Preservation planning

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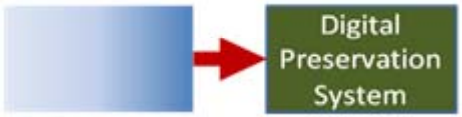
Preservation Planning 1: Agenda

- Context
  - Decision problems in digital preservation
- Overview
  - What is a preservation plan?
  - How to create a preservation plan
- Requirements
  - High-level requirements
  - Exercise

Digital Preservation in Context

- Digital Preservation is
  - … Information Management with a long-term view
  - … Interoperability over time
  - … Alignment between content, technology and consumers
  - … Relevant in very diverse scenarios
    - From digitised books to eScience and engineering
    - From web archiving to business environments
- DP always needs to consider the contextual influences of organisations and systems



Digital preservation and planning

- The mission of digital preservation
  - Overcome obsolescence threats
  - ensure (current and) future access in a usable form for specific user communities
- The mission of peservation *planning*
  - Defining the right actions → Component selection
  - Questions:
    - How to select the right action in a given scenario?
    - How to ensure trust?
    - How to enable scalability?

Preservation Planning: Question 1

- **How can we select the optimal preservation action for a given setting?**
  - What are the constraints on the decision space?
  - What are the factors influencing the decision makers' preferences?
  - How can we model multiple competing objectives and requirements?
  - How should we evaluate software components?

Preservation Planning: Question 2

- **How can we ensure trustworthy preservation planning?**
  - What are the requirements on trust that need to be addressed?
  - What decision steps and evidence need to be documented?
  - What are the aspects that a plan needs to address, and what are the elements needed to cover them?
  - How can we ensure reliable evaluation procedures and repeatable evidence?

Preservation Planning: Question 3

- **How can we ensure that decision processes scale up?**
  - How can we automate decision making?
  - How can we integrate continuous monitoring?
  - Which properties can be measured automatically, and how?
  - How can we create a controlled environment for observing the behaviour of components in a reproducible way?

