Workflows Simulation Models as Tools for e-Learning of Graphic Production

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Experimenting with a graphic production workflow model motivates students in finding solutions for many situations linked with machine and material exploitation planning. By changing parameters that describe printing capacities and with printing procedure simulation one can get closer to making the best workflow decisions.

The software basis is the XML technology and relational databases. It is insisted that graphic display should be in SVG technology. There is possibility of reaching the program and database through the web system like e-Learning tool. The possibility has been given thereby to constantly test ideas in respect to possible graphic production solutions.

Before entering the area of experimenting and changing parameters describing graphic production processes, estimates and the offer are made, and the plan for linking workflows is carried out. Accent is on the thesis that any product may be made in many ways. Simulation is the basis for discussion on the quality of the graphic production proposed solutions. All programs have been created on basis of real tasks in respect to graphic production calculations in printing plants. The experimental student variant gives possibility to develop a great number of situations without fear that this will cause expenses and damage. Experiments with extreme ideas are allowed as the parameter for prohibited, impossible solutions.

Introduction

With printing procedure simulation one can get closer to making the best decisions for a set framework including the following: machinery, time standards, and material expenditures. Simulation programs are installed in the laboratory computers and are constantly available to students with possibility of reaching the program and database through the web system. Getting acquainted, learning and testing through computer support is a turning point in resolving tasks linked with the branch in question.

Simulation has been divided into several levels. Micro-models deal with details such as bottlenecks and stoppages of certain production plan parts. These models simulate dynamic production workflows which are observed as the area where there are many unknown factors subject to possible changes and tolerances.

The macro-level of the simulation depends on fixed standard values. Production is described in its entirety as a possible job order for the production of a book, newspaper, poster and many other graphic products. Certain courses cover planning simulation in their sphere of interest. Thus graphic prepress is specialized, printing as a separate whole, and also postpress work.

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Programs for simulation are constantly going through improvement by accepting the ideas that have come up during experimenting. All programs have been created on basis of real tasks in respect to graphic production calculations in printing plants. The experimental student variant gives possibility to develop a great number of situations without fear that this will cause expenses and damage. Experiments with extreme ideas are allowed as the parameter for prohibited, impossible solutions.

A relational database on graphic production machines, capacities, standards and sample solutions has been organized in Microsoft SQL Server 2005 with the possibility of data addition and individualizing. Data has been included on old and more recent machines, different manner of operation, as for instance the one including manual binding all the way to newspaper collectors.

Digital control of graphic production standards

The preliminary condition necessary to build a graphic production program model to be used for simulation experimenting is the existence of a database containing graphic process standards. Besides the database there must be a system for digital control of graphic process standards. Through such a system the experimenter can control certain graphic production models on basis of parameter standards. Three groups of standards have been made:

- graphic prepress standards,
- printing standards,
- postpress standards.

Each group of standards has separate tables in the relational database that can be accessed with the help of the corresponding XMLSchema. Contemporary relational database technologies together with XML based technologies allow setting of standards and their mutual relationships on a much higher standard of complexity than ever before. With the help of XMLSchema it has been made possible to determine various communication dictionaries with recorded standards in the relational database. Thus the standards and their relations become XML transactions as independent and self-describing data aggregate. The XMLSchema is also a software interface towards the relational database where the integrity of all data is kept as well as the XML transactions that have taken place.

Graphic prepress has not been processed to date in such a way as to have good-quality standards. The paper's authors have classified graphic prepress standards into six categories:

- graphic design,
- layout,
- scanning,
- CTP (imposition, processing, ripping),
- specific jobs,
- outsourcing

Specific jobs may be those linked with proof printing phases and job phases that are linked with communicating the job ordering party. Such communication is linked with making PDF files that are sent for proof before entering the imposition phase for which EPS is preferred or sending and receiving proofread textual forms before being incorporated into the ready stylized layouts.

Printing machine standards have been constantly developed dating from the period before graphic industry was transformed from craftsmanship into a real industry. Such standards have been classified into four groups:

- sheet printing,
- web printing,
- digital printing,
- other printing.

The basic printing machine standards consist of a certain machine printing unit number, determined make ready time, machine format and printing speed in various qualitative conditions, technical addition to printing runs for printing adjustments and similar. All standards must be subject to modifications. This applies especially to machine speeds that change depending on the jobs, but also on the machine consumption. Standard variables differ in respect to machines that print on sheets compared to web printing machines.

One of the most complex parts of graphic production is graphic postpress. Over a hundred different dependent and independent graphic postpress processes must have their standard parameters that are most often completely different as to number and type. Figure 1 shows the dynamic standard table for machine folding of sheets that is controlled digitally with as many as four keys for standardizing: sheet format, number of folds, paper and fold type.

