Quo Vadis, Print Industry?

Perspectives for workflow automation and AI: Smart printing production

Dr. Rainer Prosi, CTO CIP4
Industrie 4.0 – more than Buzzword?

Industrie 1.0

Print 1.0
Industrie 4.0 – more than Buzzword?

Industrie 2.0  
Print 2.0
Industrie 4.0 – more than Buzzword?

Industrie 3.0                      Print 3.0
Industrie 4.0 – more than Buzzword?

Industrie 4.0

Print 4.0
Article 3 – CIP4 Bylaws

The purpose of the association is to encourage computer based integration of all processes that have to be considered in the graphic arts industry, in particular the specification of standards.


The fourth industrial revolution: Towards intelligent and flexible production

The technological foundation is provided by intelligent, digitally networked systems that will make largely self-managing production processes possible:

All interface standards are created equal? Some standards are more equal than others!

<table>
<thead>
<tr>
<th>Example</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASCII, UTF-8, EBCDIC</td>
<td>Character encoding – representation in bits and bytes</td>
</tr>
<tr>
<td>TCP/IP, FTP, HTTP, MQTT, Dateisystem</td>
<td>Data transfer – network transfer of blobs of data</td>
</tr>
<tr>
<td>CSV, XML, JSON, REST:API</td>
<td>Data structure – How are keys and values structured. NO Data Model (!) Grammar (Language with rules but no words)</td>
</tr>
<tr>
<td>HTML, EMail</td>
<td>Open data structure – Few loosely defined keywords. Structure optimized for displaying to a human reader.</td>
</tr>
<tr>
<td>XJDF, JDF, PDF, PrintTalk</td>
<td>Closed data structure – Well defined keywords. Structure optimized for automated processing.</td>
</tr>
<tr>
<td>ICS – Interoperability Conformance Specification</td>
<td>Subset of a standard that is focused on a well defined use case.</td>
</tr>
<tr>
<td>Fogra, G7, ICC</td>
<td>Important standards for print, but out of scope for workflow</td>
</tr>
<tr>
<td>Standards</td>
<td>Vendor API</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>Cross Vendor</td>
<td>Product dependent</td>
</tr>
<tr>
<td>Generalized</td>
<td>Product specific</td>
</tr>
<tr>
<td>More complex implementation</td>
<td>Simple implementation</td>
</tr>
<tr>
<td>Reusable</td>
<td>Vendor lock in</td>
</tr>
<tr>
<td>Level Playing Field</td>
<td>Big vendor advantage</td>
</tr>
</tbody>
</table>
Industrie 4.0 - Requirements

- How intelligent and independent should machines and services be?
  - Make some brochures, however the device seems reasonable based on the data.
  - Cut that sheet to 4 blocks of 17,32 x 43,5 cm and then shift to the right...
- What happens if insufficient information is provided?
- Is there an “Übercontroller” or do we have a network of equals?
  - Push or Pull? Does a device request work or a controller/MIS send work?
  - How much control is left for the operators and what is their role?
Industrie 4.0 – More Requirements

- How intelligent is the printed material?
  - Identification of work in progress…
  - Are QR codes, RFID chips ubiquitous?

- How is the customer involved?
  - Not all customers are print experts
  - Can some of the printer’s work can be offloaded to the customer?

- How transparent should the process be to the customer?
  - What May / Should / Shall the customer know?
  - What May / Should / Shall the customer not know?
JDF is a Graphic Arts Job Ticket 

Data Interchange Format Specification 
- JDF is not an Application or System

JDF is encoded in XML 
Content is referenced, not embedded 
JDF is extensible 

**JDF Job Definition + JMF Messaging + ICS Documents** define the JDF Framework
JDF describes the entire Production in one File!
- Models Process interdependencies

**All sub-processes are described in one single XML Job Ticket**
- May contain Manufacturing Instruction Details
JMF / XJMF Messaging

Real-time data interchange format

Small XML structures transferred over networks
Used for:

Snapshots of Job / Device status
Resource Consumption
Dynamic job update (Change Orders)
Job submission and queue scheduling

Generally used within an Intranet
XJDF (JDF 2.0)

- Simplified JDF Job Ticket
- Retains the details that we learned in 20+ years of JDF Development
- Simplify the Standard
  - Flatten the learning curve for implementers
  - Make using JDF simple for simple applications
  - Reduce the number of methods to express similar things
  - Enable Plug&Play integration
  - Enable use of standard XML tools and skills

Goal: It’s just <XML/>!
Customer integration with PrintTalk

PrintTalk is the envelope that defines how an XJDF job description should be used:
- Request for Quote (Customer to Printer)
- Quote (Printer to Customer)
- Purchase order (Customer to Printer)
- Invoice (Printer to Customer)
- Change order (both directions)
- Status update (both directions)
XJDF Metadata in PDF:

Product Description
ISO 21812-1
What does PDF represent today?

• Digital Film
• Description of printed Pages
  • Colors
  • Fonts
  • Trim Boxes
• …
• Global metadata in a document context (Author, Customer)

Page description language
What does PDF NOT represent today?

- Description of paper media properties
- Binding
- Page layout (simplex, duplex…)
- …

Not a Product description language

- Products may be described with JDF/XJDF
Why Metadata in PDF?

• Applying print metadata to page ranges
• Variable data / PDF/VT
  • Variable Metadata
    • Paper for the cover
    • Different paper for the body
    • page specific binding
      • Fold – outs, inserts, ...
• Product and page description in one single file

Product description language
Which Metadata in PDF?

- Only product details that are known to the customer/producer of the pdf.
- Should be independent of production process.
- Based on: XJDF Product Intent
- Encoding: PDF (NOT XML)
  - Does not require PDF 2.0

No Process description language
Applications of PDF Metadata

• Loose coupling of variable data generation and print.
• Complete description of simple products for online print procurement
• Extended „Preflight“ including finishing requirements
• Printer drivers
• …
Future standards activities

Moving XJDF / XJMF / PrintTalk to REST API

- Hop on the bandwagon of the current “technology of the week”
- Combine advantages of JSON and REST with the rich data structure of XJDF/XJMF/PrintTalk
what is the difference between JSON und XML?

<XJDF/>

{ "XJDF" : { } }
• Transformation is possible – in general.
  • ... with caveats

• Transformation requires Schema for type security
  • {“Media”:{“Dimension”:”123-456”}}
  • {“Media”:{“Dimension”:[123,456]}}

• Mixed arrays in XML need special treatment:
  • <a><b/></a><c/></a><b/></b><c/></c></a>=???
• Type safety
  • Cardinality:
    • could my single element be a list?
• Type
  • Is my attribute / XML text
    • String
    • Simple data type (number, Boolean)
    • List of simple data types
• Solution
  • Schema
  • Voodoo, if no schema is available, learn from the data
• Type safety
  • Attribute, Element text? {“a”:”text”}
    a="text"
    <a>text</a>

• Generic solution is possible but not unique
• All attributes in XML are strings – no problem...

• XJDF solution
  • In XJDF: everything (almost) is an attribute
Eine API hat multiple parts

- "End point": Where ist the URL
- Which Information is part of the endpoint, and what is in the data (payload)?
  - XJDF/XJMF has all Information in the Payload -- Redundancy

- Payload is standardised (XJDF / XJMF)
- Standardisation end points:
  - Defined in XJDF 2.2 + PrintTalk 2.2
Industrie 4.0 with XJDF, JDF and PDF

Das also war des Pudels Kern!

Dr. Rainer Prosi