



Next Generation Requirements Engineering

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The NextGenRE Project



- Next Generation Requirements Engineering (NextGenRE) is a study funded by ESA/ESTEC to improve the requirements engineering process within the European Space industry in connection with Model-based System Engineering (MBSE)

The Core Problem



- Establishing and managing a “good” set of requirements is one of the critical success factors for any space system project, and for the development of any complex product in general
- The essential problem is the “requirement string”: pure text, no semantics
- First steps toward improving on the “requirement string” are:
 - Adding semantics
 - But keeping it acceptable for users
 - Keep it possible to interact with existing methods and tools (e.g. Model Based System Engineering, DOORS)

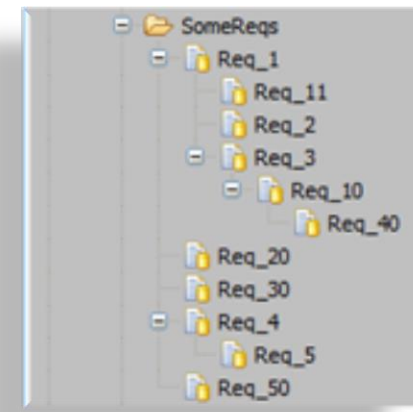
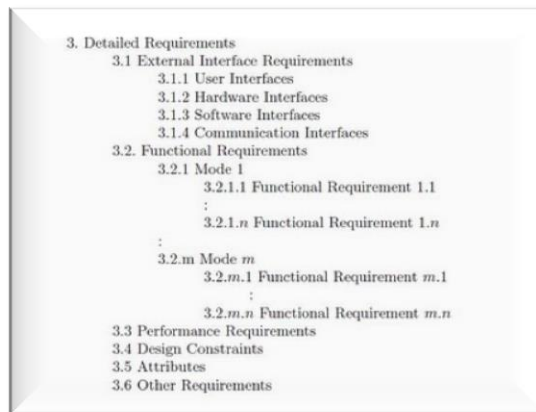
The NextGenRE Approach



- A very flexible and configurable prototyping environment including
 - **Semantic web technology** – storage of data in standard RDF format as a basis for reasoning
 - **Extended wiki technology** – stable open source wiki platform with powerful semantic extensions
 - **Model-based technology** – industry-standard SysML based modeling, model-to-text, model-to-model transformation capabilities
 - **Template patterns** – customizable templates allowing efficient creation and reuse of requirements



- In **document-centric** requirements engineering, it was acceptable that structure and semantics were only in the minds of author and reader
- But in **model-based requirements engineering**, we can add structure and semantics to the contents of the requirements themselves



Using Wiki Technology



- The central component of the NextGenRE tool is a **Wiki**
- Wikis are a natural technology for requirements engineering support
 - Full support for collaborative work
 - Built-in powerful text processing and formatting
 - Paradigm of pages and links extends naturally to requirements engineering: one page / one requirement
- Wikis have been investigated in recent years for requirements engineering
 - But information is still pure text, “understandable” only by humans



- **Semantic wikis** now make it possible to define machine-processable content and to query information in the generation of pages
- Definition of **page properties**
 - E.g. “Lisbon” page has property **population** with value 547631
- **Relationships** between pages
 - E.g. “Lisbon” page has semantic link **is_in** with value Portugal.





- We have constructed our own powerful semantic wiki by extending XWIKI



- Scalable and stable wiki
 - Macros are available to implement semantic support
 - Classes and objects values are available for pages
- **XEclipse** is an XWIKI GUI directly integrated with the mainstream Eclipse GUI



- Supports all editing capabilities of XWIKI
- It can be a valid alternative to the use of a web browser



