Documentation for aircraft maintenance based on Topic Maps

Kay Kadner
SAP Research,
Dresden, Germany
kay.kadner@sap.com

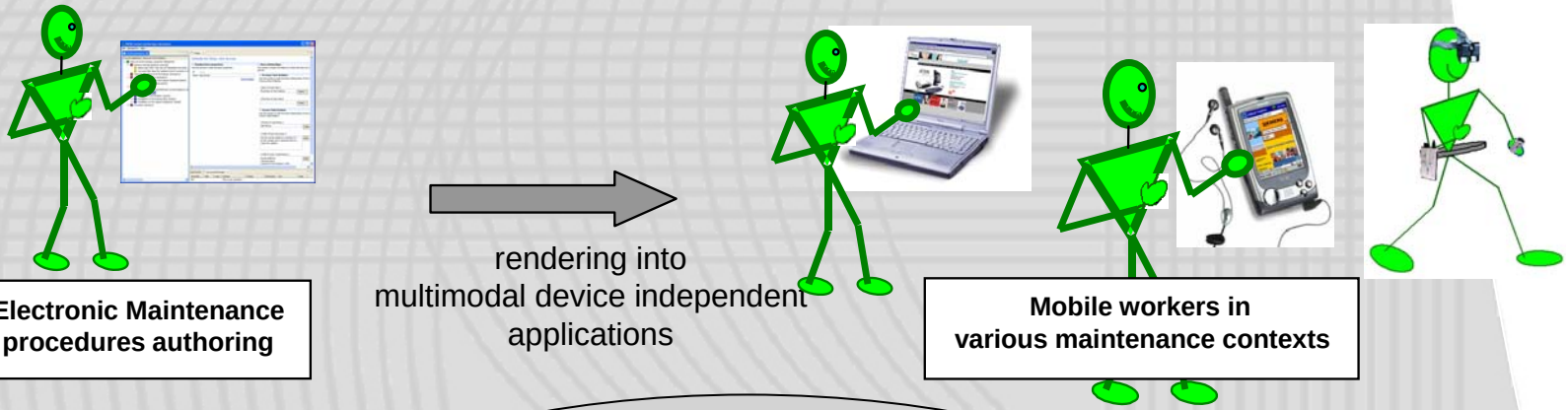
David Roussel
EADS Corporate Research Center,
Toulouse, France
david.roussel@eads.net

Outline

- Introduction
- Authoring interactive aircraft maintenance procedures & Topic Maps
  - SNOW Authoring tool features
  - Semantic enrichments
  - Descriptors for rendering
- First feedbacks on benefits (field assessment)
- Conclusion … about Topic Maps through S1000D Glasses

SNOW

- Perform various maintenance operations with the best adapted multimodal mobile devices
- Author the documentation for this



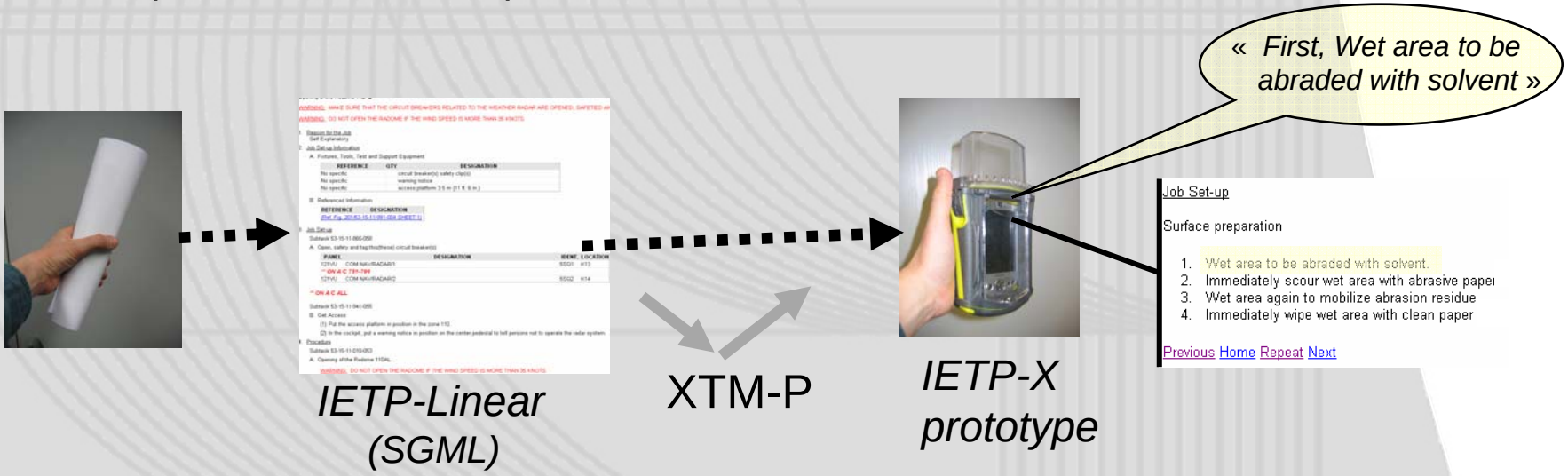
Involved Partners

EADS CCR
SAP
Fraunhofer FIRST Institut Rechnerarchitektur und Softwaretechnik
SIEMENS
ADVANCED COMPUTER VISION
A subsidiary of Austrian Research Centers
TUG
Loquendo
VOCAL TECHNOLOGY AND SERVICES

