Automation and JDF workflows

Dr. Mark Bohan, Brandon Iskey, Rick Wagner and Greg Radencic

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Abstract

Computer Integrated Manufacturing (CIM) is becoming increasingly important and forms a central pillar within print production workflows. Each process throughout the production workflow is having automated systems introduced that are either software or machine driven. This may include features such as automated imposition or servo motors to help machine set up. These are creating very effective individual systems with high production rates. The underlying feature with new product development is improvement of throughput as a result of the systems, and has been the focus of previous TAGA papers [1]. The connectivity between these different systems is critical to ensure effective implementation and ensure that we do not have the so called *"islands of automation"*. To achieve this connectivity one of the main methods being implemented is a JDF enabled workflow. The purpose of this paper is to investigate the effectiveness of an automated system within the bindery to transfer data between different devices and impact the productivity. There will also be a discussion of the product tracking with the systems.

The paper describes an experimental investigation to quantify the time savings that can be made with both automated systems and JDF connectivity in the bindery. In many cases the automation and JDF connectivity are added at the same time and it is difficult to separate the benefits from the two upgrades. This project has focused on the savings that can be made with the following machines in the bindery:

- Cutter
- Stitcher

The benefits of such systems that are implemented will depend very much on the individual workflow of different production facilities. This has been simulated

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by using different jobs within the production environment and evaluating the time savings of these different production jobs.

The production jobs put through the systems include a diverse range from simple setups to complex situations that require significant planning and testing to get the product produced correctly.

For each of the systems evaluated, three jobs have been created to cover the different complexity scenarios. These have been generated with full JDF job compatibility and could be run on JDF enabled systems. The set up time for the following system configurations were measured for each of the jobs

- Traditional manual set up
- Automated system (this may include presets in certain instances)
- JDF enabled and automated system

The time saving from automation and JDF are quantified under the different production scenarios for the complexity of jobs. This shows that the benefits gained are a combination of the automation and JDF, the increased complexity of the job provides greater benefit of the JDF enabled system. This is combined with benchmarking information on job throughput to provide the projected savings for different production environments.

Introduction

Modern bindery equipment is becoming increasing automated with the objective of creating a more efficient and streamlined workflow. The automation has the aim of minimizing the cycle times between different production jobs and where possible reducing the level of operators required for each of the production steps. Much of the work has been on the mechanics of automation, with the focus in recent years in automating, in an common and open manner, the transfer of information within a print workflow, through the use of the JDF specification.

JDF enabled workflows are increasingly common in production environments and there is a significant discussion on the savings that can be achieved by implementing these solutions. The majority of this discussion will analyze the transition to a new workflow and equipment, where there are savings to be made in both the JDF functionality and also from the automation on the equipment. The purpose of this paper is to quantify the impact of these factors in the bindery, specifically on the cutter and the stitcher.

Little has changed with the inherent design of cutters over the past fifteen years. They have been programmable, though the interface efficiencies have increased over this period. The majority of the improvements in the cutting department have been related to the ancillaries such as automated lifts, automatic jogging of the sheets, stackers for storing the prints and automatic trim removal during the cutting process. The analysis in the cutting department for this paper has compared the use of a modern programmable cutter using either the programmable interface or the JDF cutting information.

The modern stitcher has undergone significant change over the past decade in terms of automation. These traditionally were labor intensive machines where the majority of the adjustments were carried out by the operator. In recent years servo motors have been introduced to automate many of the functions, such as changing the size of the pockets. These machines have increased in complexity and a computer interface has been added to drive all the servo motors. Many of these can now be automatically set and thereby reduce the setup times required. For the purposes of the paper, the setup times from a manual stitcher have been compared to a modern automated stitcher using either the programmable interface or the JDF cutting information.

Experimental procedure

The experimental procedure was designed to follow several different jobs through the different workflows that would be present dependent on the amount of automation available on either the cutter or folder. Real jobs were produced for the project and these varied in complexity to simulate different working environments. The procedure for the cutter will be discussed initially, this will be followed by that on the stitcher.

