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Workflow Automation in the Graphic Arts Industry

CIP4

Definitions

Metadata

Process-Resource Model

(X)JDF/(X)JMF, PrintTalk

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CIP4

- ▶ **International Cooperation for the Integration of Processes in Prepress, Press and Postpress**
 - » not-for-profit standards specification association
 - » Metadata/job tickets: They specify products and production details for automatic production and business workflows
 - » JDF/JMF, XJDF/XJMF, PrintTalk and PPF
 - » Specifications, programming libraries, tools, case studies and marketing material can be used by everybody without paying royalties
 - » over 1,600 individuals from approximately 300 members from 31 countries
 - <http://www.cip4.org/>
 - » Voluntary work
 - <https://confluence.cip4.org>

Example for Device/Machine Automation



Automation in Graphic Arts Industry

This lecture covers only:

Workflow Automation

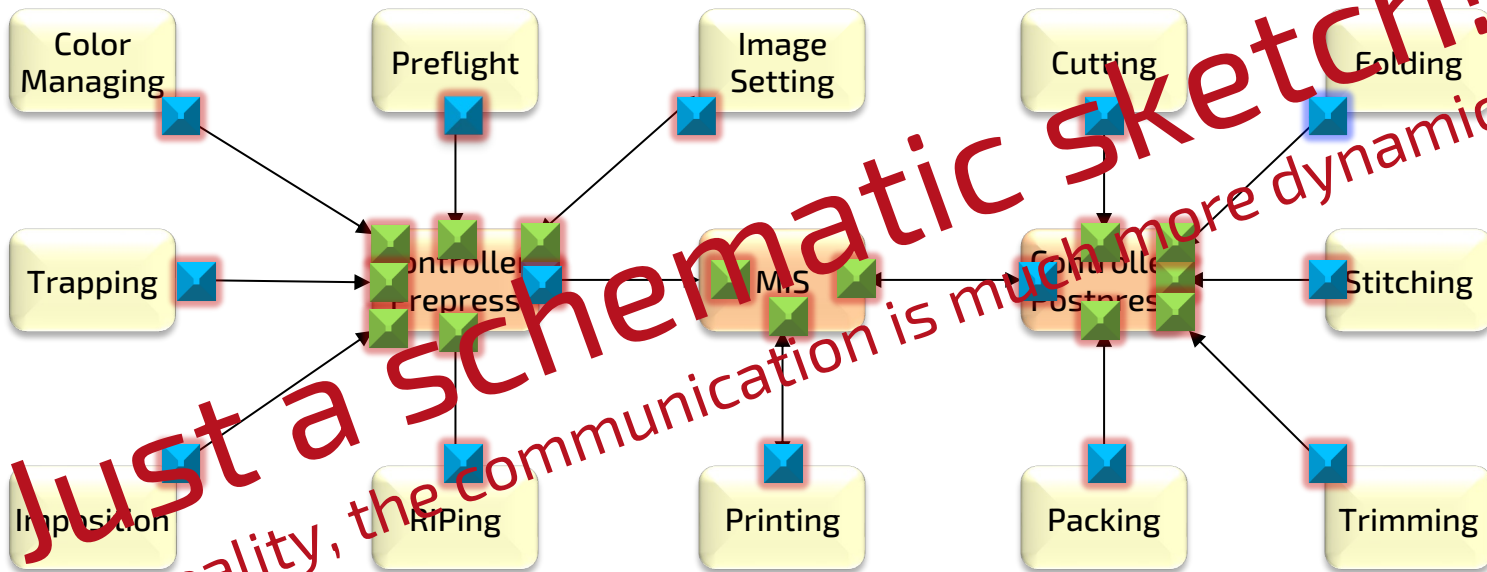
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Device Automation

Workflow and device automation depend on each other. Often device automation needs (meta) data from outside; workflow messages provide this data

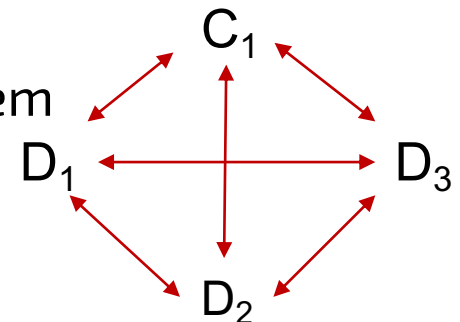
Print Production Workflow Automation

- ▶ Which information are in the packages?
 - » Green: Product intents, information for processes
 - » Blue: Time & material consumed, quality report, status



Metadata, Devices and Controller

- ▶ A **device** is either a software application or some machine. It initiates the execution of one or several processes. Sometimes, it refers only to the device driver for a machine
- ▶ **Metadata** = information/data about content data (text, images, graphics, pages) or about print production
- ▶ A **controller** routes metadata and messages in a workflow system
 - »E.g., MIS/ERP, Workflow (Management) System
- ▶ Devices and controller communicate with each other about product and production details.



Remarks to the last animated chart

- ▶ Only communication between MIS/controller and production devices are shown. Workflow, however, should cover other areas as well!
 - » Artwork creation, procurement, logistics, business partners...
- ▶ The chart suggests 3 views of workflow automation:
 - I. The network (arrows)
 - II. The information container (green and blue container)
 - III. The information inside (things inside the container)
 - » Our main focus in (III). However, in order to read the information, one also needs to know about the structure of the container - not on an IP or HTTP level, but, for example, on the XML level if the information is coded in XML

Concept of Workflow Automation

- ▶ A **workflow** denotes the sequence of production and business processes, in whole or part, during which documents, information and task descriptions are passed from one participant to another for action according to a set of procedural rules
- ▶ A **process** is an activity with a single specific objective that can be planned and executed independently
- ▶ **Workflow Automation** means automatically supplying processes (devices) with data
- ▶ A process can start and execute automatically, if...
 - » ...the data in the “green containers” is available and relevant
 - » ...the device understands the data and can execute a process automatically using the data (device automation)

What's in the Containers?

▶ Green (from controller to device):

» Job administration

Customer details, Job ID, production time window

» Description of the requested product (in it's finished stage)

