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RAPID PRINT MODE FOR IMPROVING DIGITAL PRINTING PRESS PRODUCTIVITY

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Rapid Print Mode for improving digital printing press productivity

Abstract

Digital printing sessions consist of three sequential phases: pre-print, actual printing, and post-print. When the post-print ends, printing presses go to a lower machine state. It is common for most print-end-to-print-start intents in digital printing short runs to be shorter than the overhead of the combined post-print and pre-print duration. In other words, the combined post-print, short break and pre-print durations are on the critical path for maximizing productivity and throughput. Here, a method is described for keeping digital printing presses in a state that allows significantly faster return to print. Basically, it is achieved by reducing the print-end-to-print-start duration. Not only does this significantly improve productivity and throughput, it also dramatically reduces consumable failures.

Introduction

Printing sessions are always sequentially constructed from a pre-print sequence, actual printing, and a post-print sequence. During pre-print digital press subcomponents are prepared for printing. During post-print, subcomponents are switched off one after the other in an orderly manner. A printing session is defined as consisting of one to multiple adjacent print jobs without interrupts.

When analyzing digital printing data, pre-print and post-print sequences compose of an average overhead of 20-30% to the actual printing time.

There are basically two settings for operating printing job queues. One setting specifies how jobs are processed from the print queue – either individually (step mode) or continuously (continuous mode). A second setting defines the digital press operation after a queue item completes. Digital presses will either immediately transition to a lower press state (suspend mode) or maintain subcomponent settings such that printing can be resumed as fast as possible (Pause mode). Any option of the first setting can be combined with any option of the second setting, leading to four possible combinations.

Possible scenarios are illustrated with a print queue holding three jobs:
   (a) Step & Suspend   the press will print 1 job from the queue and stop rotating upon finish.
   (b) Step & Pause   the press will print 1 job from the queue and keep rotating upon finish.
   (c) Continuous & Suspend the press will print all 3 jobs in the queue and stop rotating upon finish.
   (d) Continuous & Pause   the press will print all 3 jobs in the queue and keep rotating upon finish.

For practical reasons Pause mode has a timeout, typically on the order of 5 minutes. After the timeout, digital presses transition to a lower press state.

To maximize digital printing press operator control (and minimize workflow complexity) press vendors often choose (a) as default setting.

However, usually print queues contain several jobs. In that case, maximal productivity is obtained by using an option like (d): continuous printing while maintaining digital presses close to printing conditions when the queue empties.

Description

In post-print, heating is being turned off, voltages are switched off, print cylinders disengage, fluid flows are stopped, motors spin down, etc. It is common practice to bundle sequences of post-print subcomponent deactivations into distinct sequential post-print sub-phases. Before a phase can start, a previous phase must terminate.

Normally, a printing session ends, then post-print takes place and when completed digital presses transition to a lower state. Any next print session starts with a pre-print sequence before ink is put on media. Pre-print, in a similar manner, sequentially readies subcomponents for printing.

In digital printing, post-print and pre-print typically require about ~15s and ~35s, respectively.

Analyzing worldwide digital printing sessions, the authors find that the average time after post-print (i.e from the beginning of the lower state) to the start of initiating a subsequent print request behaves as displayed in the Fig. 1. The graph illustrates the average time between subsequent print sessions from all presses in the installed base. As can be seen, >50% of subsequent print sessions are activated within 1 min after previous printing ends.
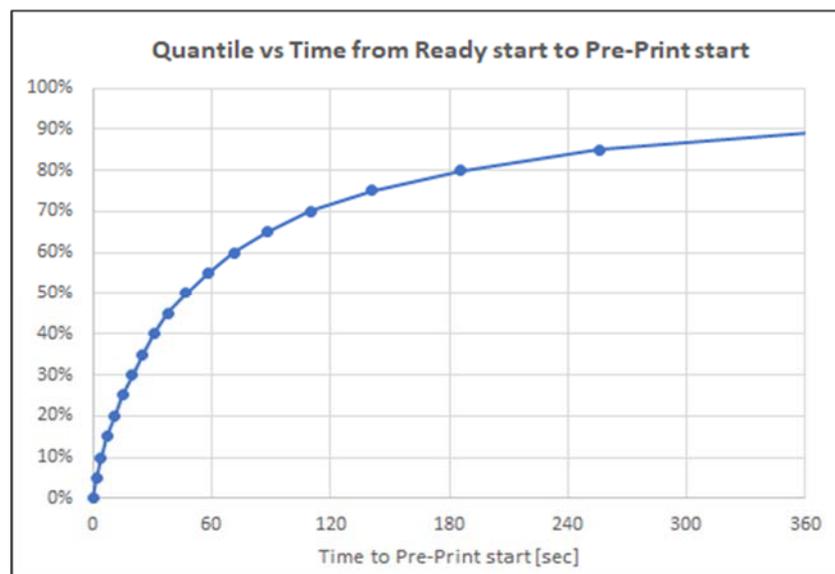

Figure 1: Time distribution for all jobs in a digital press installed base from the beginning of a lower state to Print initiation. About 50% of printed jobs are initiated within ~50s.