Topic Maps standard inside SNOW

[XTM 1.0] norm is used in a specific way (= XTM-P) to describe maintenance procedures considering :

- Interactive Electronic Technical Publication (IETP) structured world
- Content formalization *Versus* multiple designations for a same “entity”
- Decomposition into interactions (i.e. traceability requirement)
- Adaptation to various output modalities and devices



Procedures authoring with XTM-P

XTM for procedures (XTM-P): basic ideas

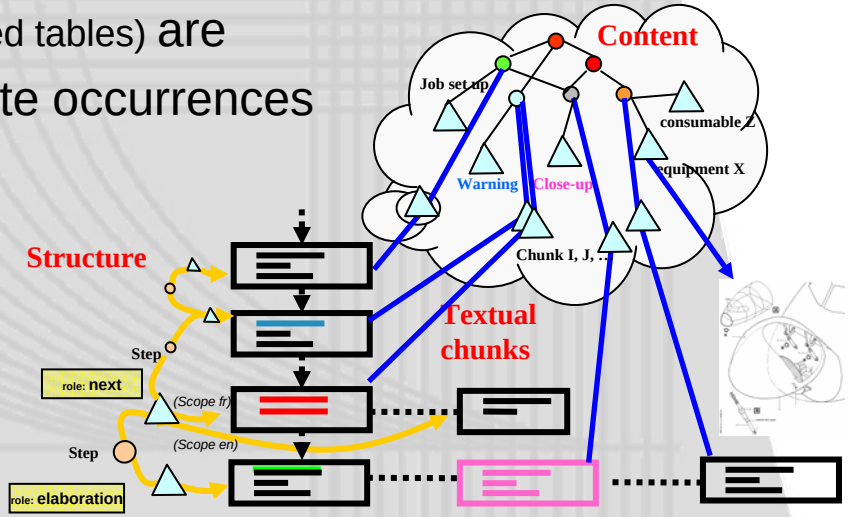
- TM supports both the contents description and structure description through a set of predefined subjects and templates

- Textual contents are granular enough to be included into the TM constructs
- (Then) the layout is optimized by coupling TM attributes and styling

- External references (e.g. graphics, specialized tables) are independent topics with specific alternate occurrences

