KEYPOINT INTELLIGENCE

SERVICE AREA:

Business Development Strategies

ANALYSIS

ARTIFICIAL INTELLIGENCE IN THE PRINTING INDUSTRY

APPLYING AI TO PRODUCTION AUTOMATION

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contents

Table of Contents

Introduction 2
Artificial Intelligence: An Overview 2
Current AI Applications in Production Printing 4
- Tilia Labs 4
- Topaz Labs 4
- Ricoh Pro Scanner 5

Potential AI Applications in Production Printing 5
- Workflow Automation 5
- Error Correction 5
- Job Onboarding 5
- Productivity Analysis 6
- Preventative Maintenance 6
- Planning and Scheduling 6
- Robotics 6
- Direct Marketing 7
- MIS and ERP 7

The Bottom Line: Advice to Printers and Vendors 7

Introduction

Artificial Intelligence (AI) is perhaps one of the greatest buzzwords of all time. This high-tech term is bantered about endlessly in the media, and you can't help but imagine cyborgs and self-driving cars when you hear it. Even so, AI isn't science fiction and it's much more than a buzzword—it is currently available technology that is poised to transform our world, including printing, in the coming decade. Despite its popularity, the term "Artificial Intelligence" is often misused. This document explores what AI is (and isn't), provides examples of where it is being used in the print industry today, highlights potential application areas, and offers suggestions for software vendors that are considering it.

Artificial Intelligence: An Overview

The concept of AI has been around for a long time, and not just in science fiction movies. In fact, AI was first discussed in an academic setting during The Dartmouth Summer Research Project in 1956. Of course, we didn't have the computational power, storage capacity, or interconnectivity necessary to realize its potential back then. By the 1980s, however, our computers were powerful enough to support early forms of AI called expert systems. Then, in 1997, IBM's Deep Blue chess-playing AI beat Grandmaster chess champion Gary Kasparov at his own game. This involved a supercomputer in 1997, but that is no longer required given how our computational infrastructure has advanced over the past quarter-century. Cloud servers now have the power and capacity to apply this technology to a wide range of areas, including weather prediction, virus analysis, or asking questions of your phone's voice assistant.

All this being said, what is AI, and how does it differ from traditional programming? Most AI definitions are less than helpful:

- According to Oxford Languages, AI is "the theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages."
- According to Merriam Webster, AI is "an area of computer science that deals with giving machines the ability to seem like they have human intelligence."

Isn't there a fundamental rule not to use part of a phrase (in this case, intelligence) when defining that phrase (Artificial Intelligence)? So the question then becomes, what is intelligence? Merriam Webster defines Intelligence as "the ability to learn or understand or to deal with new or trying situations, or the ability to apply knowledge to manipulate one's environment or to think abstractly as measured by objective criteria (such as tests)."

By combining the offerings above, I was able to produce what I think is a much more useful definition of the AI term:

> **Artificial Intelligence is the theory and development of computer systems to learn, understand, and deal with new situations.**
>
> ***— Greg Cholmondeley, Keypoint Intelligence***

This simple definition highlights the difference between AI systems and traditional software programs: AI can deal with new situations whereas traditional software only handles the cases it is programmed to perform. Consider automating a prepress workflow using traditional techniques:

1. You could link together strings of prepress functions into unique workflows. Prepress operators would drop jobs into hot folders for each. This automates prepress, but requires separate workflows for each situation and operator involvement to select the proper workflow.
2. You could write software to inspect job tickets and document files and use if/then/else decision trees to process jobs. This reduces operator decision-making but would become quite complex if forced to handle every situation. Also, these programs dump anything that is not recognized into manual handling folders.
3. Advanced systems like Xerox FreeFlow use rules-based programming with reusable subroutines and modules to dramatically reduce the amount of coding. Still, this requires specific coding of every possibility based on the jobs and characteristics of each unique installation.

By comparison, an AI solution would begin with a core set of capabilities that grows as it learns the types of jobs and how you handle them in your shop. You teach the software to handle work rather than program it. This is like hiring a knowledgeable prepress operator and training them to work in your shop.