With the default setting (a), after printing ends at least 50s are required until printing restarts (15s for post-print + 35s for pre-print). Note, that the 50s minimum time only occurs if operators immediately initiate next prints.

Basically, the Pause mode keeps digital press subcomponents in states as close as possible to their printing conditions. In certain cases, this mode is automatically activated. Such cases are, for example, when presses sense that media or inks are about to run out. Some customers select operating in the Pause mode, i.e. options (b) or (d). This mode enables shortest back-to-print time.

Figure 2 illustrates the benefit of changing the default to an option like (d). The time-limited Pause mode is activated when print sessions end. If a next printing is requested before the Pause timeout, printing will resume typically within ~10s. Alternatively, when the Pause mode timeout is exceeded, the press transitions to a shortened, different post-print sequence before transitioning to a lower state.
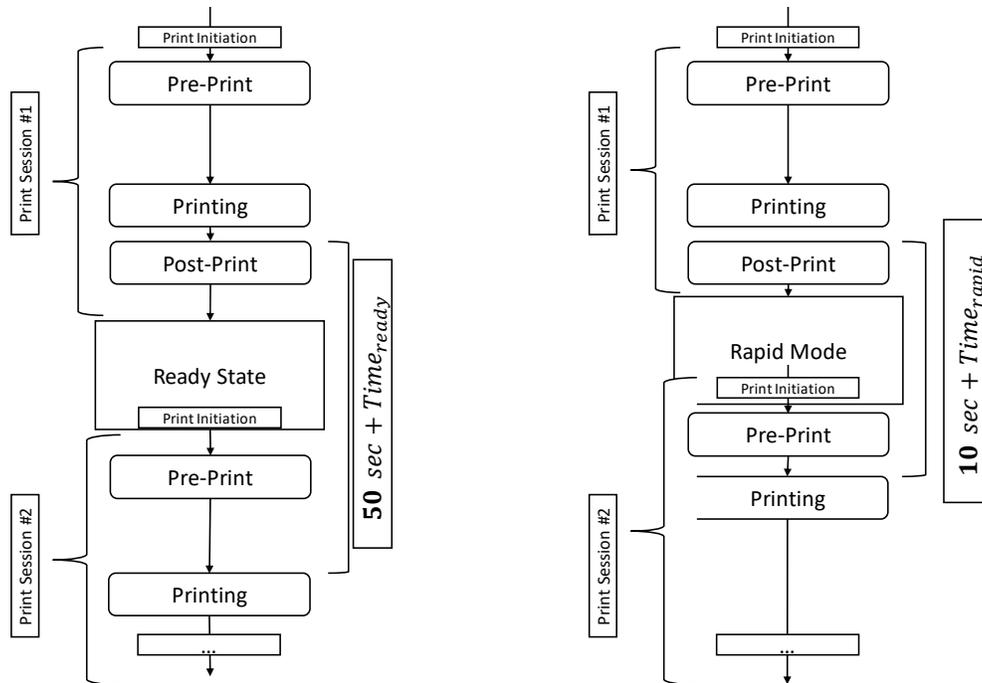
Figure 2: Left panel: flow chart showing the breakdown of two adjacent print sessions. The minimum print-to-print time is ~50s. Right panel (invention): flow chart showing the breakdown of two adjacent print sessions with a short print-to-print time of ~10s.

The Rapid Print Mode sequence can be the same or different from the Pause mode sequence existing today in many digital presses. Such differences are, for example, settings of subcomponent parameters optimized according to customer-selected or press learned timeout durations.

To further accommodate the frequent short times between an ending of a print session and the start of a subsequent print session, it is beneficial to enable the print button on the user interface even when digital presses are in a post-print sequence. Such buffering of the print activation increases likelihood that the time between adjacent sessions is further minimized.

In the Rapid Print Mode, most print jobs will experience faster job delivery (see Fig. 1). In other words, for ~50% of the jobs, the time from pressing the print button till sheet delivery to a stacker will be shortened. Referring to a typical digital press installed base, daily net printing time will increase by ~7%. Furthermore, the Rapid Print Mode also reduces the amount of stop-start sequences. Such transitions have a high hazard rate for damaging digital press consumables. Therefore, reducing the amount of stop-start transitions further improves productivity by minimizing the need to replace consumables.

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