the user input is validated to make sure that all required data is supplied and follows the rules defined in the layout definition. The result from the merge process is passed to the renderer that, with the use of all external resources needed, produce a printable document. For printing purposes, Adobe's PDF format is suitable as it can in itself contain fonts, images and complex layouts in one single file.

The document rendering process is illustrated by Figure 7.

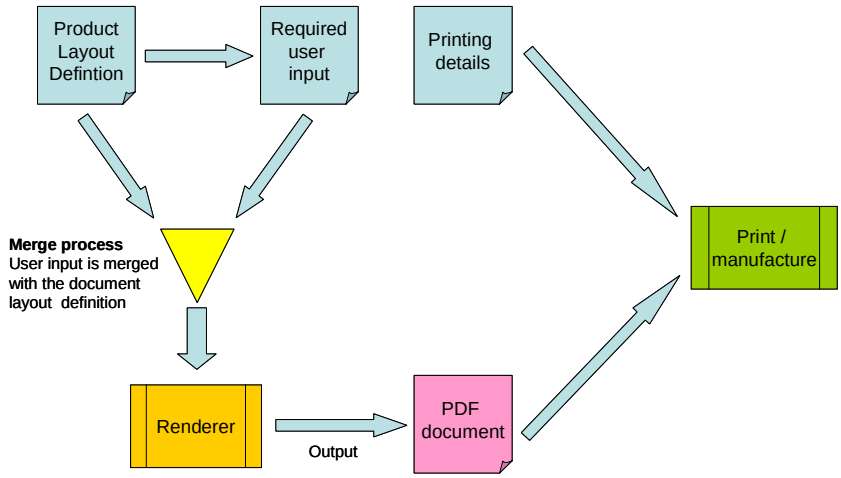


*Figure 7. The rendering process.*

Overall benefits of using the Product Layout Definition

Since the atomic elements are shared between different Product Layout Definitions, general changes are done easily. If for example a specific font is changed in the graphic profile of the products, it need only be changed once in the format element for the change to be made on all product layouts.

The time needed to create all the atomic elements needed for a set of products is generally longer than the time needed to group them into Product Layout Definitions. However, this is time well spent. Once the atomic elements are created, it is a simple and quick job to define and manage new products.

The graphic profile of the set of products is simple to maintain due to the fact that fonts, colors etc. are globally defined.

Technologies used

Atomic elements and Product Layout Definitions are stored as XML in the PO System. XML is a way of structuring data and can easily be used by computer programs for data manipulation. Simply put, a Product Layout Definition is an XML document that represents all aspects of the printed counterpart.

Results

The time benefits using the PO System are apparent when using it for repeated orders. The initial time cost for product design is larger than traditional design. However, each consecutive order has a lower time cost than a traditional repeated order.

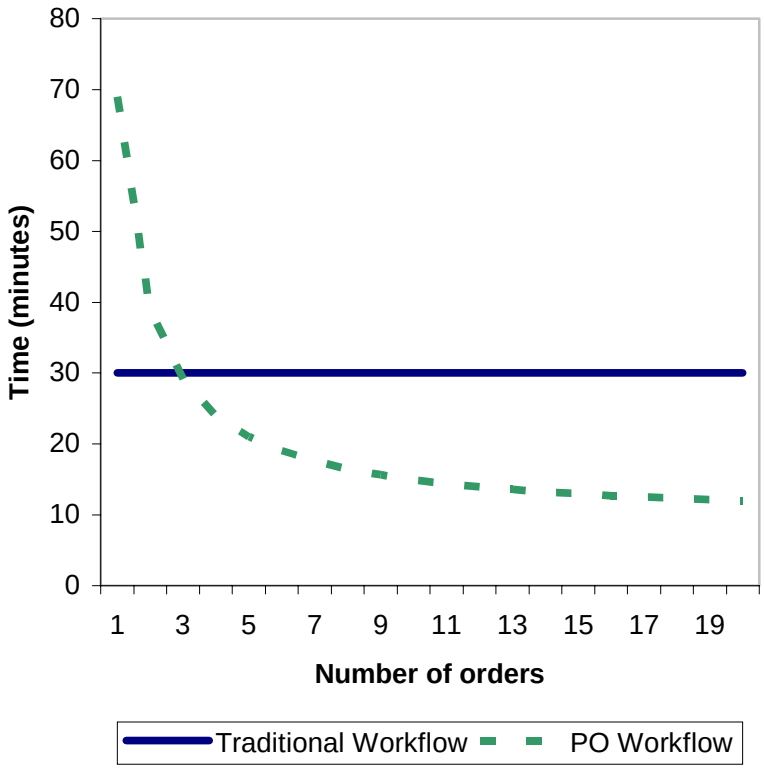


*Figure 8 Comparison of the time summations of prepress and ordering in the traditional workflow and the PO Workflow.*

Figure 8 illustrates the timesavings of separating the design and adaptation activities. In the traditional workflow, the design has to be repeated for each order. Since the design activity is only done once in the PO Workflow, the time for this activity may be spread across the number of orders.

The mean ordering time in the PO System is 9 minutes, compared to 30 minutes in the traditional workflow. The design activity in the PO System takes approximately 60 minutes per product.

In the process from design to a print ready document, manual labor is the largest cost. This is due to the fact that there are no raw material costs, and the IT related costs are relatively small in comparison.

Other observations are that orders in the PO System has quality issues on 1% of the printed orders compared to 3% on orders from the traditional workflow for business stationary print. These results are from comparing PO System orders and what we call side orders (orders with a traditional workflow) during a three-year period.

In a traditional workflow, the value adding time is only 5% of the throughput time in prepress (Olsson, 1997). This is mainly due to the number of handovers between activities in the traditional workflow. In the PO System the value adding time on repetitive orders is approximately 30% higher.

Traditionally, in the process from when a print order is given to when it goes into the press, the printer requires additional information in 50% of all orders. Customer and printer are in contact at least 2 times during the process to give additional information or to get information on deliveries (Lindgren, 2000). No additional information is required by the printer on repetitive orders, using the PO System.

Further benefits from the PO System:

- Users can track his orders online.
- Ordering history and statistics are available.
- Accessibility. The system is available 24 / 7.
- No skills are required to order user defined printed products.
- Shorter lead-times.
- Less stock that becomes obsolete (Print on Demand).

## Conclusion

The presented PO Workflow in combination with the Product Layout Definition has sped up the process to order a repetitive print product. This is not only true for the end customer, but the printer also spends less time on order management as the whole print order is defined digitally. The time spent on quality issues and between activities have decreased. The conclusion drawn is that the PO System's automation will improve lead-times. We have also shown how the system makes ordering repetitive printed products to something anyone can do.

## Further research

In further research, we will create workflows for more unique products and with the possibility to make the system more flexible for different type of users and

products. There are however limitations in what can be done with sufficient response time on open networks, and what users want. Packaging and advertising (especially classifieds) are two interesting areas for the PO System.

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