Some of the notable differences between traditional programming and AI programming are:

- Traditional programming only does what it is told to do. AI excels at pattern recognition and learns by correction. Thus, rules-based programming is limited but precise, while AI can handle much broader capabilities but can (and will) make mistakes in new situations. AI learns from its mistakes, just like people do.

- Traditional programming rapidly grows in programming size and complexity as the environmental complexity increases. Thus, it works well for applications with limited and well-defined possibilities. AI is designed to handle new and unexpected situations and more real-world applications where anything can happen.

Current AI Applications in Production Printing

While AI is gaining footholds in numerous segments, it's still in its infancy in production printing. That will change in the coming decade, but some vendors are already exploring the AI space.

Tilia Labs

Tilia Labs' products are built on AI from the ground up. The system creates a digital twin of the entire factory that includes printing, post-press, die-making, and ad hoc processes. The AI uses this data describing the types and quantities of presses and finishers, their capabilities, and the media each supports to build models of how jobs can be produced. A brute-force approach to this problem would be impossibly complex for job mixes that can contain narrow format documents, rectangular and irregularly shaped labels and signage, and three-dimensional folding carton jobs.

Tilia Labs' system starts with offline learning to narrow the search possibilities based on job attributes. Its AI element then uses online learning to determine the best ways to imposition, gang, and batch those incoming jobs. The result is that, rather than relying upon a static template library, this AI-based system generates custom templates for repeat jobs, new jobs, and new combinations of jobs on the fly to get work out efficiently and on time. In addition, while customers typically use this AI solution for impositioning, the shop modeling and AI engine is a dynamic and configurable system integrated with shipping that could be used more broadly for planning and scheduling.

Topaz Labs

Topaz Labs isn't precisely in the production printing space, but some printers and graphic artists do use it. The firm provides products for sharpening, denoising, and sharpening images and video. Printers regularly receive poor-quality or low-resolution images, so operators employ various filters and deconvolution plugins to manually sharpen images, minimize noise, and scale images. Selecting and applying these tools requires highly skilled staff yet often produces unsatisfactory results. The engineers at Topaz Labs trained an Artificial Neural Network with millions of blur-sharp image pairs to teach it how blurry or noisy images should appear when cleaned and sharpened. The AI system applies this understanding to new images to reconstruct the original image. The process isn't perfect (operators still need to use the appropriate tool and settings for each situation), but the process is greatly simplified and the results can be stunning. I could envision automated

preflighting software incorporating functionality like this to enhance most low-resolution images without requesting new images from clients.

Ricoh Pro Scanner

The RICOH Pro Scanner Option, available for RICOH Pro VC60000 and standard on the RICOH Pro VC70000 continuous-feed inkjet platforms, incorporates AI and Machine Learning (ML). The system uses continuous real-time feedback to constantly learn and improve performance through analyzing digital data as well as the physical print samples. This capability enables print devices to automate common operator tasks, self-assess and make decisions about tasks like printhead cleaning, jet-out detection, ink density verification, and registration without operator intervention. Its optional intelligent pattern recognition capabilities can automatically check printed results against submitted files to identify, flag, and sometimes automatically correct issues. If desired, the printing process can be restarted unattended.

Potential AI Applications in Production Printing

The print production automation space is ripe with opportunities for leveraging AI. Here are a few thoughts:

Workflow Automation

Complexity and setup are some of the biggest hindrances to the adoption of workflow automation. These systems can be labor-intensive when implementing and customizing to the unique operational needs of each commercial printer, in-plant, or converter. These systems can also require significant reprogramming and enhancements when new accounts, jobs, services, or equipment are added. AI is a perfect companion for this type of application in that it can learn and adapt to a shop's unique capabilities, jobs, and work processes instead of requiring explicit programming.