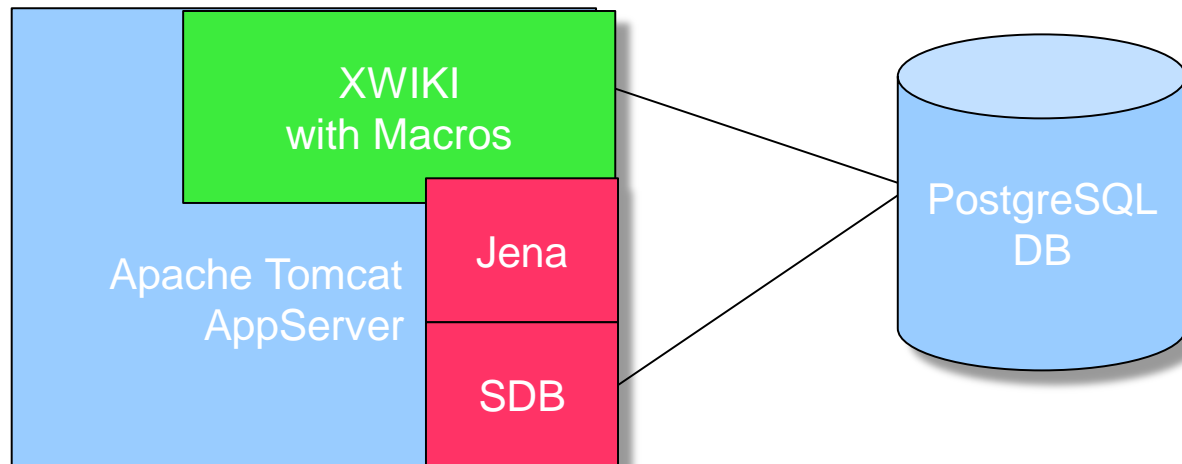
- To introduce semantics, we have adopted the technology of the **Semantic Web**
- Data is stored in Resource Description Framework (RDF) format so that reasoning can be performed
- The RDF database has been connected to the Wiki in order to create the **Semantic Wiki**



Our **SemXWiki** Architecture



- *Semantic macro support* has been developed to add semantic information to wiki pages
- Macro support is based on the Jena Ontology API
- Apache Tomcat is the Java AppServer
- SDB is the persistent storage for semantic information
- PostgreSQL is the backend database





- Practical semantic support to
 - Define resources and their semantic properties in pages
 - e.g. define requirements and properties
 - Obtain semantic properties in pages
 - use SPARQL for semantic queries
 - Use classes and objects tagged to pages
 - classes are used to structure requirements and define templates
 - objects are attached to semantic information



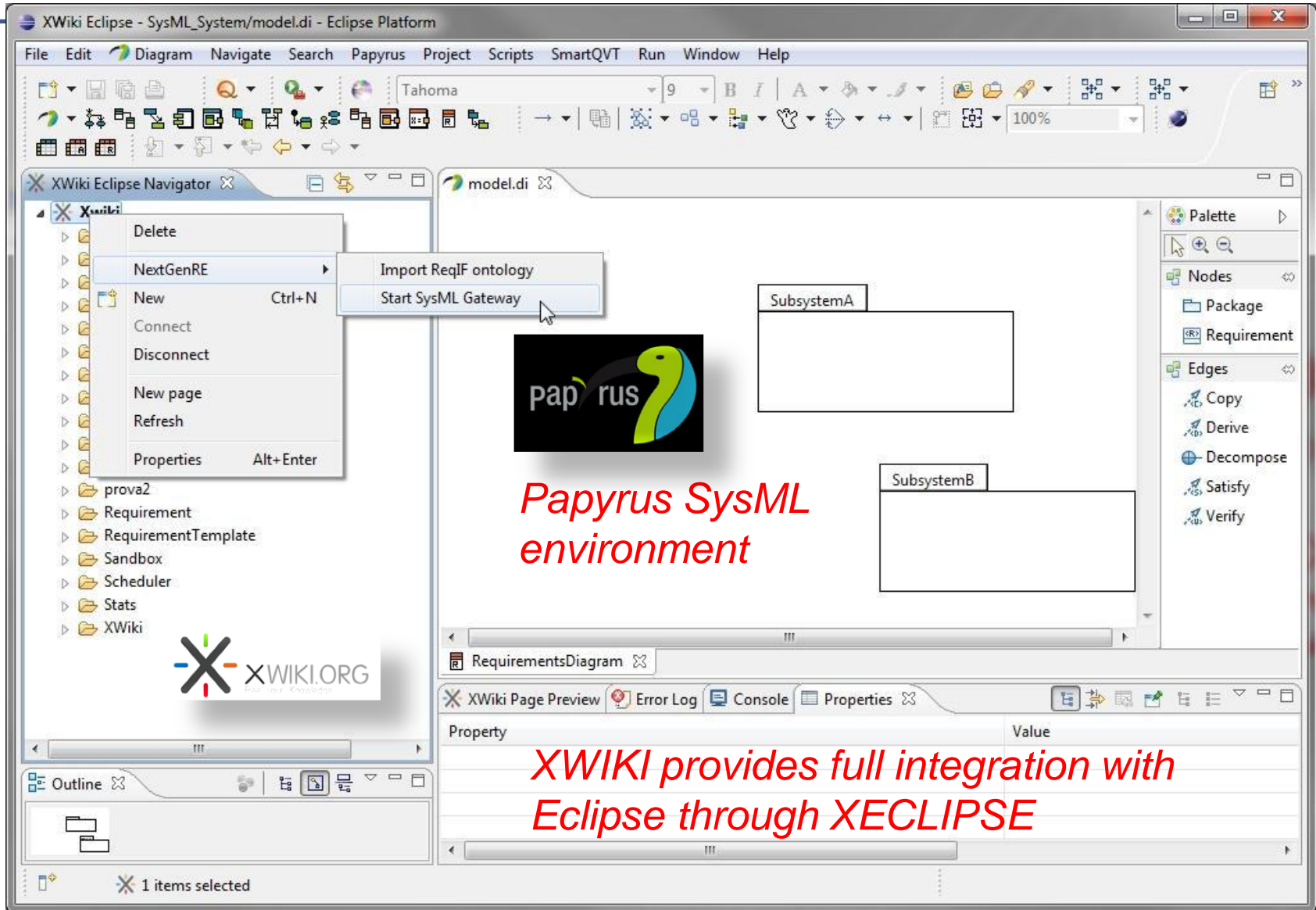
- The use of semantic web technology enables the construction of powerful **reasoners**
 - Whenever the semantics can be well-defined
 - Automatic processors can look for contradictions and inconsistencies
 - E.g:
 - a high level requirement is specified for a system architecture,
 - a reasoner could check whether redundant or even conflicting requirements have been derived at lower levels