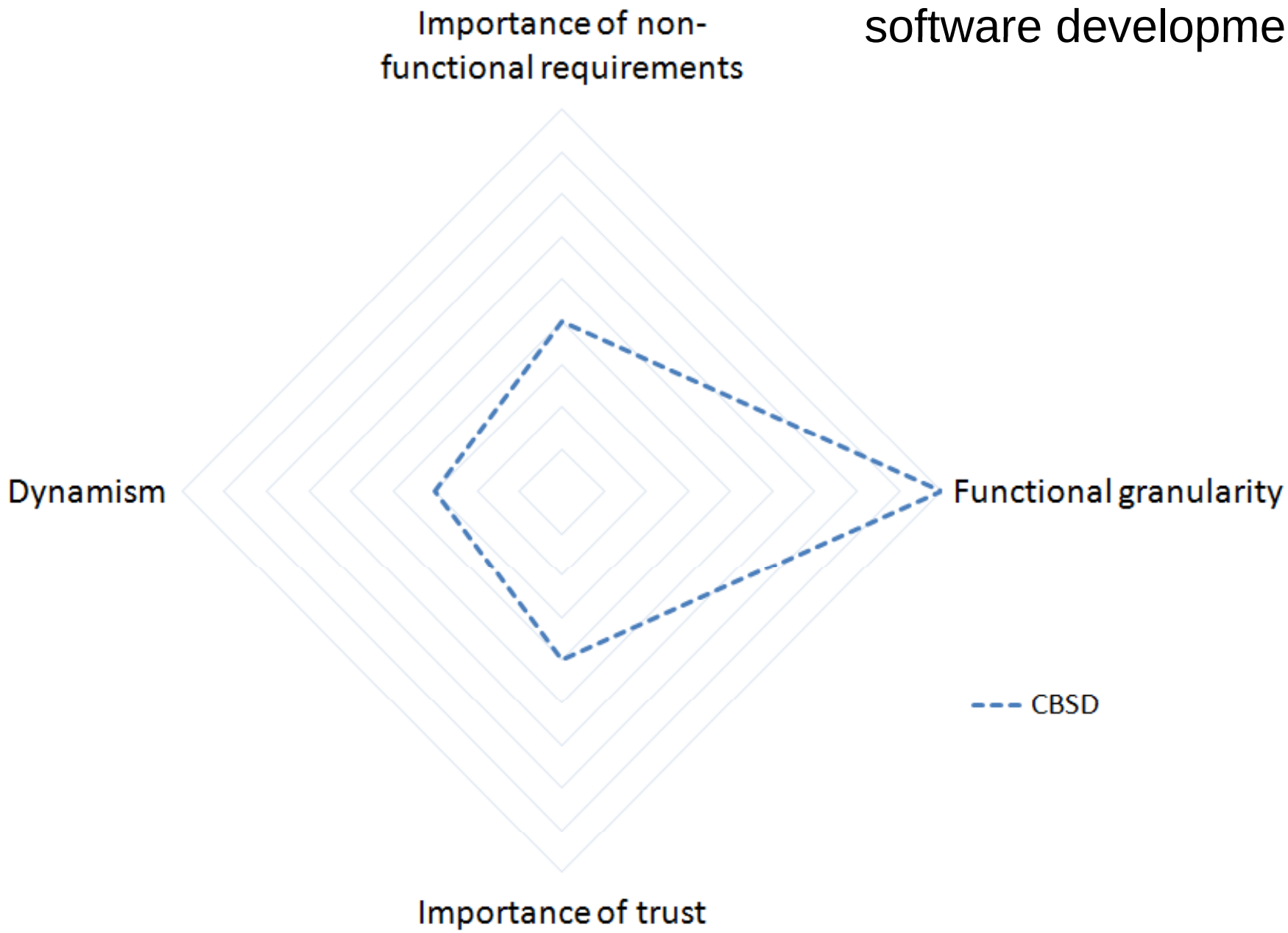
Challenges in Preservation Planning

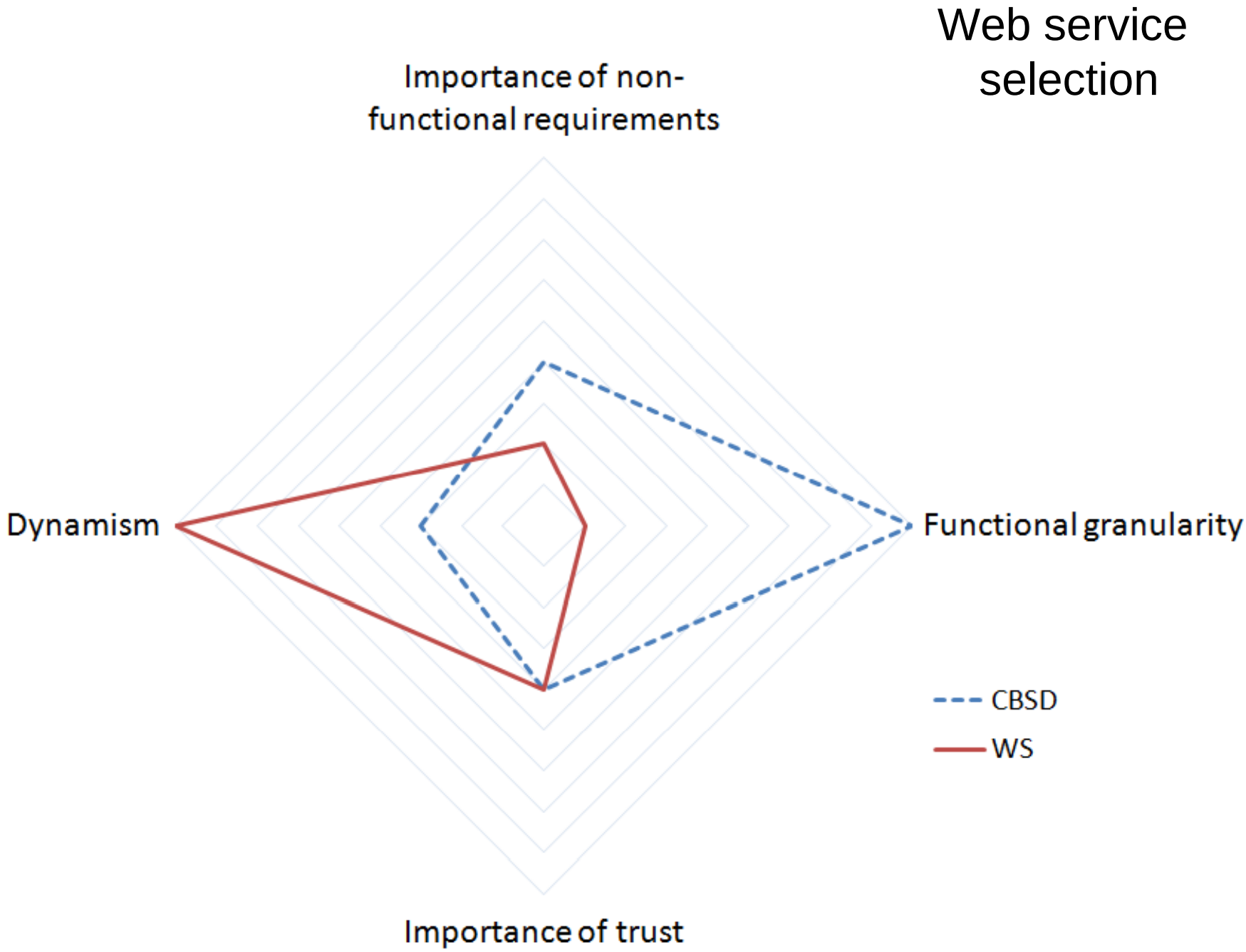
- Evaluating preservation actions
- Multi-objective decision making
- Component selection
- Trustworthy repositories
- Transparent documentation and evidence
- Automation and tool support
- Decision factors and measurements