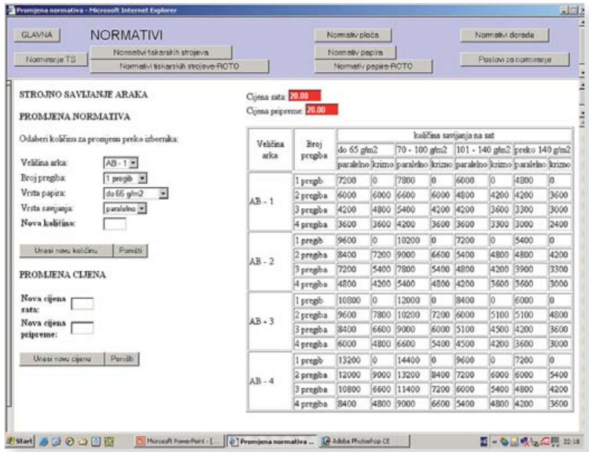

Figure 1: Machine sheet folding standards

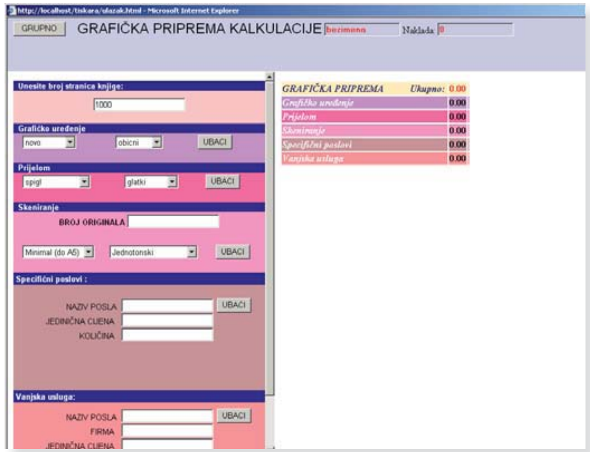

Figure 2: The system for building graphic prepress phase models

Graphic production modeling

Before entering any experimentation phase and modifying parameters that describe the graphic production processes, calculations are made and plans are developed for connecting workflow phases. Stress is on the thesis that each product may be made in many different ways. Simulation is the basis for discussions on quality of the graphic production proposed solutions.

Figure 2 shows the system for dynamic building of graphic prepress phase models that may be found in contemporary graphic production workflows using a built-up database of standards.

Graphic prepress modeling is based on knowledge coming from the following areas: scene and sample digitalization, color separation, text and image integration, offset plate direct and indirect production, production of bitmaps for digital printing, RIP function and digital file individualization.

Standards for graphic processes with the help of XML elements and attributes are described in the model. A system of equations and functions is incorporated that connect the variables between different graphic prepress phases. A Prepress model is built with the help of defined operations, process nodes and graphic prepress recourses.

The system for constructing printing phase models contains many parameters and an equation aggregate linking them. Simulation programs are in a constant development phase accepting ideas that have come up during experimenting. All programs have emerged from real tasks based on graphic product calculations in printing plants. An experimental study variant gives the opportunity to elaborate a great number of situations without fear of extra costs and damage. Experiments with extreme ideas are allowed as an indicator of prohibited, impossible solutions. It is also possible to analyze in this manner the virtual machine with n printing units, with various automation levels, with different make ready periods and printing working speeds.

Figure 3 shows a printing phase simulator for sheet printing. It contains four groups of simulation variables and parameters:

- experimental variables (machine type, paper type, offset plate type, printing run, required number of pages that are of a certain format, number of colors on the front and back pages)
- standard parameters (number of printing units, make ready time for the first and the following sheets, machine washing time, speed, machine format, paper weight, offset plate durability),
- executed control variables (standardized machine speed, number of pages on the sheet, number of sheet runs through the machine, the necessary number of different sheets, the required number of machine make readies, technical addition in total and per run, number of required offset plates)
- variables as a result of simulation (quantity and paper cost, quantity and plate cost, quantity and ink cost, required time and machine make ready cost, required time and printing machine work cost, overall time and overall printing phase cost)

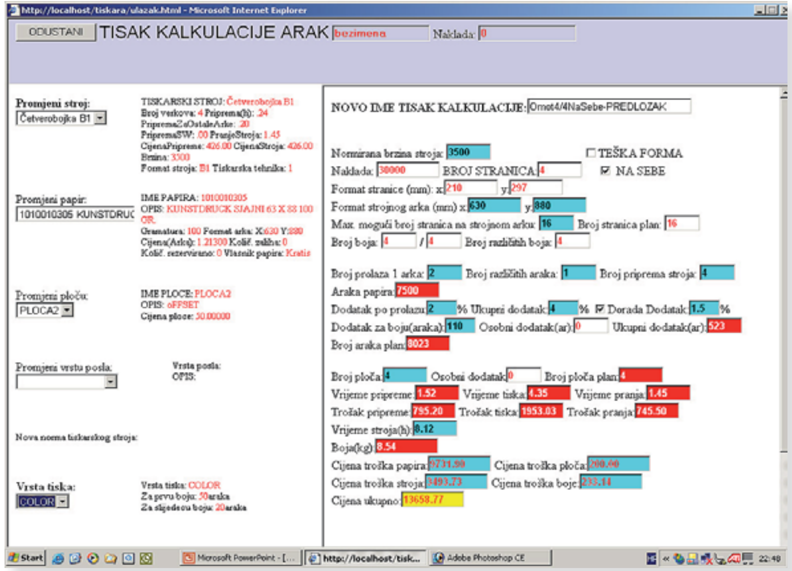

Figure 3: Printing phase simulator for sheet printing

Work with such a simulator enables learning of interlinked dependencies between all printing parameters on one hand and also studying machine utilization for various printing machines. As a result of experimental work with a simulating model figure 4 shows sub-chain productivity – press for a concrete problem coming from practical production. The task was to determine the optimum use of two web press machines: the independent Lithoman, the independent Polyman and the hybrid use of both machines. It is easy to get information from the graph as to which printing runs it is best to use those two machines.