Connection to Design



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Papyrus SysML environment

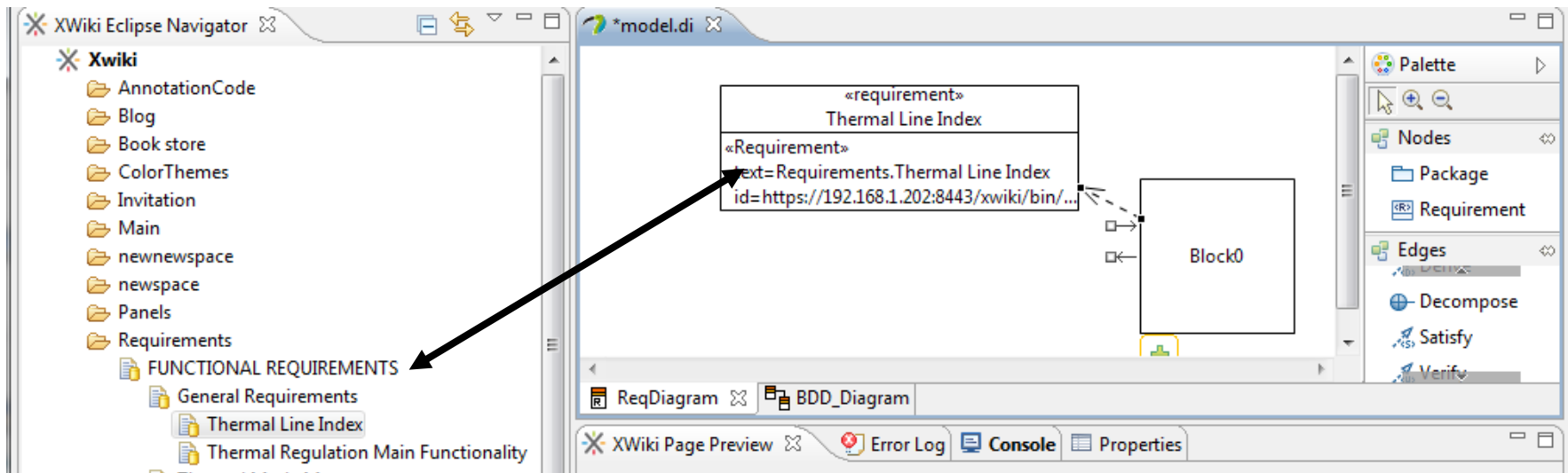
| Property | Value |
|----------|-------|
| | |
| | |
| | |