e.g., printing substrate, page formats, binding intent, type of inks

» Production issues for pre-setting devices and apps

e.g., actual printing substrate, screening type, folding positions

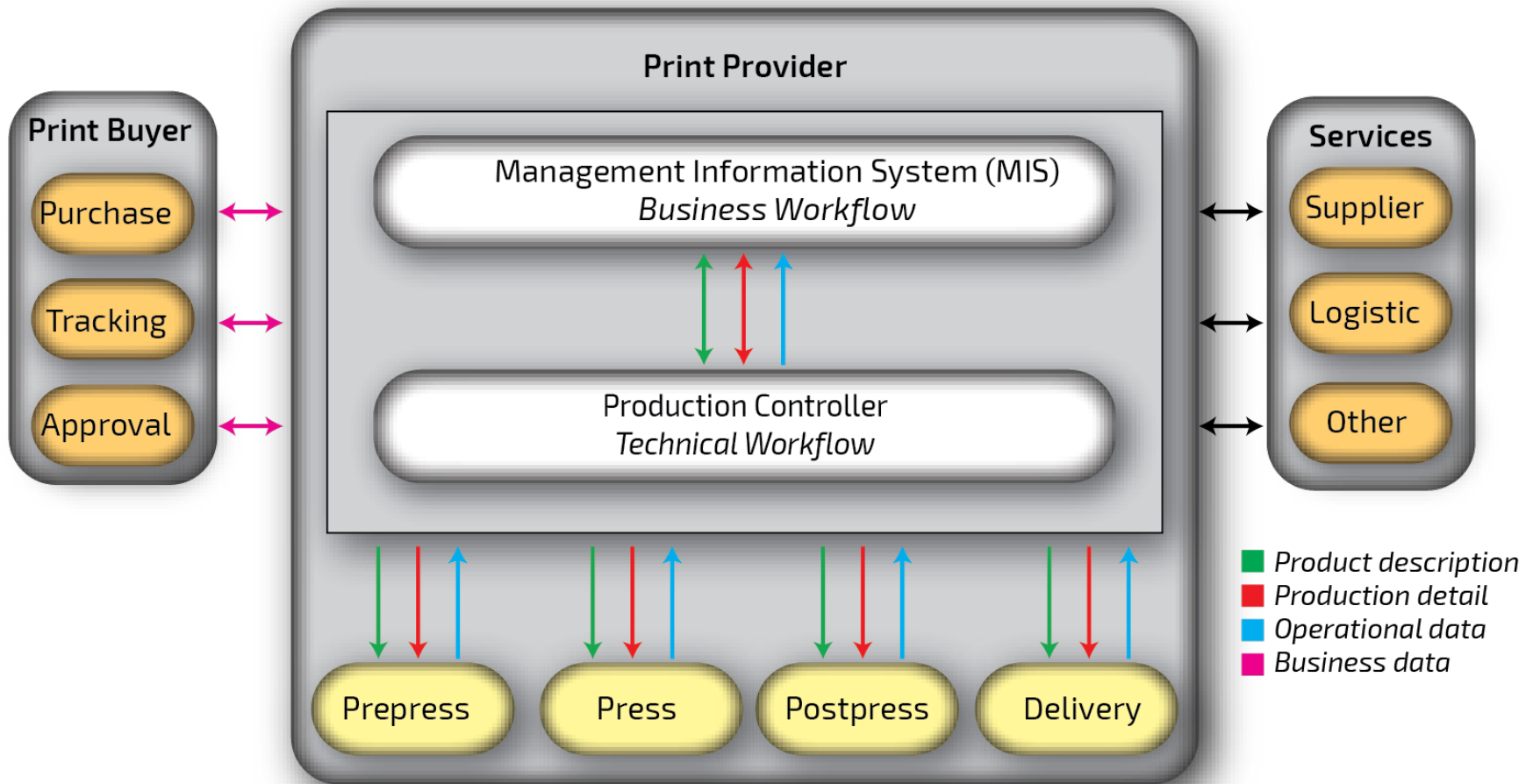
» Queries and commands

e.g. What is the status? Update job, cancel job

▶ Blue (from device to controller):

» Time & material consumed (currently/in total), job tracking, ...

Data Exchange between PP, PB and 3rd Party

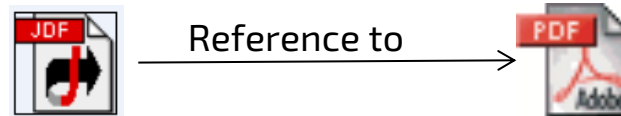


What is Metadata in the Printing Industry?

- ▶ Structured **data about data** (e.g., about images, PDF files) or product intent description, print production issues, operational data
- ▶ Metadata can be embedded in content data or defined externally to content data (i.e. stored in a file or database)
- ▶ Examples of metadata formats:
 - » Embedded: Exif in images; XMP is in images, PDF, ID, AI, ...
 - » Not embedded: **JDF/JMF, XJDF/XJMF, PrintTalk**, PJTF, PPF (CIP3)
- ▶ Most metadata is coded in XML or in recent times in JSON
 - » Exceptions: Exif, PJTF, PPF

Metadata – Content

- ▶ Metadata often references content (print) data



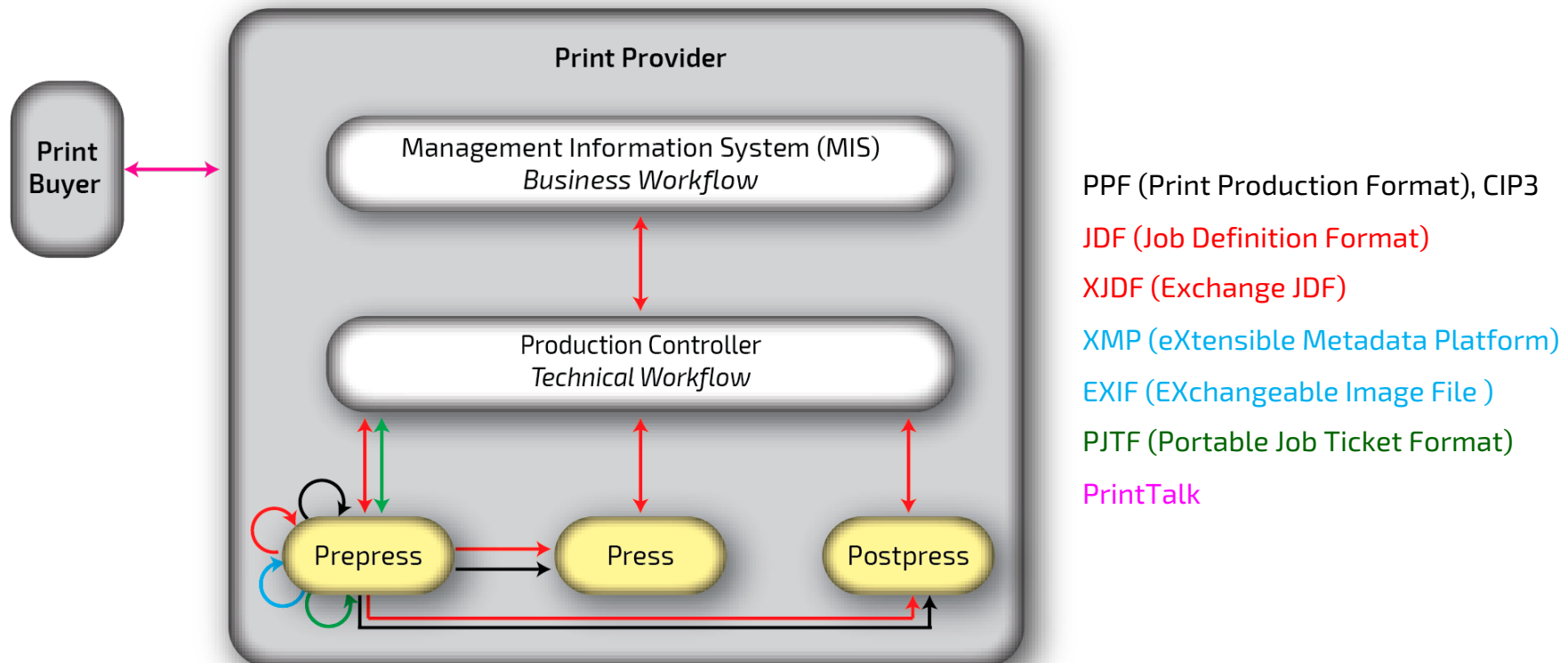
```
<RunList Run="1" Status="Draft">
  <LayoutElement>
    <FileSpec MimeType="application/pdf"
      URL="file:///Jobs/2010-12-13/System/uebung_01.pdf"/>
  </LayoutElement>
</RunList>
```

Extract from a sample JDF file

- ▶ Metadata in PDF: XMP, Output Intent, die cut data...
 - » Receiver of single pages in PDF/VT (or PDF 2.0)
 - » Product intend: ISO/CD 21812-1:2019

Metadata and Their Ecosystems

- ▶ Often several metadata formats used in a production
 - » Format conversions during production
e.g., Exif to XMP, XMP to JDF, XJDF to JDF, CSV to JDF,...