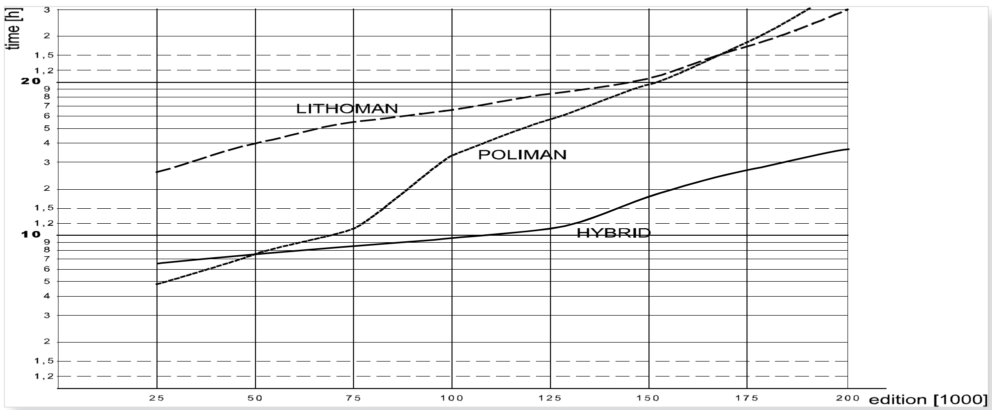

Figure 4: Subchain productivity - press

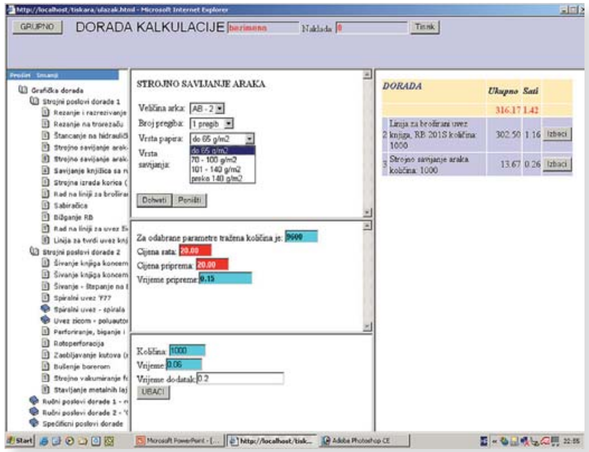

Figure 5: System for building graphic postpress phase models

Figure 5 shows the system for building graphic postpress phase models. Each operation in graphic postpress has parameters for standards that are in many cases different from operation to operation.

The display standard level is provided, as well as the factorization of the calculated quantities for all modeling types. The calculated time is displayed with the possibility of extension and comments made by the user. This is essential for improving standards in case the entered ones are at a certain moment inadequate for a possible situation that has sprung up, including the goal to have the possibility for later standards alterations in the database to be applied for future models. Complex graphic postpress activities may consist of several dozens phase types. The model works for any eventual phase insertion.

It is possible to edit each phase separately through return references to the module for input of the wanted quantity and calculator module. The phase integrator is the XSLT module started by the occasion when a new phase appears as a trigger of the model re-calculator. Triggering and starting of the XSLT processor is carried out with the help of XMLDOM technology.

Conclusion

In order to be able to construct printing workflow models we must have knowledge on the existing printing works resources and the manner and type of business operations that take place there. Such knowledge contains stochastic and function data for constructing models based on the state of matters found on basis of which the desired simulation model will be derived. The data is gathered on basis of recording, measurements and questionnaires. Each printing works already has its well established workflows for producing its standard products, but not in the form of digital models. In order to turn such workflows into digital models, the knowledge and experience must be described digitally and archived. After such a system has been created, the existing knowledge is incorporated into the database as well as the measurements that had been made on basis of real production processes and they are the basis for building workflow models of good quality.

A relational database on graphic production machines, capacities, standards and sample solutions has been organized in Microsoft SQL Server 2005 with the possibility of data addition and individualizing. Data has been included on old and more recent machines, different manner of operation, as for instance the one including manual binding all the way to newspaper collectors.

In this research graphic production models are basis for web e-Learning tools. The experimental student variant gives possibility to develop a great number of situations without fear that this will cause expenses and damage. The possibility has been given thereby to constantly test ideas in respect to possible graphic production solutions. Experiments with extreme ideas are allowed as the parameter for prohibited or impossible solutions.

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