XWIKI provides full integration with Eclipse through XECLIPSE

Connection to SysML



- Requirements stored in XWiki can be represented in SysML by using drag&drop facility...
- Then links to SysML modeling elements can be created (e.g. satisfy relationship)



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- We support connections to existing requirement tools (e.g. DOORS) through Import / Export facilities based on the **Requirements Interchange Format (ReqIF)**
- now managed by the Object Management Group and under implementation in the Eclipse Requirements Modeling Framework





Wiki Home » XWiki Space » Data types » Requirement capture

Requirement capture

Last modified by Administrator on 2011/12/19 12:19

Class: Requirement

Class properties:

- Enter the requirement text (Content: TextArea)
- ID (ID: String)
- Version (Version: Number)
- Degree of importance (Priority: Static List)
- Progress Status (ProgressStatus: Static List)
- Category (Category: Static List)
- Comment (Comment: String)
- Flexibility (Flexibility: Static List)
- Conformity Status (ConformityStatus: Boolean)
- parent (parent: String)
- *You can use the class editor to add or modify the class properties.*

EDIT: Inline form ▼

MSRO » MI-010 » MI-020 » MI-030 🌐

MI-030

ENTER THE REQUIREMENT TEXT

The mission shall perform safely the capture, b

ID

MI-030

VERSION

DEGREE OF IMPORTANCE

High

Low

PROGRESS STATUS

Analysis (definition in progress) ▼

Analysis (definition in progress)

Obsolete (deleted)

Reference (currently used)

Superseded (older version no more in use)

Maintenance

Mission

Operation

Performance

RAMS

Security

COMMENT

FLEXIBILITY

High

Low

Medium

CONFORMITY STATUS

No ▼



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AD1-MSR Orbiter MRD iss 1 rev 1

AD1-MSR Orbiter MRD iss 1 rev 1

Last modified by Administrator on 2012/02/23 16:17

1MSRO MRD Requirements

Document production

Baseline

- o B1
- o B2

Applicable document list

| value |
|-------|
| AD4 |
| AD5 |
| AD6 |

List of TBx

| value |
|-------|
| TBC |

AD1-MSR Orbiter MRD iss 1 rev 1 » AD5

Last modified by Administrator on 2012/02/16 18:04

List of requirements related to AD5 :

| doc | desc |
|-----------------------|---|
| MSRO-MRD.1-1-19MI-190 | The mission design shall be compatible with the MSRO-MRD.1-1-19MI-190 |
| MSRO-MRD.1-1-5MI-50 | The MSR Orbiter interfaces to the MSRO-MRD.1-1-5MI-50 |

Addition of a semantic property on each page

Use of semantic query to request all the pages containing a value of this property

Wiki Home » Tags

Tags

Last modified by Administrator on 2011/08/17 08:37

AD5

All documents tagged with AD5

- MSRO-MRD
 - 1.1.19MI-190
 - 1.1.5MI-50
 - 1.1.13MI-130

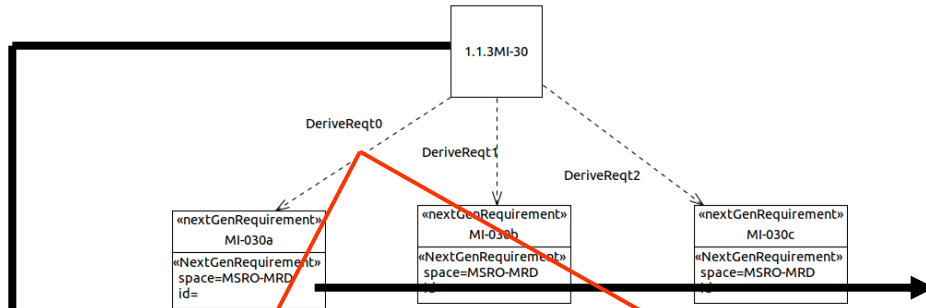
Definition of tag on each page

xWiki manages the page and request creation



Based on semantic properties

- Implicit part of the template



AD1-MSR Orbiter MRD iss 1 rev 1 » IMSRO MRD Requirements » 1.1Mission requirements » 1.1.3MI-30

1.1.3MI-30

Last modified by Administrator on 2012/02/17 11:55

The mission shall perform safely the capture, bio-seal and return to Earth of the MSR Orbiting Sample

| Property | Value |
|---|------------------|
| http://www.tas.com/DERIVREQ | MSRO-MRD.MI-030a |
| http://www.tas.com/DERIVREQ | MSRO-MRD.MI-030b |
| http://www.tas.com/DERIVREQ | MSRO-MRD.MI-030c |