Evaluating preservation actions

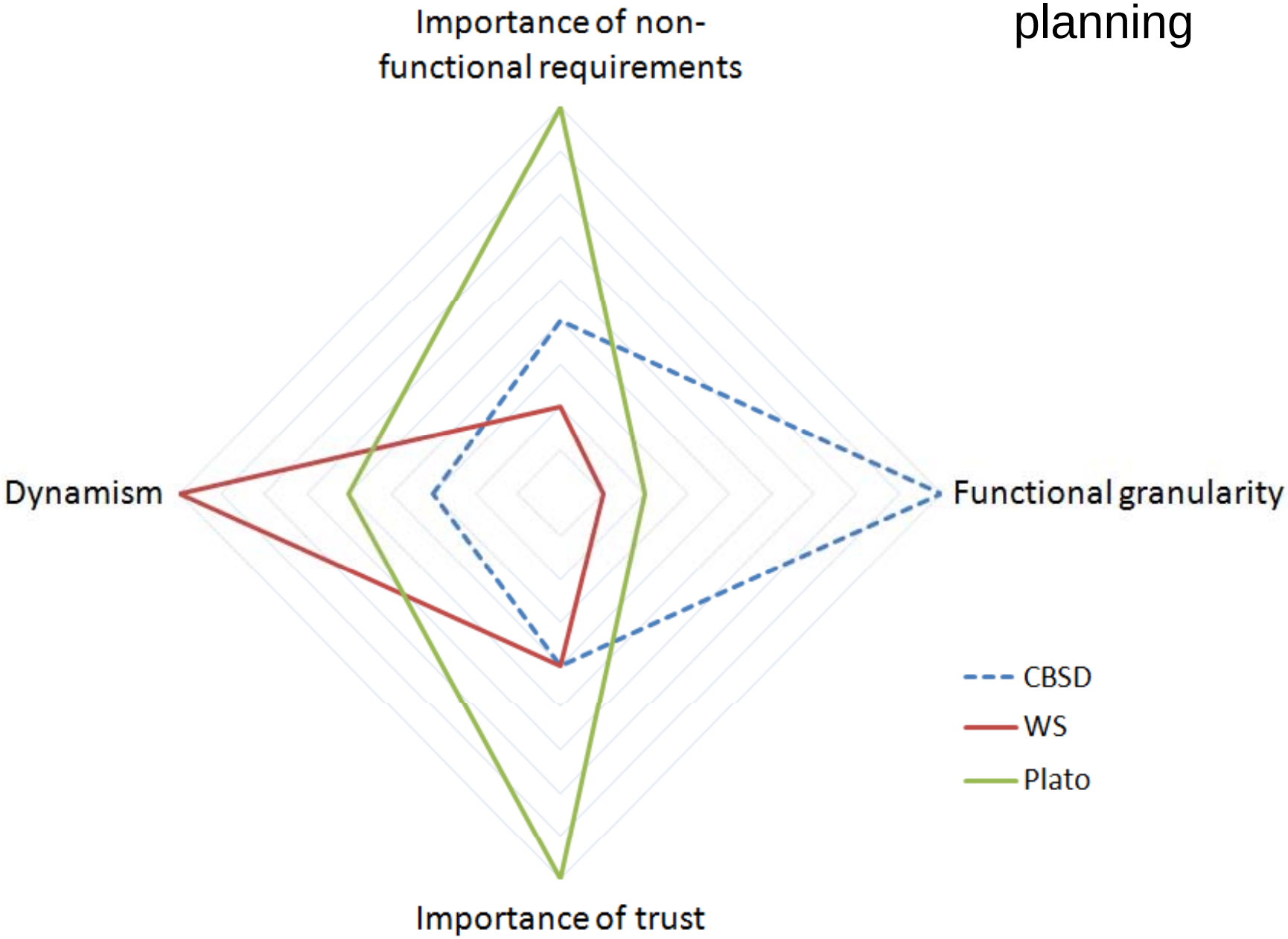
- Several actions available (migration, emulation, ...)
- Challenges:
  - Quality varies across tools
  - Properties vary across content
  - Usage varies across communities
  - Requirements vary across scenarios
  - Risk tolerance varies across collections
  - Preferences and constraints vary across organisations
  - Cost structures and compatibility varies across environments
  - Constraints, priorities and requirements shift constantly
- Comparable to
  - Component selection
  - Web service selection