Production Models

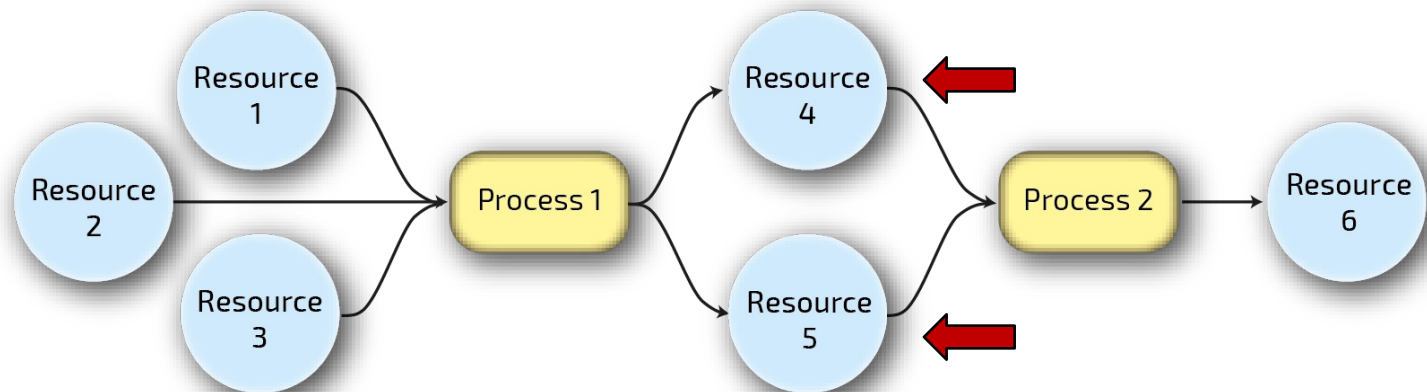
- ▶ if you want to specify a workflow - especially an automated one - you have to define the production processes and how they are connected
 - »A universal print production “model” is needed!
- ▶ Different models are available
 - »Process list (or activity list or to-do-list): List of processes w/o execution order
 - »Process chart: defines the order but does not define the interfaces between the processes
 - »Flow chart
 - »**Process-Resource-Model**

Flow Charts might Become Scary



Process-Resource Models

- ▶ Processes are described by verbs, resources are physical things, files or parameter sets
 - » Processes normally have several input resources, i.e. prerequisites that are needed for running a process
 - » Processes have one or more output resource(s), i.e. the result(s) that the process produces
 - » A output resource of one process might be the input resource of the next process (a “transitional” resource)

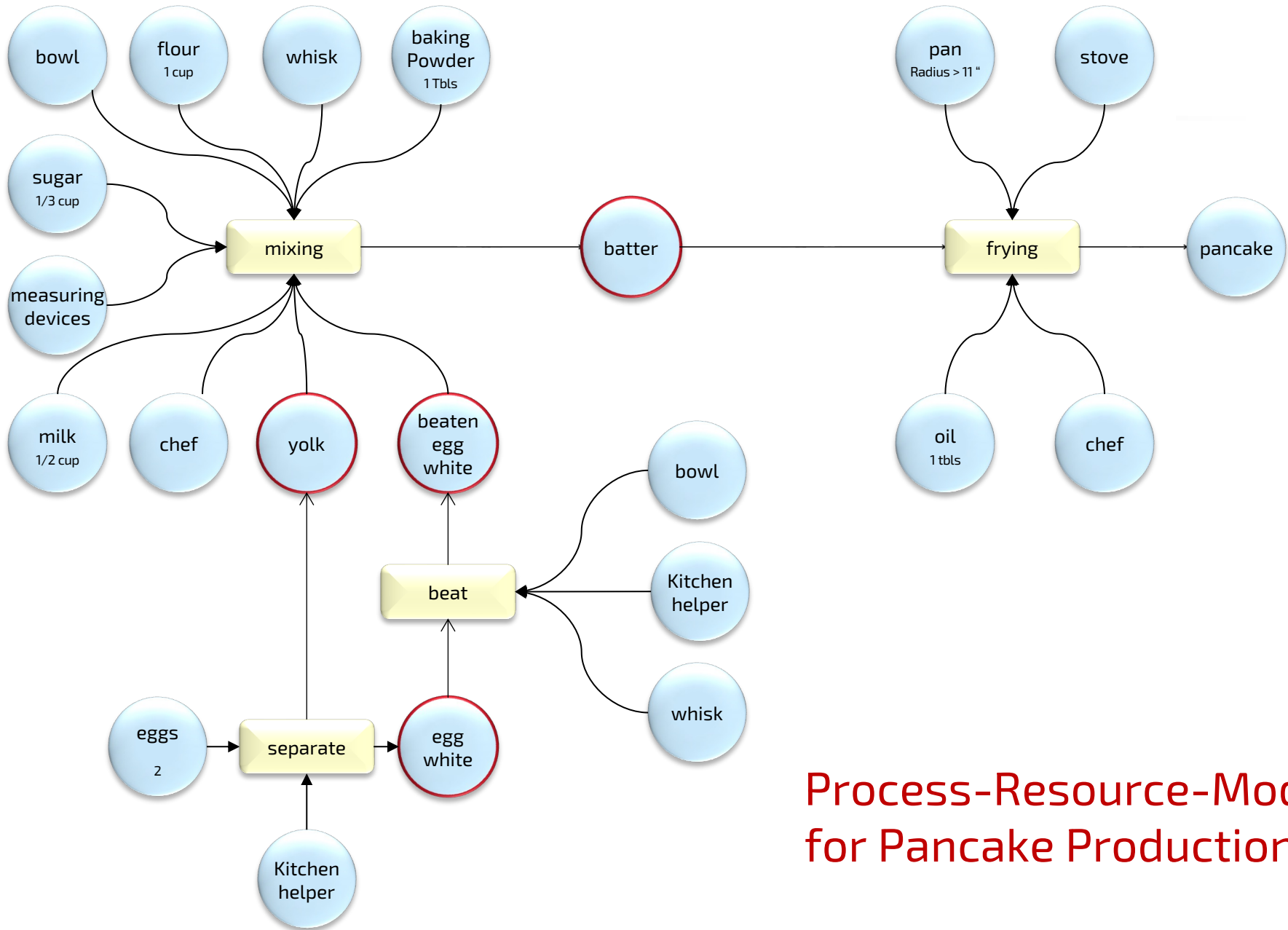


Process-Resource Model (PRM)



Let's make
pancakes!