SGML procedures

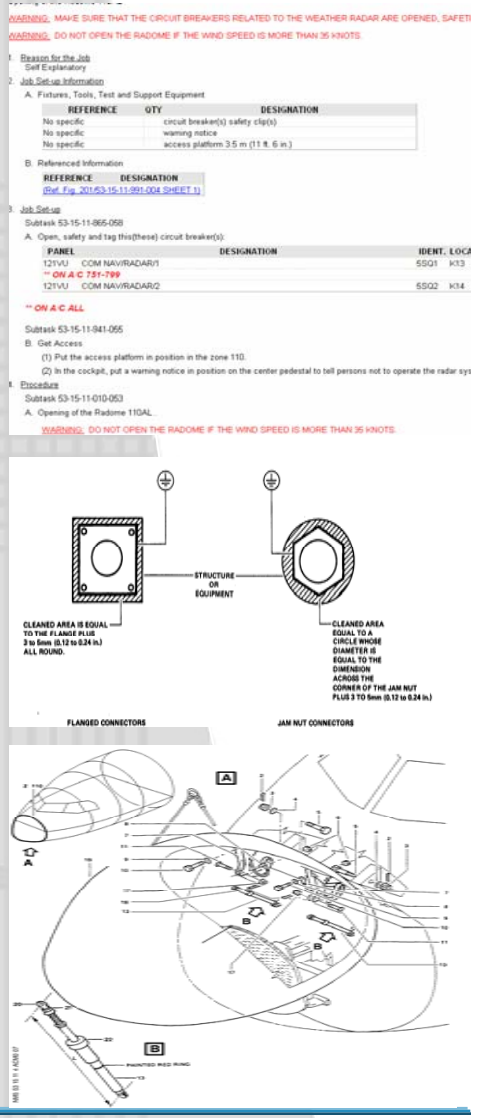
Conversion + reauthoring



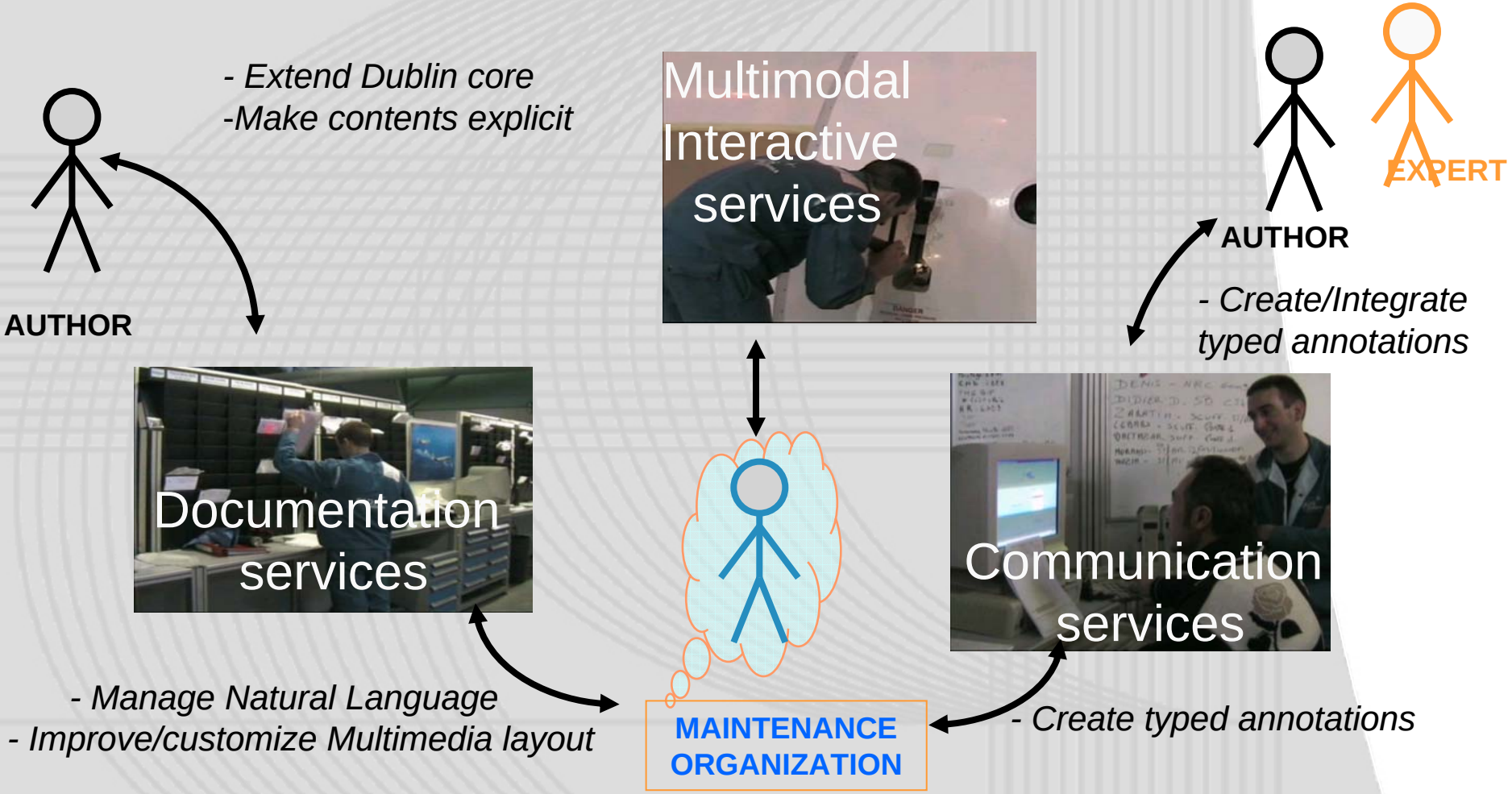
XTM-P

Structured content description: required primitives, templates, …

- Metadata: Dublin core, aircraft technical parts …
- Status: Note, warning, caution, …
- Organization:
  - Job setup info, Job setup, Procedure, Job close up, …
- Associated references:
  - Equipment, tool, consumable, graphic, …
- Hierarchical relationships:
  - Phase, step, instruction, …
- "TBD" relationships (underspecified in the S1000D)
  - A graphic can be self-commented, or identify an equipment part mentioned outside
  - A *note* can give an important condition for a *task* or a local background for an *instruction*