Component based software development




Web service selection
Importance of non-functional requirements
Dynamism
Functional granularity
Importance of trust
CBSD
WS

Preservation planning

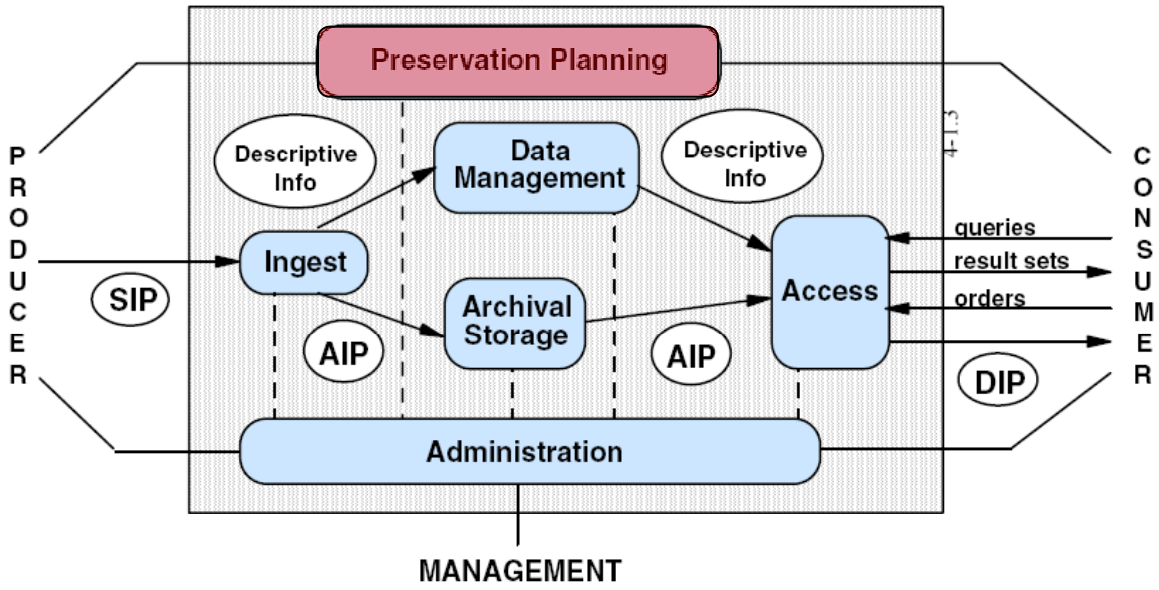


Evaluating preservation actions

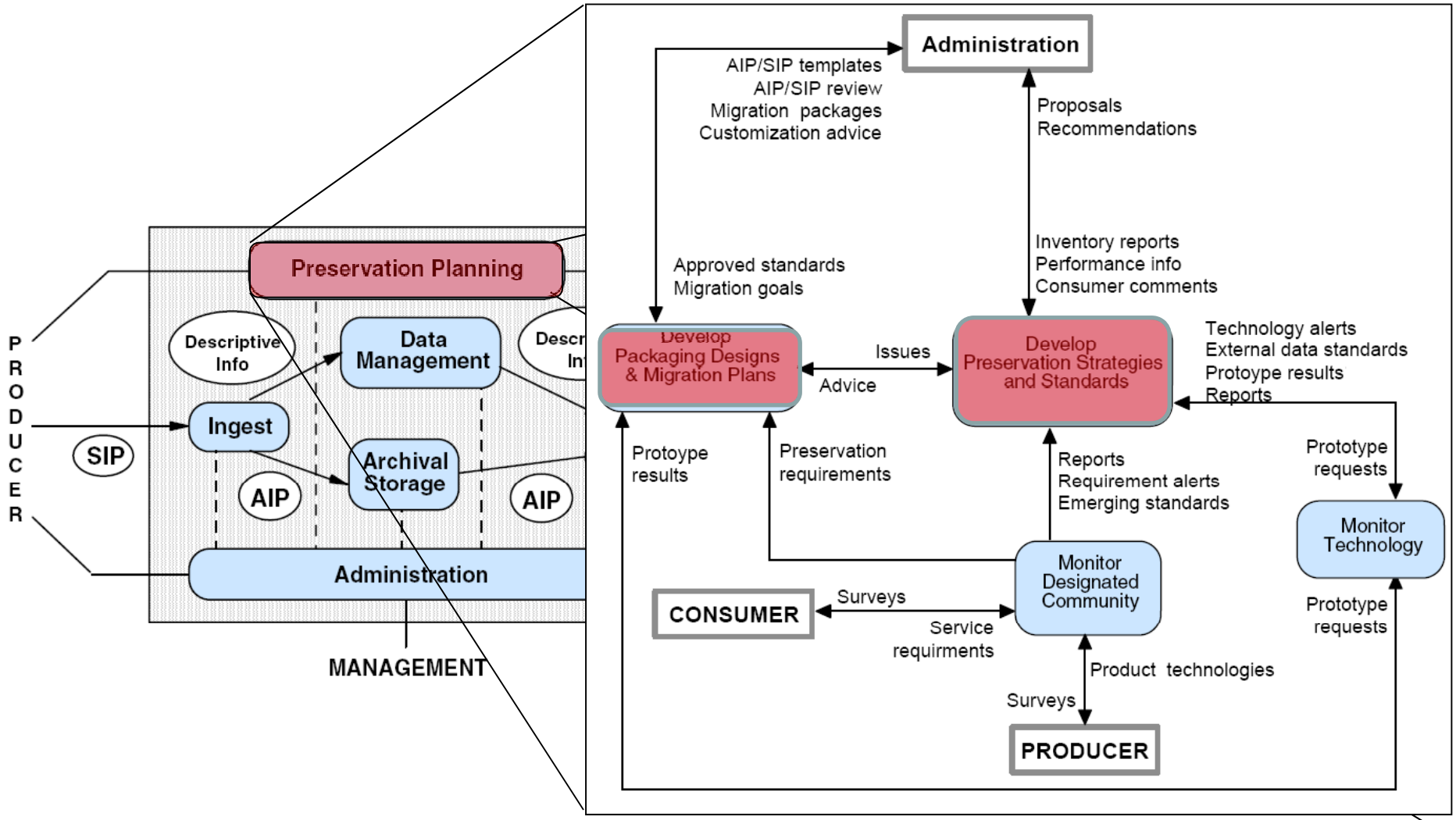
- Context: Trustworthy repositories
  - Open Archival Information Systems model (OAIS)
  - Trustworthy repositories criteria (TRAC, nestor)
  - Trust requires evidence
  - Evidence needs repeatable, objective facts

- Preservation planning approach
  - Evaluate potential actions objectively against scenario-specific requirements in a repeatable way
  - Sample-based experiments in controlled environment
  - Quantitative analysis of strengths and weaknesses
  - Evaluate suitability of each potential action