Error Correction

Printers and in-plants will increasingly use AI systems to identify and correct low-resolution images, jet-outs, and other challenges. Commercial printers and in-plants will use AI to flag unexpected job ticketing issues such as unlikely quantities or plexing compared to similar or historical customer jobs. Color management systems will learn how frequently various presses require color quality verification and recalibration. These decisions will likely be based upon historical calibration data as well as learning the types of color-critical jobs a shop prefers to calibrate before running.

Job Onboarding

Getting orders and job resources into a digital workflow is an essential first step in production automation. Even so, customers don't use web-to-print and e-commerce solutions as much as most would like. e-Commerce is, however, one of the fastest-growing

AI applications, and it has applicability in commercial printing. AI bots could process e-mail submissions from customers who prefer that submission method. Imagine an AI bot parsing an e-mail, creating a ticket based upon its contents and prior customer history, and sending an order confirmation e-mail back to the customer with a fully specified ticket and a link to a proof file for approval. All the customer would need to do would be to tweak any misunderstandings and approve the job. Or imagine an AI answering the phone, recognizing the customer's phone number, and saying, "Good morning, Jeff. I see that you have three jobs in our system. Do you want to know their status, or would you like to place a new order?" The AI-powered assistant could then use Natural Language Processing to take their order. Such an AI phone bot might seem overkill for most shops, but it could reduce hold times and CSR staffing requirements for shops with customers who prefer to place orders verbally.

Productivity Analysis

AI has a massive opportunity in analyzing productivity, identifying issues, and suggesting areas to investigate or improve. Existing productivity and business intelligence solutions are already compiling and uploading vast amounts of printer data to the cloud. They offer customizable web dashboards to visualize volumes, productivity, and other metrics. While these can indicate opportunities for improvement, unearthing the root causes often involves extensive business understanding and lengthy investigation. AI systems excel at pattern recognition. AI productivity analysis systems could look at this big data to identify underperforming shifts, locations, or devices. It could learn the best practices of high performers and make improvement suggestions. And this isn't just about labor—such AI systems could quickly identify bottlenecks anywhere in the workflow.

Preventative Maintenance

AI systems can leverage the same data captured and used for productivity analysis to predict maintenance issues. Maybe a press is starting to experience more jams than usual or requires increasingly frequent recalibration. AI could learn from data gleaned within a print shop or from anonymized data captured across the marketplace to predict issues and suggest preventative maintenance.

Planning and Scheduling

Planning and scheduling systems are becoming incredibly complex. Future planning solutions will use AI to simplify this process.

Robotics

Robotics can reduce unskilled labor costs, improve productivity, and reduce personal safety issues in situations where heavy lifting is required. Unloading printers and moving printed output to the correct bindery or staging area could significantly impact

productivity while eliminating the least desirable part of running a press. AI will be a necessary component of making a robotic system of this type work.

Direct Marketing

Although many print service providers (PSPs) also offer marketing services, most find it challenging to set up campaigns, perform A/B testing, learn from past successes and failures, and apply that learning to new campaigns. Few PSPs complete all these steps, and many personalized direct marketing campaigns are therefore not as effective as they could be. AI systems linked to campaign management systems and response measurements will assist in fine-tuning direct marketing campaigns.

MIS and ERP

MIS and ERP systems contain vast amounts of data that AI systems will use to retain customers, identify pricing or production issues, and make recommendations to improve business results.

opinion

The Bottom Line: Advice to Printers and Vendors

The key message is that while mainstream AI developers might not be specifically focusing on our industry, AI is coming to print production automation. Production printing has many areas that are well-suited for AI systems. Most of them are not as complex as applications like self-driving cars, fraud protection, personalized shopping, or healthcare advice. If you're a vendor in this space, begin investigating how your offerings could benefit from AI, and consider acquiring AI experts because they have a very different skill set than traditional programmers. If you're a print provider, start automating your systems and collecting your printer and MIS data. AI solutions require automated systems and data to work. Transitioning from a fully manual operation to an AI-automated one will be more complicated than simply adding intelligence to your automation.

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Comments or Questions?