Sorry,
let's make a PRM recipe



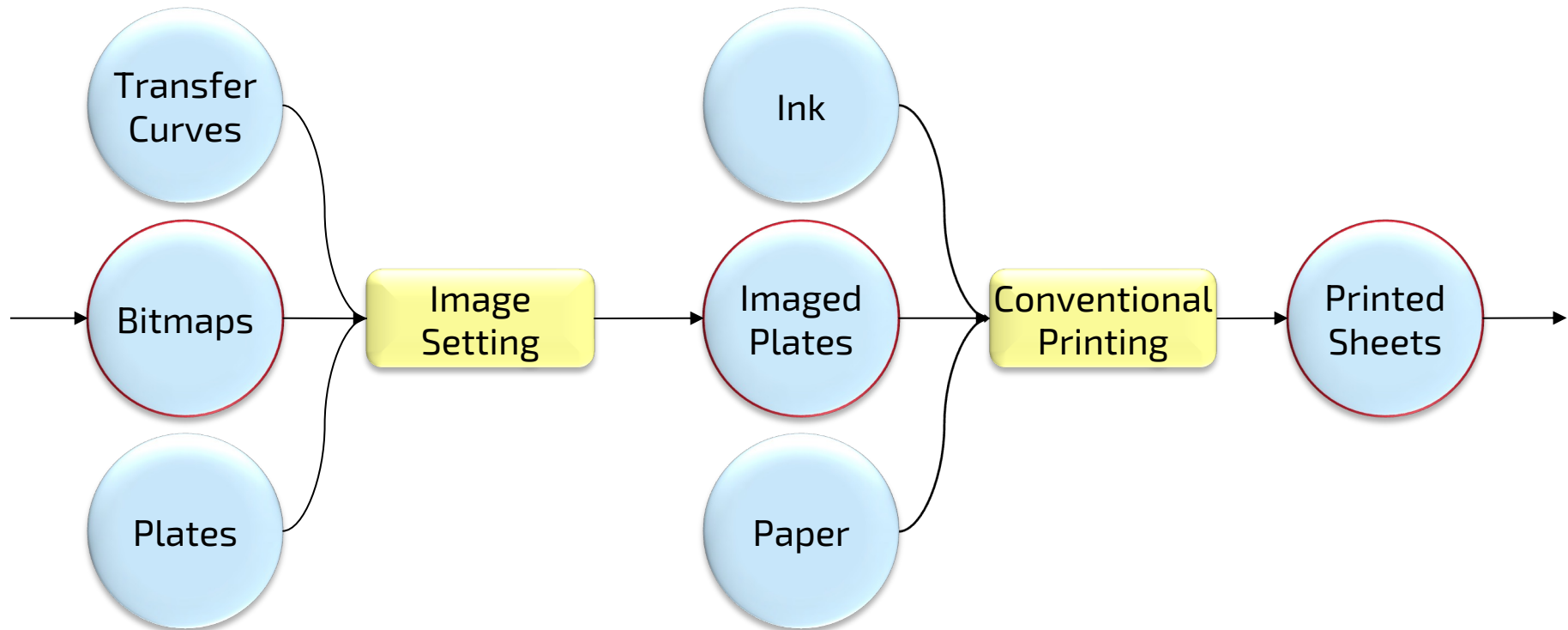
Process-Resource-Model for Pancake Production

Processes and Resources Must be Specified

- ▶ If you want to replace the “chef” by a “mixing robot”, a “frying robot”, a “separating robot” and a “beating robot” a precise specification for all processes and resources is needed, which...
 - » ...must be clear, unambiguous, universal (not for pancakes only!) and represents a complete “language”
 - » ...should be an open standard – otherwise the pancake manufacturers cannot buy robots from different vendors
- ▶ The specification is the tricky part - and, of course, robots must understand the language and can execute the processes accordingly
- ▶ Please Note: The PRM is just a model, just a description what to do (“recipe”). It's not the production!

Example of PRM in Print

- ▶ Production is described by a network of processes and resources
 - » Each process is executable when all mandatory input resources are available and the production time window is reached



Model a print production workflow

Please choose a workflow. Then drag the first puzzle of the workflow to the red rod-shaped start, then the second one to the first, etc.

Choose Workflow **Home** **Print** EN SR **Stitched Brochure**

You are a hero!

done:17% wrong tries: 2

Information about:

Resource PDF sheets

The outcome of the imposition process is a PDF sheet, which can be imaged, for example, on an offset plate by a platesetter. The PDF sheets contains all pages on the correct positions as well as marks.

Please hover over or double click on a card to get some extra information

<https://www.torontomu.ca/~wdp/workflow-puzzle/print/print.html>

JDF/JMF, XJDF/XJDF and PrintTalk

▶ Job Definition Format (JDF), Job Messaging Format (JMF)

» About 100 processes and 170 resources defined in JDF

» JDF normally contains the workflow logic

» JMF is the “SMS” for the printing industry. It allows dynamic interaction between the team players