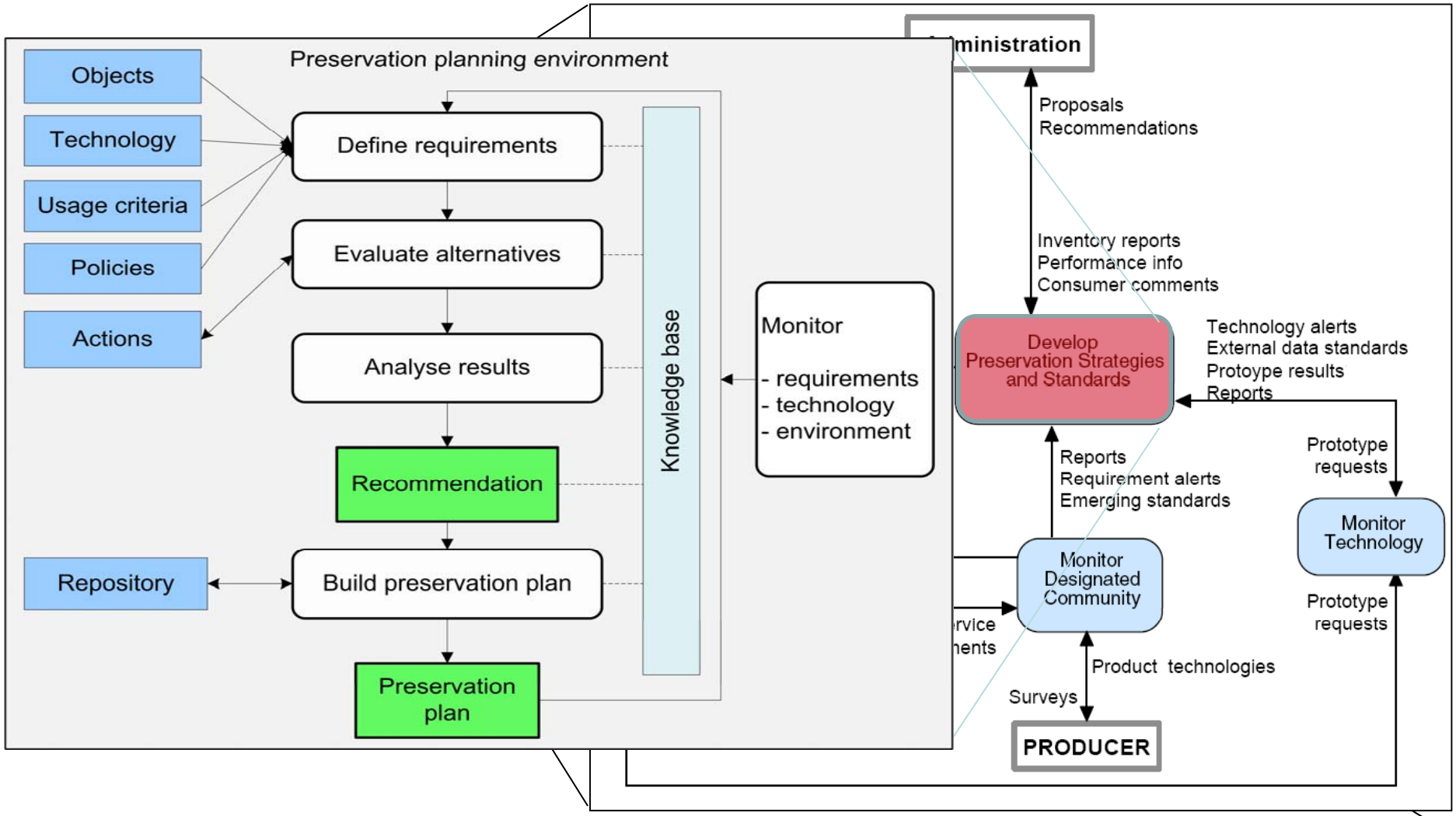
OAIS and Preservation Planning

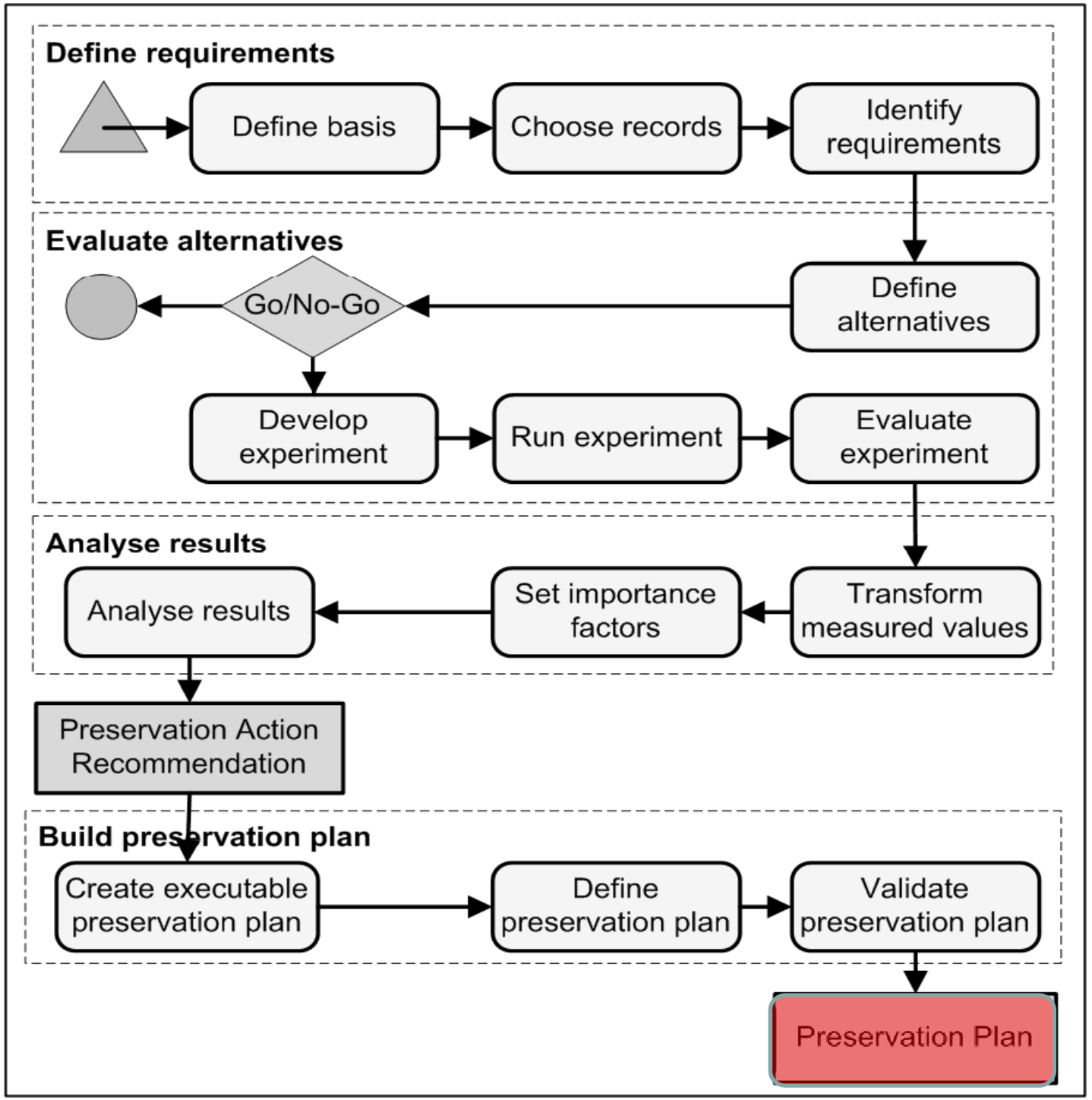


Preservation Planning and OAIS



Preservation Planning and OAIS




Define requirements
Define basis
Choose records
Identify requirements
Evaluate alternatives
Go/No-Go
Define alternatives
Develop experiment
Run experiment
Evaluate experiment
Analyse results
Analyse results
Set importance factors
Transform measured values
Preservation Action Recommendation
Build preservation plan
Create executable preservation plan
Define preservation plan
Validate preservation plan
Preservation Plan

What is a preservation plan?

- Definition of scope
  - What to preserve
- Set of actions
  - How to preserve it
- Evaluation of actions, recommendation for one
  - How to do it and why do it this way
- Documentation of actions and reasons
  - Why did we decide that
- Conditions for QA and monitoring
  - What to look out for

What is a preservation plan?

- ‘A ***preservation plan*** defines a series of preservation actions to be taken by a responsible institution to address an identified risk for a given set of digital objects or records (called collection).‘

- The Preservation Plan takes into account the preservation **policies**, **legal obligations**, **organisational** and **technical constraints**, **user requirements** and **preservation goals**.
- It also describes the preservation **context**, the **evaluated alternative preservation strategies** and the **resulting decision** for one strategy, including the rationale of the decision.

Characteristics of a preservation plan

- Translation of a preservation policy
- Specification of how to treat a collection in a given institutional setting
- Monitored for
  - ✓ changes in technology
  - ✓ changes in organisational setting
  - ✓ changes in user requirements
  - ✓ changes in available tools
  - ✓ changes in preservation methods
- Species concrete action
  - ✓ The **preservation action plan** can be an executable workflow definition, detailing actions and required technical environment
  - ✓ The preservation plan provides the context/background of the preservation action plan

The content of a preservation plan

1. Identification
2. Status
   - ✓ What was the immediate reason for this plan?
   - ✓ Has it been approved and if so, when and by whom
   - ✓ How does it relate to other plans related to a specific type of objects?
3. Description of institutional setting
4. Description of the collection (digital objects)
5. Purpose and requirements
6. Evidence of decision for a specific preservation action
   - ✓ what is the foundation of the decision
   - ✓ description of evaluation of possible actions
7. Costs considerations
8. Trigger for re-evaluation
9. Roles and responsibilities
10. Preservation action plan
    - ✓ executable program

TRAC and Preservation Planning I

A 3.2 Repository has procedures and policies in place, and mechanisms for their review, update, and development as the repository grows and as technology and community practice evolve.