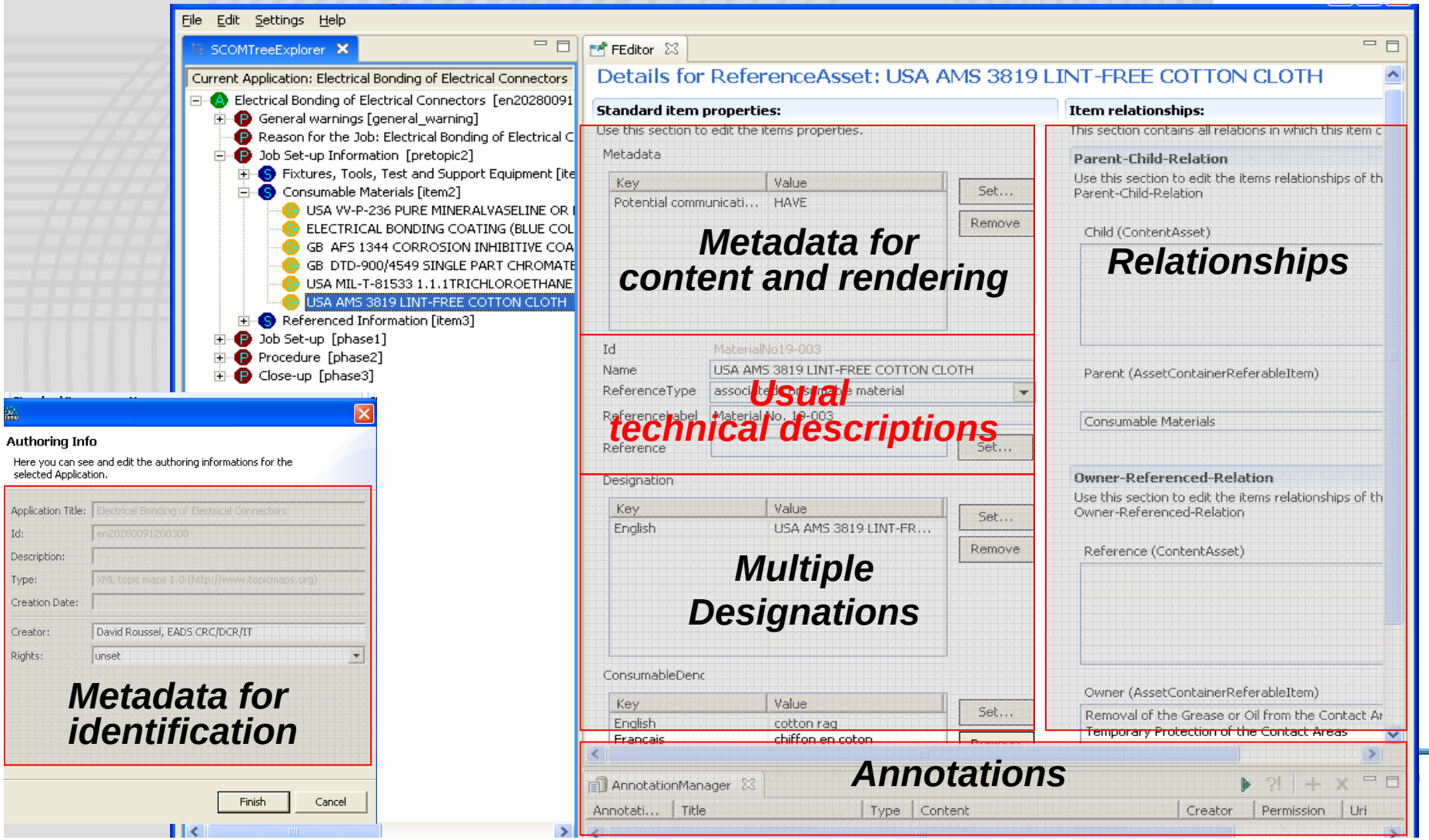


SNOW services & Authoring environment



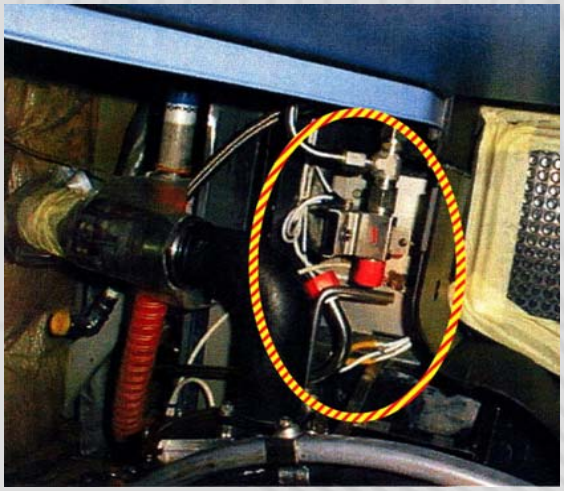
SNOW Authoring tool

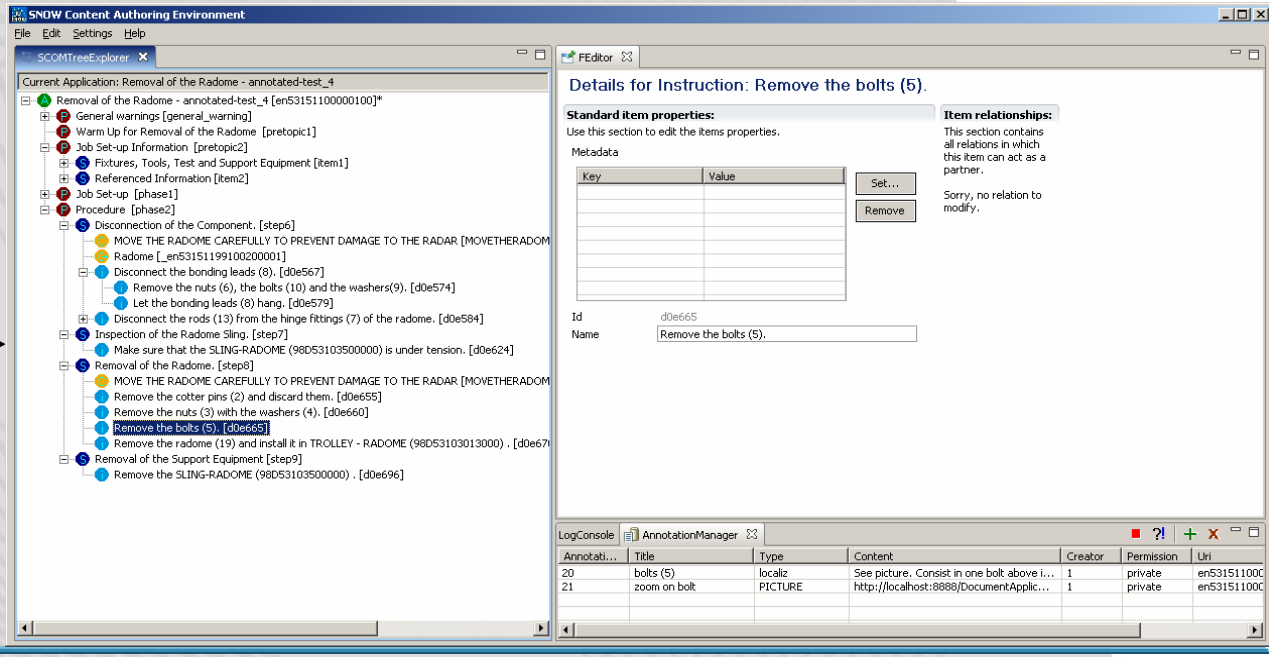
Our prototype adopts a hierarchy of phases, steps and instructions to author maintenance procedures and hides the topic map machinery



Shared multimedia typed annotations of procedures

- To report trouble to remote experts or technical writers
- To manage potential feedbacks related to intensions of communication
- To alert on procedure's modifications (by technical writers)
- To personalize procedures (maintenance company context)
  - by additional information merged with the target "topic"
  - independently from the regular procedure updates (by the manufacturer)