▶ Baby JDF: XJDF and XJMF

» X stands for “Exchange”; XJDF simplifies JDF

» Just a protocol between controller & devices; no workflow logic



▶ PrintTalk

» Defines business objects like RFQ, quote, confirmation, ... , invoice

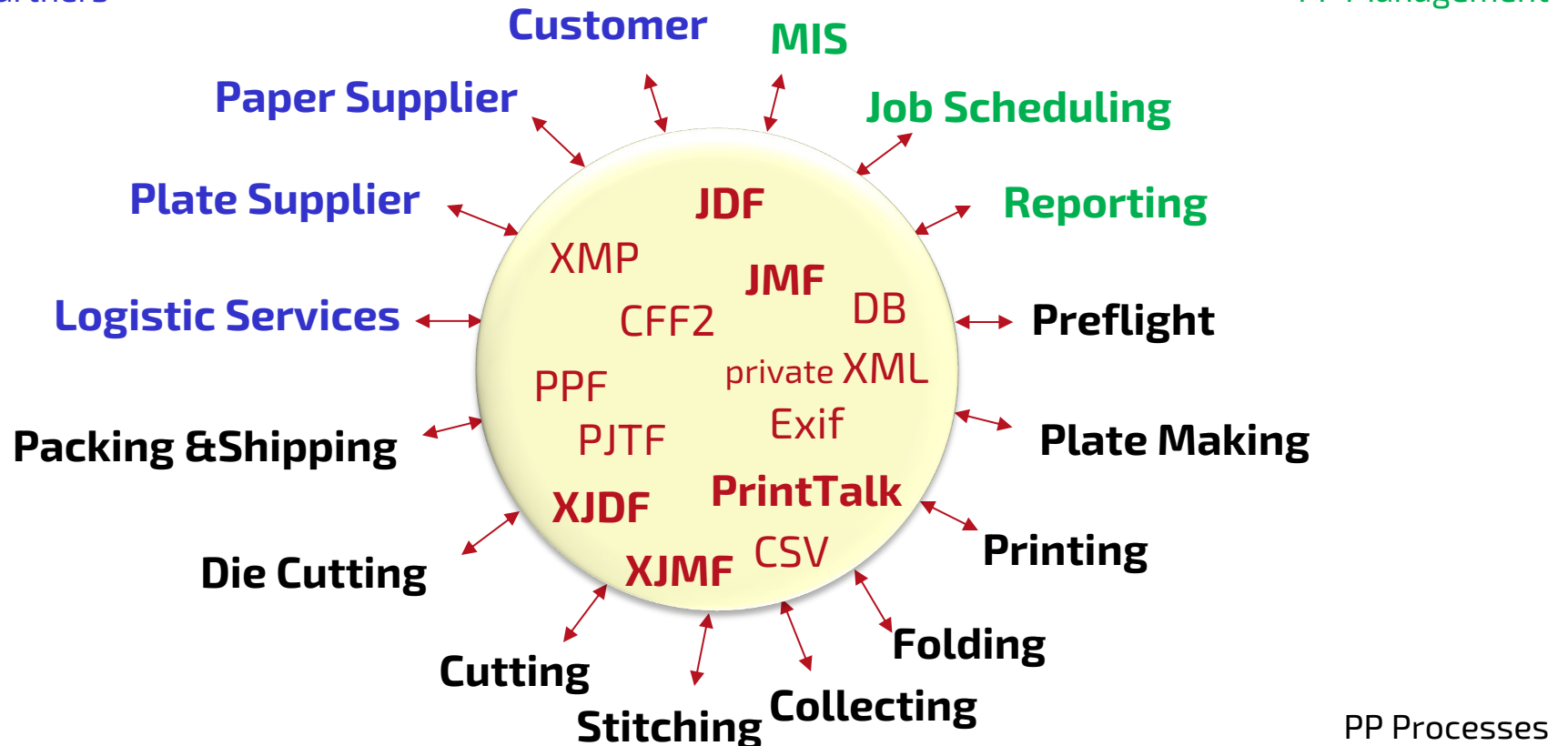
» PrintTalk can embed (X)JDF



Metadata Communication Hub

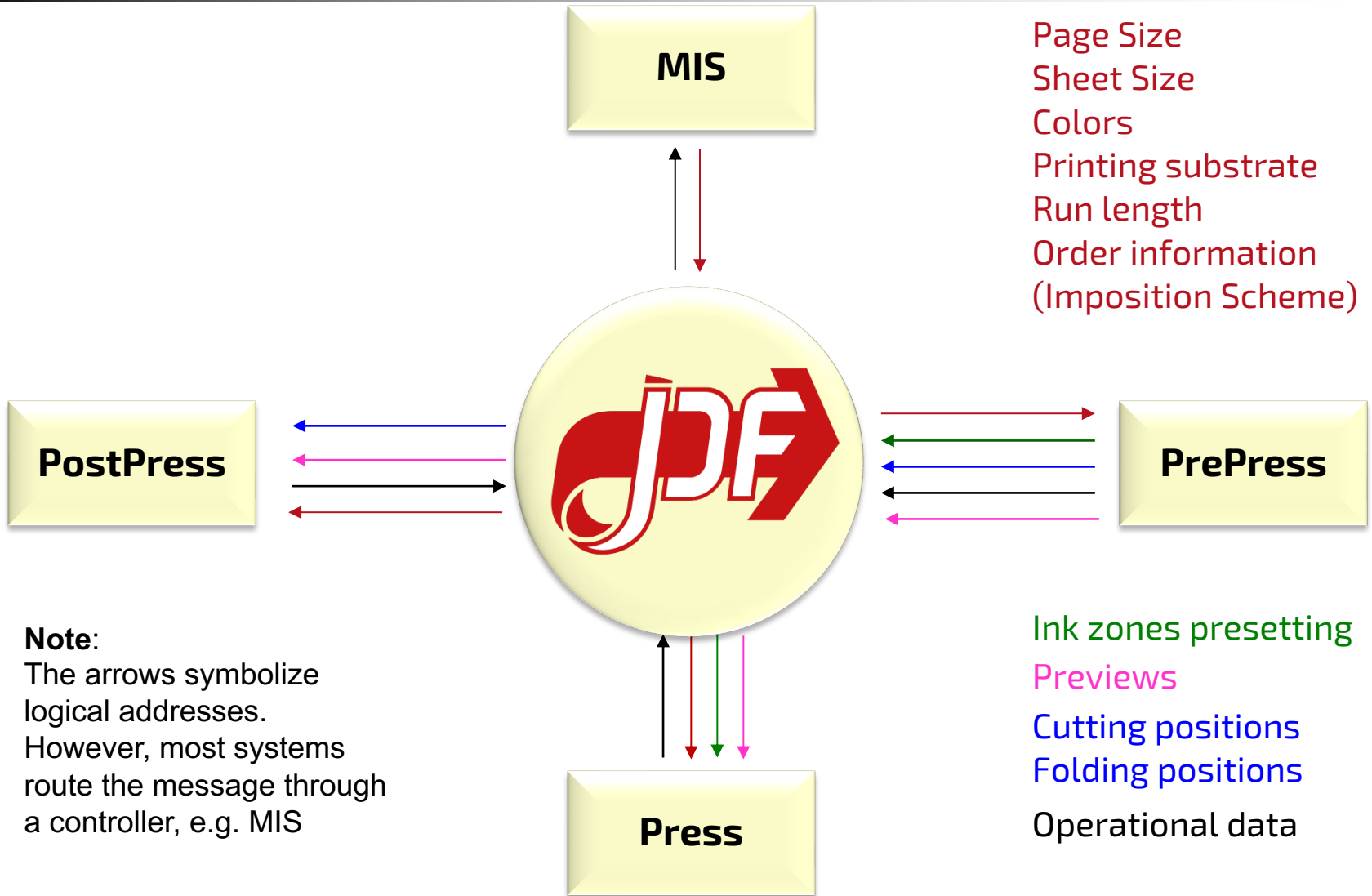
PP's Partners

PP Management



Industrial Digitalization ↔ Workflow Automation

Information Exchange with JDF/XJDF



Planning Board – The Integration Champion

HEIDELBERG

Datei | Bearbeiten | Ansicht | Gerät | Werkzeuge | Hilfe

Maschinensicht | Tagessicht | Wochensicht | Gesamtsicht | Übersicht Einzelauftrag | Auslastung | Personalplanung

Gesamtsicht (0:00 - 24:00) | Maschinenset: PR+100JO | 1 | 2 | 1. April 2016 - 29. Juni 2016

Voreinstellungen | 0/144 2 | Belegen/Freigeben | Verwerfen | Aktivieren

Auftrag: Kunde: Bedruckstoff: Farben: Maschine:

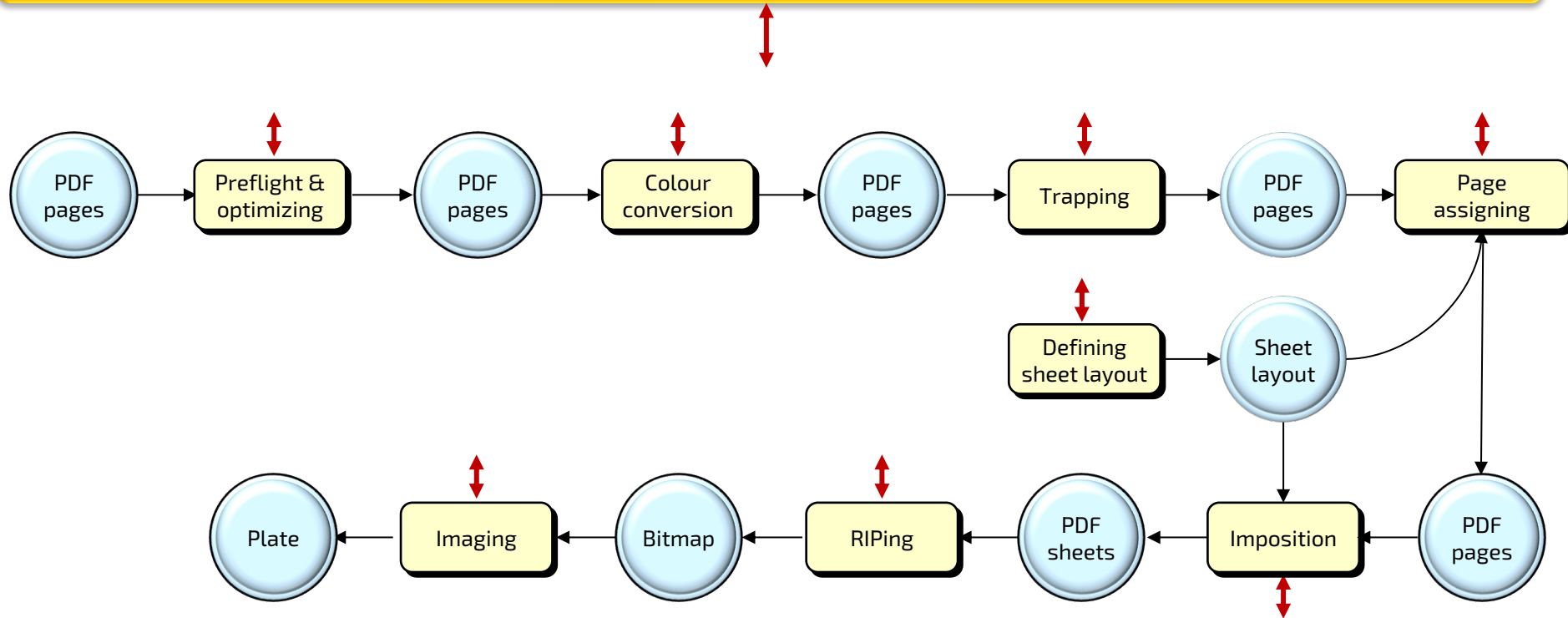
Checkpoint Filter aus | Listen tauschen:

Fälligkeitstermin | Status | Auftrag

Bogen	Beginn	Dauer	Arbeitsgang	Maschine	Menge	Bedruckstoff	Format	Farben	Gesamtfr
2. Mai 2016 (58)									
unverplant (21)									
Wartend (37)									
102810 - 100 Jahre Offsetdruck (16)									
OH1601272_Bro68S - Imp63 (21)									
Innenteil_1	05.04.16 11:00	00:23	Drucken	SM102-12P7L_DT	546	596820065922 (LuxaSatin dull)	914x660	4/0(CMYK)	
Innenteil_1	05.04.16 10:44	00:16	Platten belichten	Suprasetter_145(imageSetter...	8	596820065922 (LuxaSatin dull)	1030x790	4/4(CMYK)(CMYK)	
Innenteil_1	05.04.16 14:39	00:35	Falzen	KH78_1	513	596820065922 (LuxaSatin dull)	914x660		
Innenteil_1	05.04.16 11:23	00:23	Drucken	SM102-12P7L_DT	546	596820065922 (LuxaSatin dull)	914x660	0/4(CMYK)	
Innenteil_2	05.04.16 11:00	00:16	Platten belichten	Suprasetter_145(imageSetter...	8	596820065922 (LuxaSatin dull)	1030x790	4/4(CMYK)(CMYK)	
Innenteil_2	05.04.16 12:54	00:35	Falzen	KH78_1	513	596820065922 (LuxaSatin dull)	914x660		
Innenteil_2	05.04.16 12:09	00:23	Drucken	SM102-12P7L_DT	546	596820065922 (LuxaSatin dull)	914x660	0/4(CMYK)	
Innenteil_2	05.04.16 11:46	00:23	Drucken	SM102-12P7L_DT	546	596820065922 (LuxaSatin dull)	914x660	4/0(CMYK)	
Innenteil_3	05.04.16 11:16	00:16	Platten belichten	Suprasetter_145(imageSetter...	8	596820065922 (LuxaSatin dull)	1030x790	4/4(CMYK)(CMYK)	
Innenteil_3	05.04.16 12:55	00:23	Drucken	SM102-12P7L_DT	546	596820065922 (LuxaSatin dull)	914x660	0/4(CMYK)	
Innenteil_3	05.04.16 13:29	00:35	Falzen	KH78_1	513	596820065922 (LuxaSatin dull)	914x660		
Innenteil_3	05.04.16 12:32	00:23	Drucken	SM102-12P7L_DT	546	596820065922 (LuxaSatin dull)	914x660	4/0(CMYK)	

PRM for Prepress in Commercial Printing

MIS – Production Controller – Planning Board



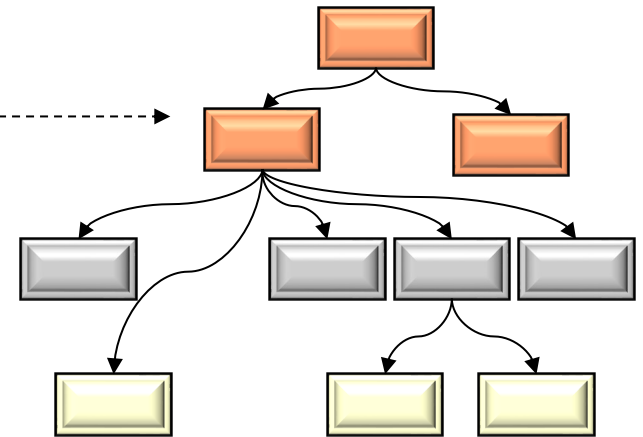
Inside of JDF: Hierarchy of JDF Nodes

- ▶ Typically, MIS initializes a JDF for each print job
- ▶ A JDF-Job is defined by :

»Product nodes

»Process group nodes

»Process nodes



- ▶ JDF nodes are described by XML-elements and XML-attributes.
 - »Encoding: `<JDF Type="...">`
 - »“Arrows” between those elements represent JDF sub-nodes

Location of Resources

- ▶ Nodes can also contain resources
- ▶ Since some resources are used by several processes the resources are not necessarily in the JDF node that refers to them as input or output
 - » Copies of resources should be avoided
- ▶ Other means of defining which is an resource of a node: *ResourceLink*
- ▶ Thus:
 - » The Resource can be (almost) anywhere in any JDF node
 - » The *ResourceLinks* in a JDF node define the reference (via ID) to the resources for the node.