MSRO-MRD » MSRO URD example » MI-030a

MI-030a

Last modified by Administrator on 2012/02/17 11:52

Enter the requirement text

The mission shall perform safely the capture of a sample

ID

MI-030a

Version

Degree of importance

High

Progress Status

Analysis (definition in progress)

Category

Functional Mission

Comment

Flexibility

Low

Conformity Status

No

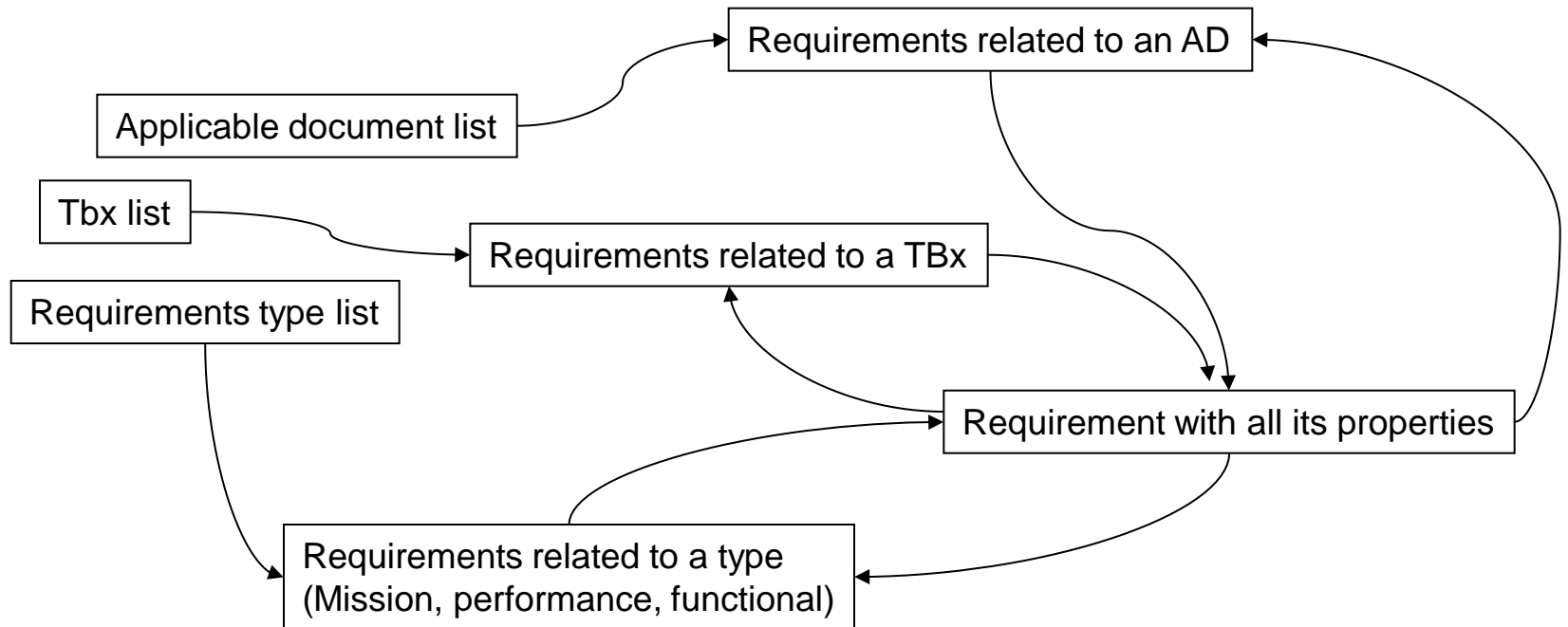
<set property operation aborted!>

| Property | Value |
|---|-----------------------------------|
| http://www.tas.com/DERIVREQ | MSRO-MRD.MI-030a |
| http://www.tas.com/REQPARENT | MSRO-MRD.1-1-3MI-30 |
| http://www.tas.com/REQPARENT | MSRO-MRD.1-1-4MI-40 |
| http://www.tas.com/ID | MI-030a |
| http://www.tas.com/CONTENT | {html clean="false" wiki="false"} |
| http://www.tas.com/PRIORITY | High |

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- A way to have a fully navigable model



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THANK YOU !



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