In the analysis of the cutter and stitcher times the sequence of jobs from design was followed, for the purposes of this paper the times from the cutting section of the work are reported, although there were time savings in the pre-press department. The jobs were created in design with the job planning section being carried out in Creo Upfront, and LithoTechnics Metrix. These are planning applications and the JDF data with respect to the cutting patterns were generated at this point as well as the data to set up the stitcher. These templates were exported to an imposition package for the contents to be placed in the job. The plates were then produced and the three different jobs were printed. They were passed to the bindery where they either passed through the cutter or stitcher.

The cutter workflow varied dependent on whether the JDF presetting data was used, a schematic of the two workflows is shown in Figure 1. In the programmable workflow the job to be cut is initially ruled out to indicate all the cut lines. These lines are then marked in sequence to indicate the cut order. Following this, the sheets are transferred to the cutter and the cuts are programmed into the cutter in sequence. This is achieved by manually positioning for each cut, carrying it out and then programming the coordinates. The cut program is then checked and the cutting can begin. In the JDF workflow the data from the planning is imported directly into the cutter, the cut program is then checked and the cutting can begin.

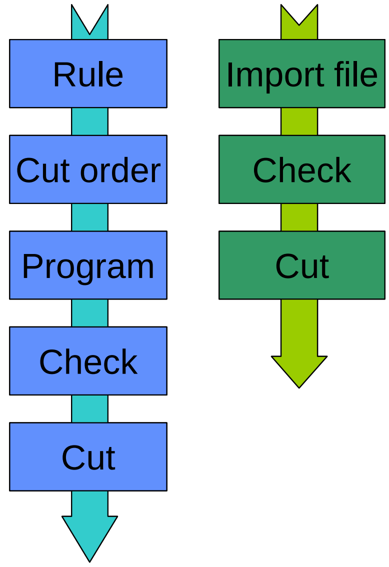

Figure 1: Cut sequence for programmable and JDF workflows

Three different jobs were created for the evaluation of the cutter, these varied in complexity to represent different jobs that would typically be produced in production environment. These vary in the number of cuts and are summarized below:

- Poster: This is a 4 cut job, with the outside edges of the sheet being trimmed.
- Covers: This is a 12 cut job, with the covers for a publication being ganged into a single print run. The trim boxes for the job are shown in Figure 2.
- Labels: This is a 51 cut job, with different labels being ganged into a single print run. For this example standard images were used for the labels and the trim boxes for the job are shown in Figure 2. This job layout was optimized to minimize paper usage dependent on the total number of labels required and the sheet size being used.