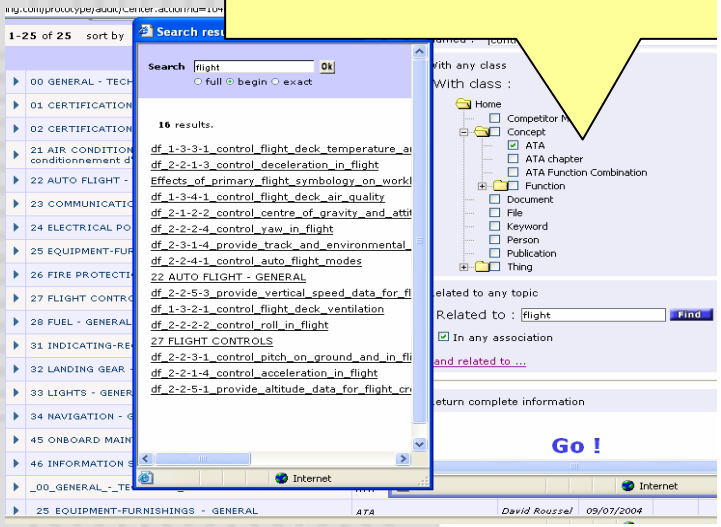


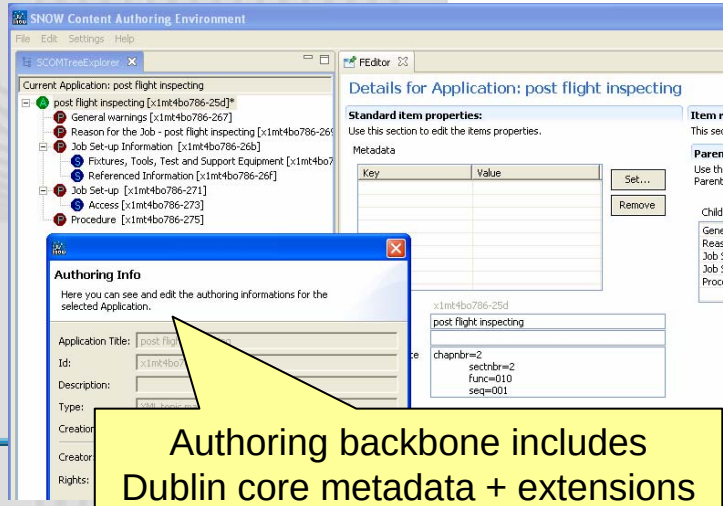
Authoring work with Dublin Core extensions

XTM-P combines several metadata set (instead of information codes) to improve computer-supported content reused.

```
<topic id="en1-3-4-1-00121-1000-01-1"> …

  <occurrence>

    </instanceOf> <topicRef xlink:href= "identification.xtm#function" /> </inst...

    < resourceData>1-3-2-1 </resourceData>

 </occurrence>   <occurrence>

      <instanceOf> <topicRef xlink:href="identification.xtm#dc-title" /> </inst…

     <resourceData> flight deck ventilation inspecting </resourceData>

 </occurrence>  <occurrence>

      <instanceOf> <topicRef xlink:href= "identification.xtm#file-ext" />

     </instanceOf>

     <resourceData>-00121-1000</resourceData>
```

Semantic add constraints on types and relationships for information retrieval





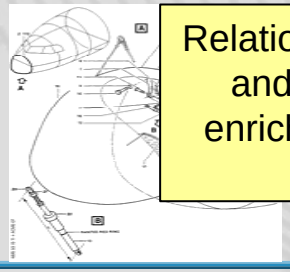
Authoring backbone includes Dublin core metadata + extensions

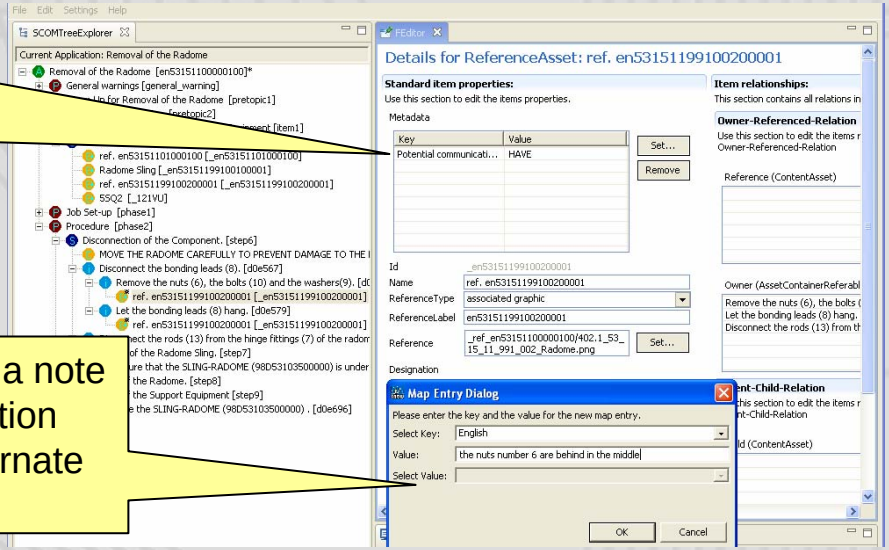
Content enrichment with explicit communication acts and typed relationships

```
<association id=" d0e574-en53151199100200001">
<instanceOf>   <topicRef xlink:href="proc-templates.xtm#Pragmatic-rel"/></instanceOf>
        … relation between Graphic en53151199100200001 and Instruction d0e574…
</association>

 <topic id=" d0e574-en53151199100200001-reification">
   <instanceOf>   <topicRef xlink:href="proc-templates.xtm#associated-graphic"/> </inst…
   <subjectIdentity>  <subjectIndicatorRef xlink:href="#d0e574-en53151199100200001"/></sub…
   …
   <basename> the nuts number 6 are behind in the middle of the radome </basename>
 </topic>
```

Extensible typology of **communication acts** to make explicit the intended role of each information

Relationship between a note and a given instruction enriched with an alternate description