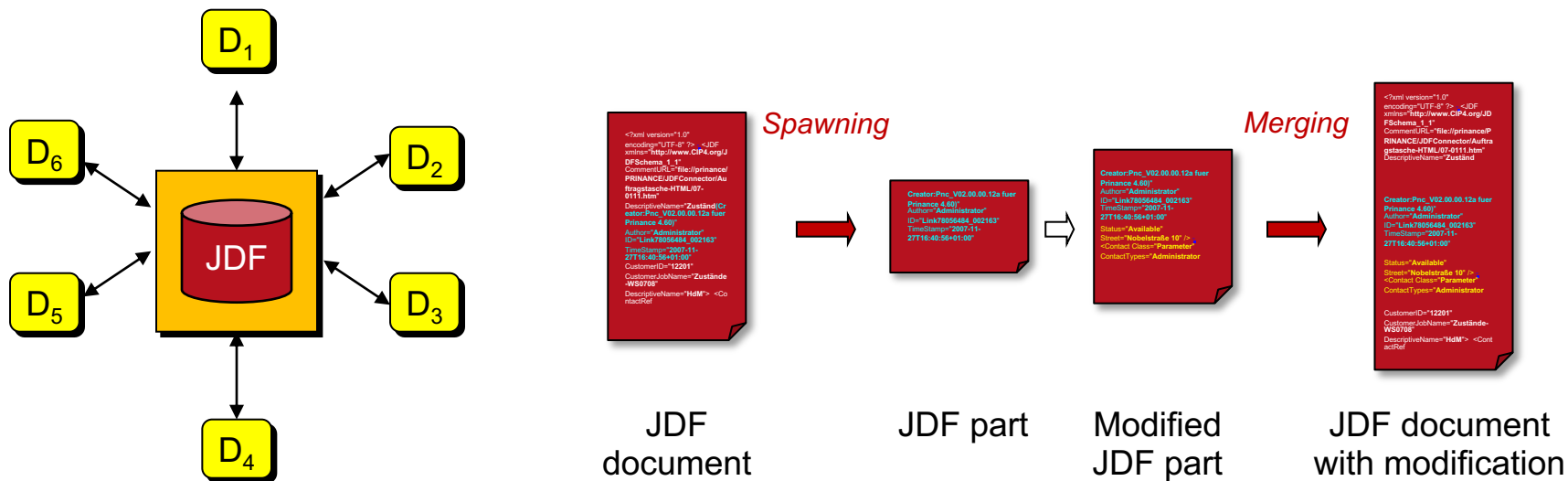
Sequential Architecture



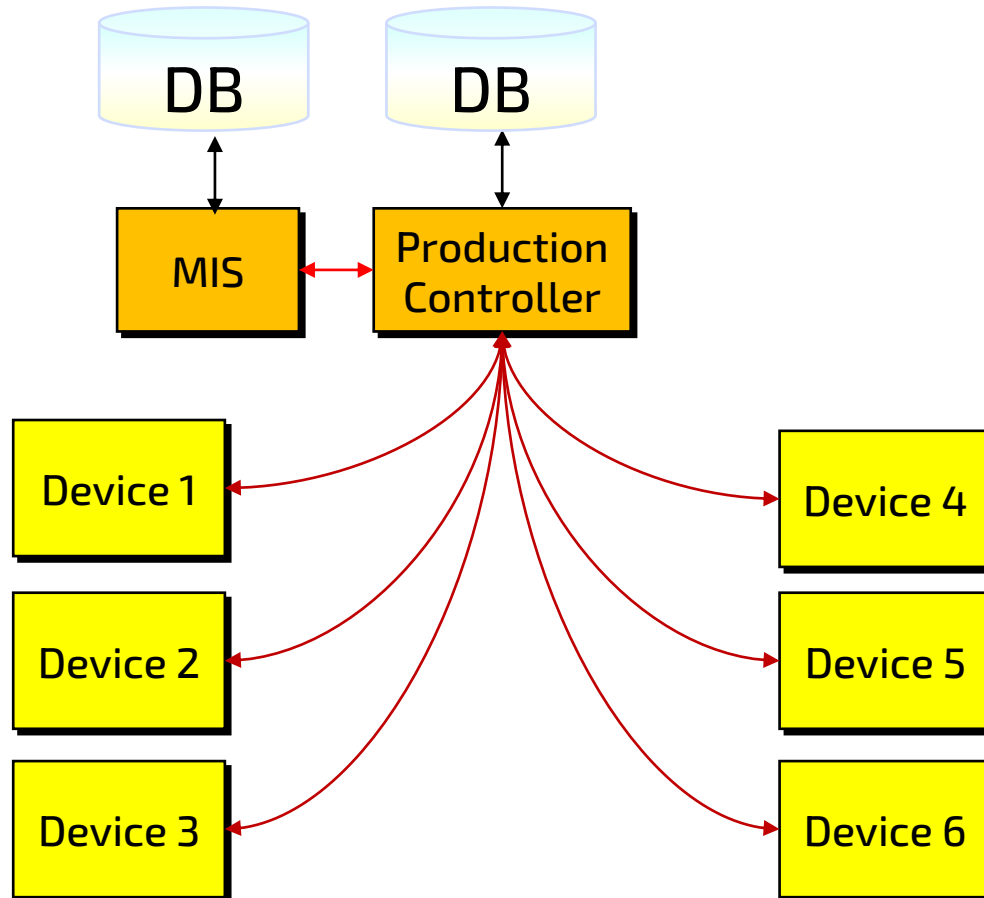
- ▶ A single JDF file per job passes from one JDF module to the next e.g., via hot folder
 - » No database, original concept, somehow outdated
 - » JDF “gains weight” during production
- ▶ In reality, processes are not sequential
 - » overlaps (*pipes*), parallelism (data consistency)
- ▶ Quite complex if level of JDF-integration is high
 - » Difficult to maintain de-central data storage

Central JDF Storage For All Modules D_1, \dots, D_6

- ▶ Some software is in charge for w/r of JDF, e.g., MIS
- ▶ Processes may not use/update JDF data at the same time
 - » *Spawning&merging*: A JDF part rw-spawned only once at a time
 - » Nevertheless: Each module must be prepared to extract JDF nodes it needs from entire job ticket



(X)JDF is just a communication protocol

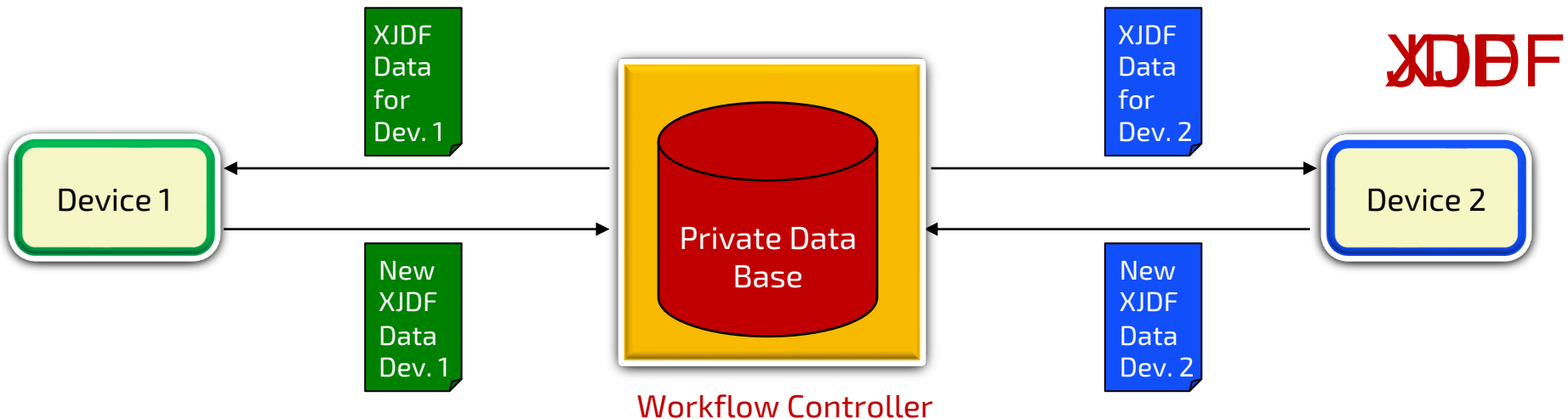


(X)JDF, (X)JMF
Private DB access

XJDF – The simplified JDF

- ▶ JDF is designed to contain information for the entire production
 - » JDF node tree, resources, ResourceLinks, ...
 - » This leads to quite complex data structures
 - » Moreover, such description is often stored additionally in private data bases of MIS or production controller
- ▶ XJDF does not contain the entire workflow logic
 - » It is merely an interface protocol between a production controller and specific devices
 - » Easier to implement, less costly – especially for the devices
 - » Workflow logic is stored in private data bases of controller