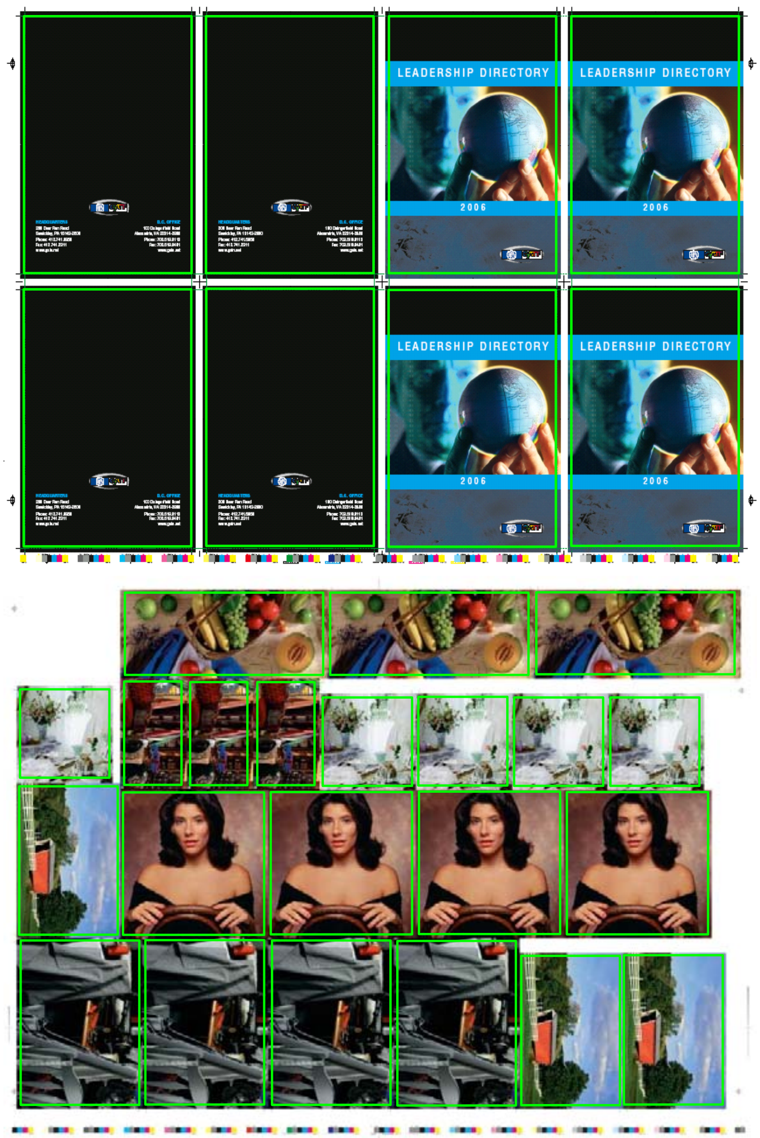

Figure 2: Cover (12 cut) and label (51 cut) print jobs

The analysis of stitching times was achieved by setting up the stitcher to produce different jobs and assessing the time for changes between each production job. The sequence of jobs included both full and half size products and a baseline was initially created on the machine to ensure that a true comparison of set up times could be achieved. The same sequence was used for the programmable and the JDF workflows and it is shown below:

- Four pockets, full size. This was used as the baseline to ensure that the stitcher was set up consistently prior to the start of the investigation.
- Three pockets, half size.
- Three pockets, full size.
- Two pockets, half size.

There was significant automation (servo motors) on the stitcher, though there were steps that have to be carried out with the actions of the operator. The machine set up sequence used for the job is shown in Table 1. This shows the set up for the programmable workflow, steps 5 to 7 (highlighted) would be removed in a JDF enabled workflow.

Step 1: Start
Step 2: Turn off/on pockets
Step 3: Start Program-Lower Knives
Step 4: Take Out Old Job
Step 5: Create new Job
Step 6: Select/Set Pockets
Step 7: Final Trim Size
Step 8: Calculate
Step 9: Load Job
Step 10: Stop all Movement
Step 11: Check Book Thickness
Step 12: Set Obliques
Step 13: Set Sheet Detectors
Step 14: Move Staple
Step 15: Check Pockets

Table 1: Steps required setting up stitcher

Results and discussion

The results will discuss initially the evaluation of the different production jobs on the cutter, and this will be followed by a discussion of those obtained from the stitcher.

The times taken for each of the production steps for the three cutting jobs described earlier were recorded. An experienced cutter operator was used for the investigation and each of the steps were repeated at least three times and the average data obtained is use for the analysis of the times and the impact of the JDF enabled workflows.

The rule out and mark up times were collected for the poster (4 cut), cover (12 cut) and label (51 cut) production jobs. The time taken to move between the different work areas for mark up and cutting has not been included in the analysis. Using the JDF data resulted in small time savings, with the poster taking under one minute to complete, while the cover took approximately three minutes. The label job took longer, with the ruling taking approximately 6½ minutes, with an additional 5 minutes to work out the cut sequence.