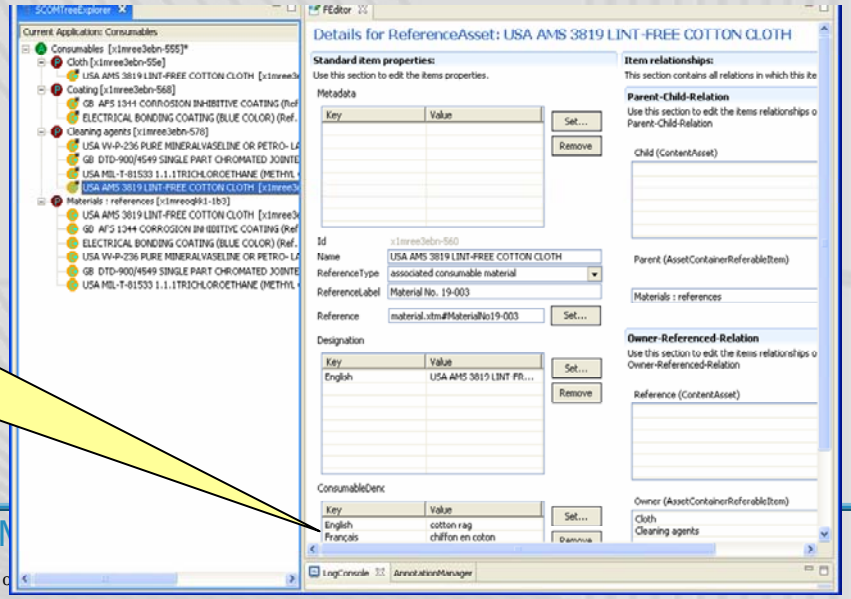




Content Management with multiple designations taking into multicultural aspects


```
<topic id="_accessplatform2m6ft7in">
    <instanceOf> <topicRef xlink:href="proc-templates.xtm#reference"/>  </instanceOf>
    <baseName>
       <scope> <topicRef xlink:href="PSIs.xtm#en"/>
                    <topicRef xlink:href="proc-templates.xtm#designation"/> </scope>
      <baseNameString> access platform of 6 ft. 7 in. </baseNameString>
    </baseName>
    <baseName>
      <scope>  <topicRef xlink:href="PSIs.xtm#fr"/>
                   <topicRef xlink:href="proc-templates.xtm#designation"/>  </scope>
      <baseNameString> élévateur de 2 m </baseNameString>
    </baseName>
</topic>
```

Scopes also enable substitutes description for non specific tools or consumables in a maintenance context

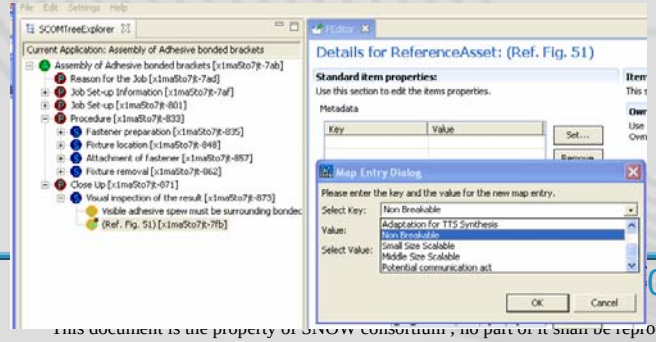


Content adaptation relying on rendering hints

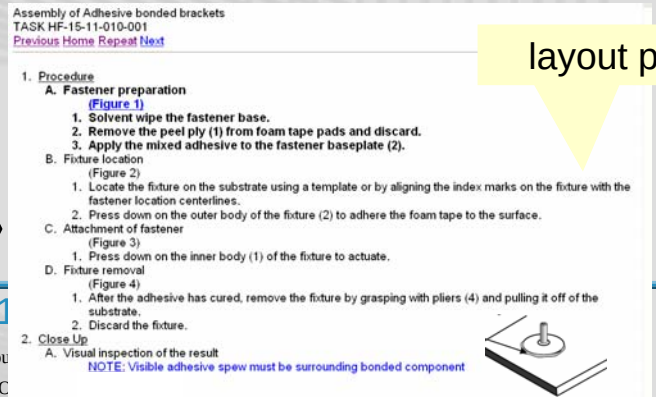
Rendering Hints are special metadata for rendering, which
- cannot be derived from the semantic descriptions (e.g. *scalability*).
- improve the layout quality according end-user usability criteria or preferences (e.g. *importance*).

```
<association >
    <instanceOf > <topicRef xlink:href =" proc-templates.xtm#Pragmatic-rel " />
     </ instanceOf >
    <scope > <topicRef xlink:href ="#non-breakable" /> </ scope >
    <member >
        … An instruction I and a graphic G …
</association >

<topic id=" Bonding_details ">
  <instanceOf > < subjectIndicatorRef xlink:href ="# graphic " /> </ instanceOf >
  <occurrence >
  <instanceOf > <topicRef xlink:href ="#small-size-scalable"/> </ instanceOf >
  < resourceRef xlink:href =" Bonding_details . tif " /> …
```

This graphic is necessary for instruction I and scalable.