Comparison JDF - XJDF



- ▶ Main technical advantages of XJDF to JDF
 - » Devices need not to extract relevant data from the job ticket
 - » Data bases are handling data update – no need for extra mechanism (*spawn & merge*) as with JDF
 - » One XJDF node only with XJDF, no node tree, no ResourceLinks

PrintTalk

- ▶ PrintTalk® is a CIP4 protocol that handles business aspects in the graphic arts industry
- ▶ Main application area is the interface PB - PP
 - » PrintTalk is used in the background for example by
 - » Web-to-Print systems
 - » Customer portals
- ▶ Moreover, PrintTalk is deployed by MIS – MIS and by MIS – WMS communication
 - » E.g., between subsidiaries of a print shop
- ▶ PrintTalk is XML based
 - » The root element of a PrintTalk document is `<PrintTalk...>`

Lab Work: EasyXJDF Hands on I

- ▶ Download *EasyXJDF* from CIP4.org
 - » See [Tools & Libraries](#)
 - » For Mac take dmg file
- ▶ Open the dmg file on Macintosh
 - » Control & Open
- ▶ Fill entries in GUI with whatever you like
 - » Choose PDF as content
- ▶ “Save as ...”
- ▶ Unzip and open the ptk file with XML editor or any dumb text editor and...

Lab Work: EasyXJDF Hands on II

- ▶ ... answer the following questions:
 - »What is the type of PrintTalk Business Object?
 - »What is the *DescriptiveName* of the XJDF job?
 - »How many Products are in the *ProductList*?
 - »How many *Intent* elements do you find?
 - »What are the names of the *Intent* elements?
 - »How many *ResourceSets* do you find in the file?
 - »What are the names of the *ResourceSets*?

Outcome of *EasyXJDF* - 1

```
<ptk:PrintTalk version="2.0" payloadID="..." Timestamp="20190327T16:44:40Z">
  <ptk:Request>
    <ptk:PurchaseOrder BusinessID="4711">
      <xjdf:XJDF Category="Web2Print" DescriptiveName="Industry 4 0 and JDF"
        JobID="4711" Version="2.0">
        <xjdf:GeneralID IDValue="42" IDUsage="CatalogID"/>
        <xjdf:ProductList>
          <xjdf:Product Amount="2222">
            <xjdf:Intent Name="MediaIntent">
              <xjdf:MediaIntent MediaQuality="Lumisilk 120"/>
            </xjdf:Intent>
            <xjdf:Intent Name="ColorIntent">
              <xjdf:ColorIntent>
                <xjdf:SurfaceColor NumColors="4" Surface="Front"/>
                <xjdf:SurfaceColor NumColors="0" Surface="Back"/>
              </xjdf:ColorIntent>
            </xjdf:Intent>
            <xjdf:Intent Name="LayoutIntent">
              <xjdf:LayoutIntent FinishedDimensions="566... 651... 0.0"
                PrintedPages="1" Sides="OneSided"/>
            </xjdf:Intent>
          </xjdf:Product>
        </xjdf:ProductList>
      </xjdf:XJDF>
    </ptk:PurchaseOrder>
  </ptk:Request>
</ptk:PrintTalk>
```

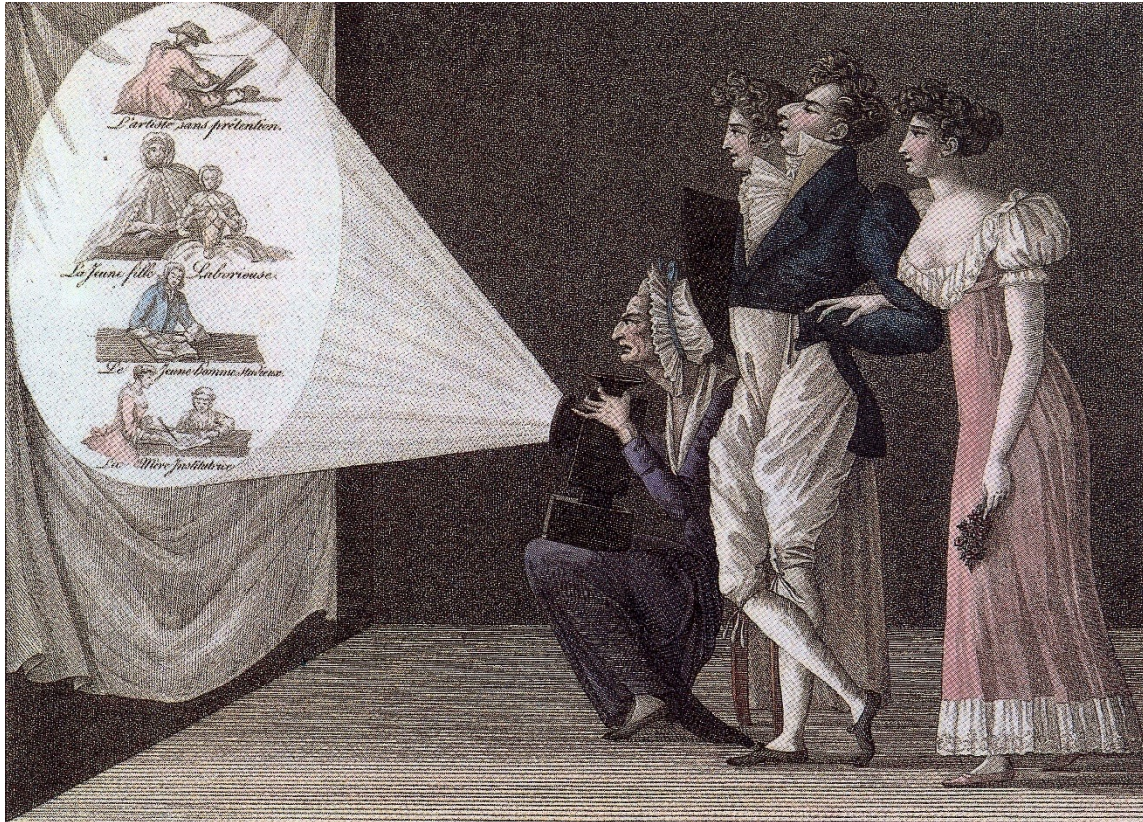
Outcome of *EasyXJDF* - 2

```
→ < <xjdf:ResourceSet Name="CustomerInfo">
    <xjdf:Resource ID="CustomerInfo_c799d2eb-1377-45da-8679 ..." >
        <xjdf:CustomerInfo CustomerID="MickeyMouse"/>
    </xjdf:Resource>
</xjdf:ResourceSet>
→ <xjdf:ResourceSet Name="RunList">
    <xjdf:Resource ID="RunList_0ba58ec1-3093-4c0e-ae44-e38 ..." >
        <xjdf:RunList>
            <xjdf:FileSpec URL="asset/JDF Specification 1.7.pdf"/>
        </xjdf:RunList>
    </xjdf:Resource>
</xjdf:ResourceSet>
</xjdf:XJDF>
</xjdf:XJDF>
```

```
</ptk:PurchaseOrder>
</ptk:Request>
</ptk:PrintTalk>
```

Summary

- ▶ (X)JDF most important metadata in print production
 - » They are based on the Process Resource Model
 - » They define the product intent and the production processes via their input and output resources
 - » They contain information only, not the specifics how the information is used and distributed. They fuel the automation, but they don't execute the automation.
- ▶ XJDF is a simplified version of JDF. It does not contain the entire workflow logic
 - » Both formats are used in parallel
- ▶ PrintTalk defines the business workflow of a print provider and print buyer



Thank you for your attention!

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