The results obtained from the poster (4 cut) and cover (12 cut), Figure 3, production jobs produced similar results, though the times were different. The programming of the cutter took longer than the cutting in both cases, for the twelve cut poster this step took approximately 6½ minutes, a step that was eliminated in the JDF enabled workflow. The time to cut the jobs was similar, with no significant difference between using either the program created or the JDF data. These were repetitive cutting jobs and had little complexity.

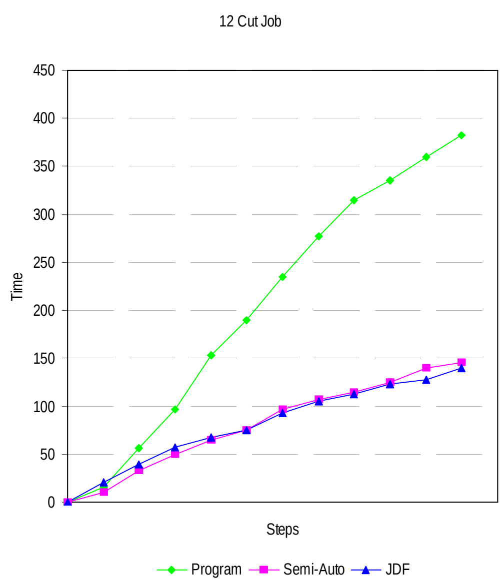

Figure 3: Time required cutting cover print job (12 cut)

The results obtained from the label (51 cut), Figure 4, production job showed significant differences between the production approaches. The complexity of the job resulted in an extremely long programming stage, taking almost 45 minutes. Again, in the JDF enabled workflow this step was eliminated. Importantly, the complexity of the cutting sequence that was required with this job resulted in several errors being introduced in the programming stage. These were identified during the checking section of the cut sequence, Figure 1. However, due to the complexity it was unclear where the errors had been introduced and the program was re-entered. This has not been included in the timings quoted in the study. In addition to the programming time savings the time required for cutting was also reduced by approximately 35% using the JDF data. This was due to a graphical interface that showed the cut sequence on the cutter and how each of the stacks should be positioned. This feature reduced the amount of cut errors by not requiring the operator to remember the 51 cut sequence and it de-skilled the operation.

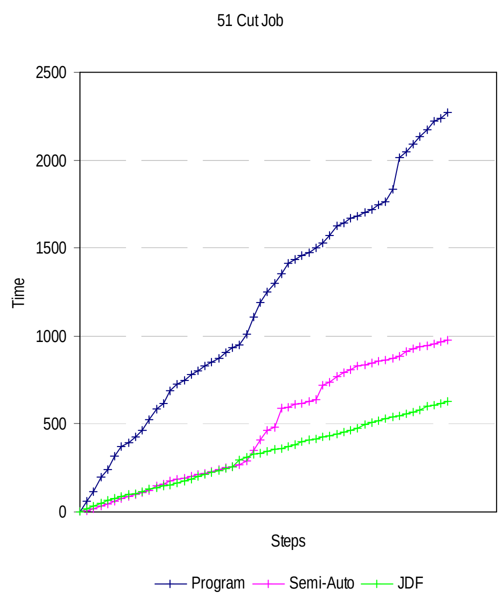

Figure 4: Time required cutting label print job (51 cut)

The total time for the ruling, marking and programming are all eliminated by the transfer of the JDF cutting data. The benefits of transferring the JDF cutting data depend on the complexity of the individual cut jobs and run lengths, the benefits are greater the shorter the run length. For complex label applications there are significant advantages to be gained by passing the JDF cutting data, there were also significant savings to be made in the pre-press department with the transfer of templates.

The set up of the jobs on a manual stitcher was carried out at a commercial operation and varied between 42 and 45 minutes, dependent on the number of pockets that needed to altered.