IETP preview



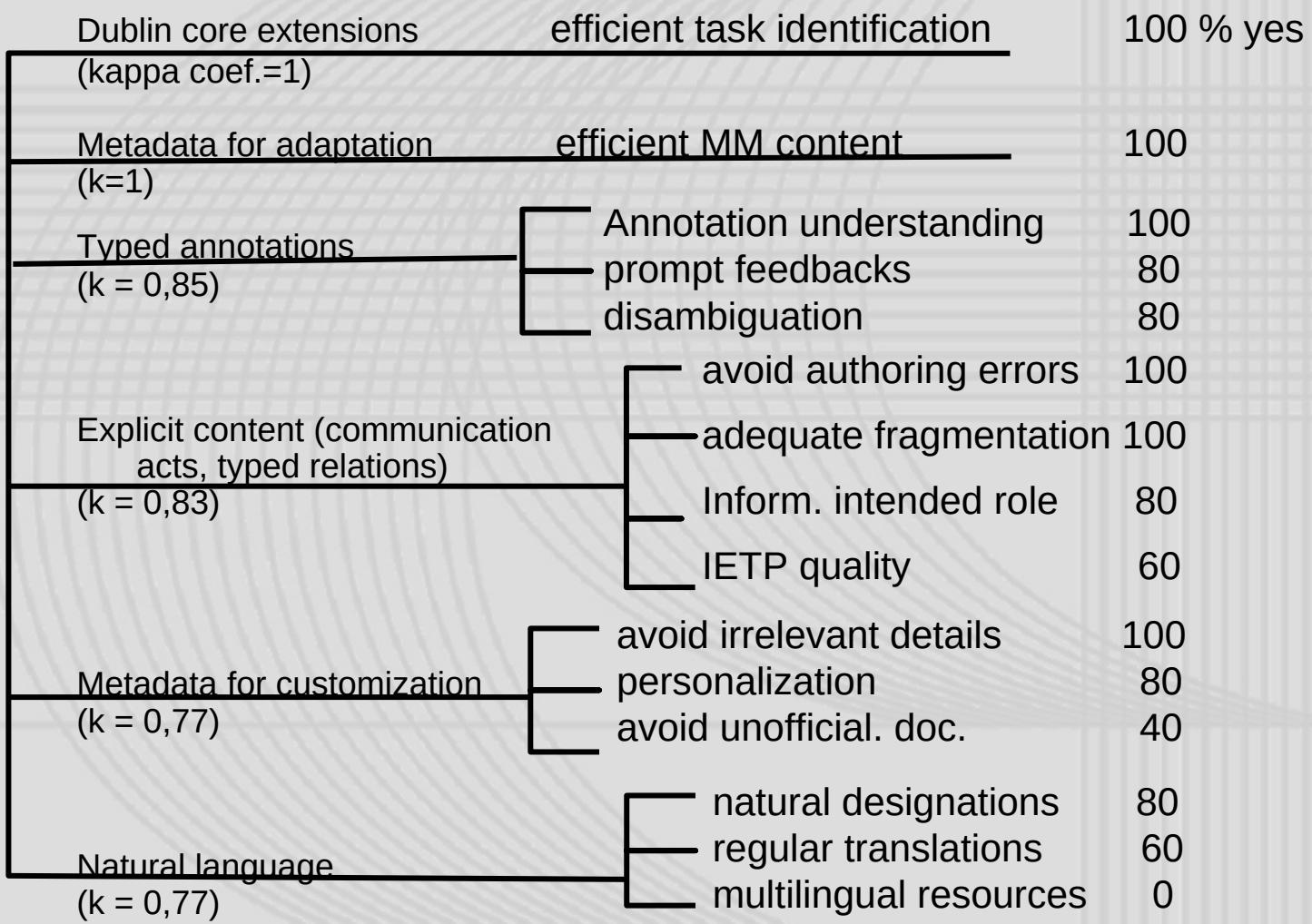
layout preview

First evaluation of Benefits

How Semantic data models – as illustrated by XTM-P – are perceived by samples of EADS technical documentation engineers

Field assessment of benefits as causal attributions

Evaluation : YES/NO questionnaire filled by EADS technical data engineering groups about SNOW authoring approach relevance in their context



Conclusion

Structured procedural contents can be captured in TM terms.

Topic Maps is perceived as a valuable standard for:

- Metadata set definition and combination for identification
- « Contextual » contents adaptation

Perspectives

- Extend technical documentation standards *(S1000D Data modules header for technical contents e.g. tables).*
- Rules and constraints to specify requirements on predefined subjects used in separated documents (*S1000D Business rule for Technical Documentation exchange).*
- Constraints on associations to guide editing and design robust information extractors.