The same production jobs were taken through a programmable JDF enabled stitcher, with each of the steps outlined in Table 1 being recorded. The times taken with the automated programming and JDF data transfer approaches are shown in Figure 5 for setting up the three half size pockets. The initial steps show the same times as the steps are identical, regardless of the approach being utilized. During the programming stages, steps 5 to 7, there are time savings using the JDF stitcher data, during these steps the timelines deviate. There are similar requirements for the remainder of the setup and the timelines are approximately parallel. The total time required for either of the setups is significantly less than that required for the manual setup of a stitcher.

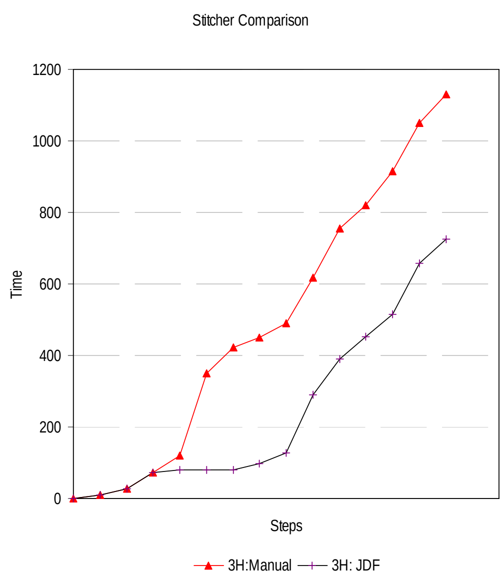

Figure 5: Comparison of stitcher times for three half pockets

The data for all three setups configurations is shown in Figure 6. These show similar trends to those observed with the three half size pockets. The reduction in time is generated primarily during the programming stages. The times are greatly reduced when compared to the manual setup of the stitcher, with the times reducing from an average of 43 minutes to 18 minutes using the programming on the stitcher. This time saving is a direct result of automation on the stitcher and is not related to the transfer of JDF data. The times can be reduced further using the JDF data, with an average setup time of 11 minutes. It is not possible to fully utilize the JDF data without the automation. From a practical perspective, the use of automation and the transfer of JDF data allows the production facility to easily transfer between jobs and facilitates the interruption of a long job with a rush order.

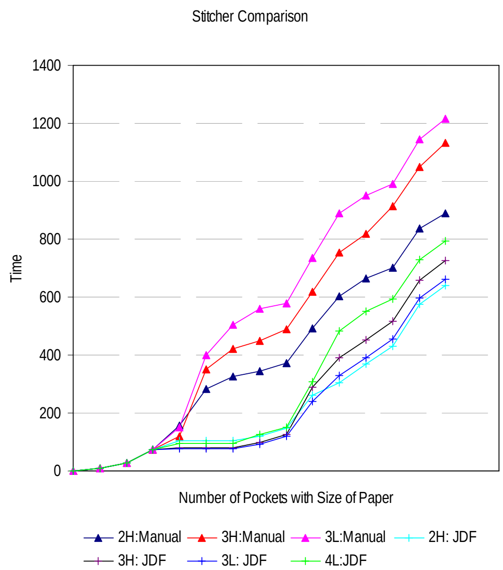

Figure 6: Comparison of stitcher times for all jobs

Conclusions

A series of print production jobs have been successfully used to quantify the impact of automation and JDF workflows in the bindery, specifically on the cutter and stitcher.

The results from the cutter have shown time savings can be generated for simple cutting jobs is obtained primarily in the programming step being eliminated; there is little difference in the cutting times for these jobs. The complex label job showed significant savings could be achieved in addition to eliminating the programming step, which in this case took approximately 45 minutes. The time savings on the production job was approximately 35%. In addition, the use of the JDF data improved the accuracy of the cutting by minimizing production errors and de-skilled the operators job.

The results from the stitcher showed a significant impact of automation with an average time reduction from 43 minutes to 18 minutes as a direct result of using a stitcher with the automation to increase the set up times. This could be further increased by the implementation of a JDF enabled workflow to an average set up time of 11 minutes.

References

1. MacPhee, J. “Presses – Past, present and Future”, 50th TAGA Conference, 1998.