- Policies, plans, monitoring

A3.6 Repository has a documented history of the changes to its operations, procedures, software, and hardware that, where appropriate, is linked to relevant preservation strategies and describes potential effects on preserving digital content.

- Preservation plans need traceability

TRAC and Preservation Planning II

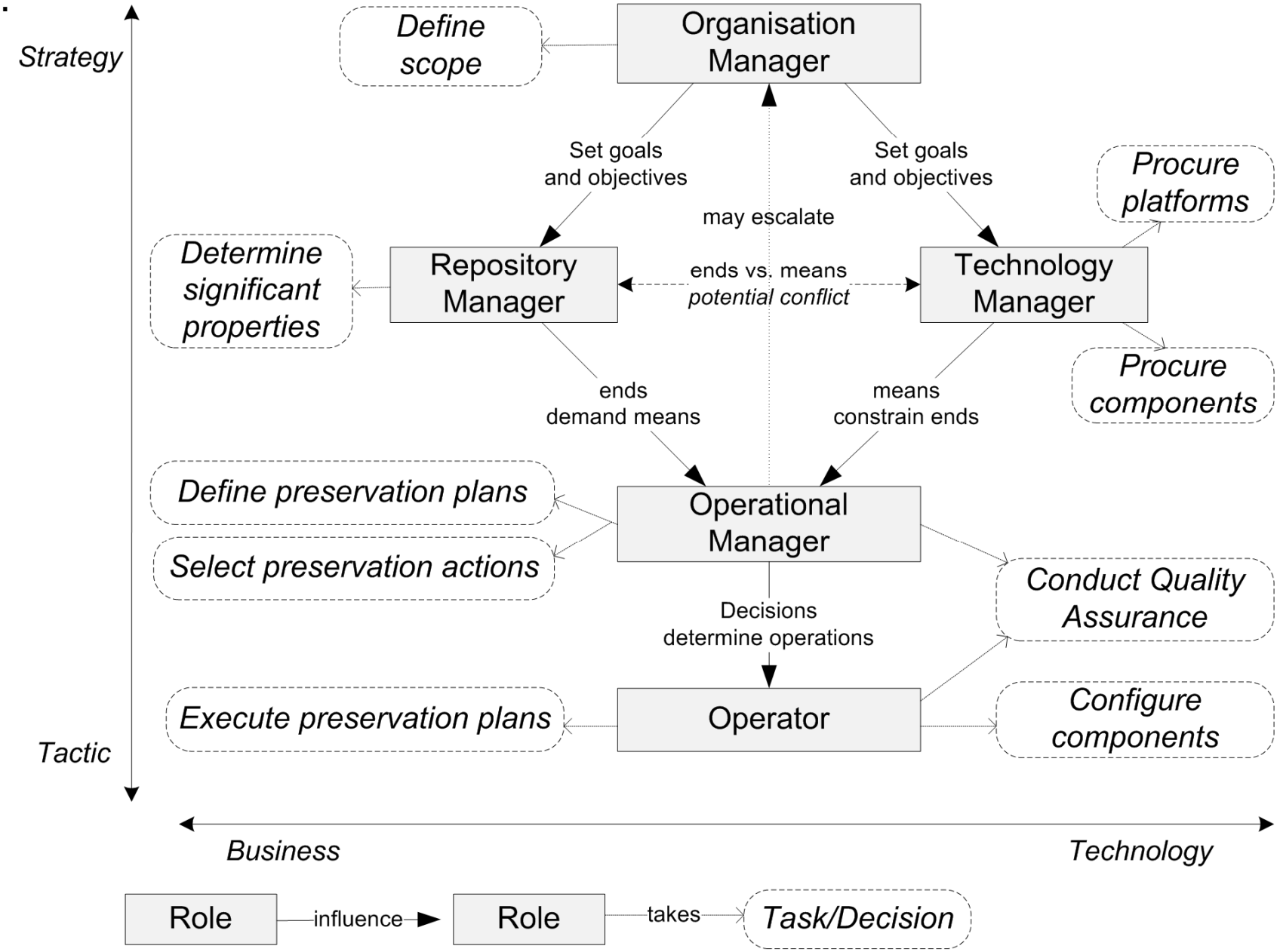
B3.1 Repository has documented preservation strategies.

- Preservation Plan

B3.3 Repository has mechanisms to change its preservation plans as a result of its monitoring activities.

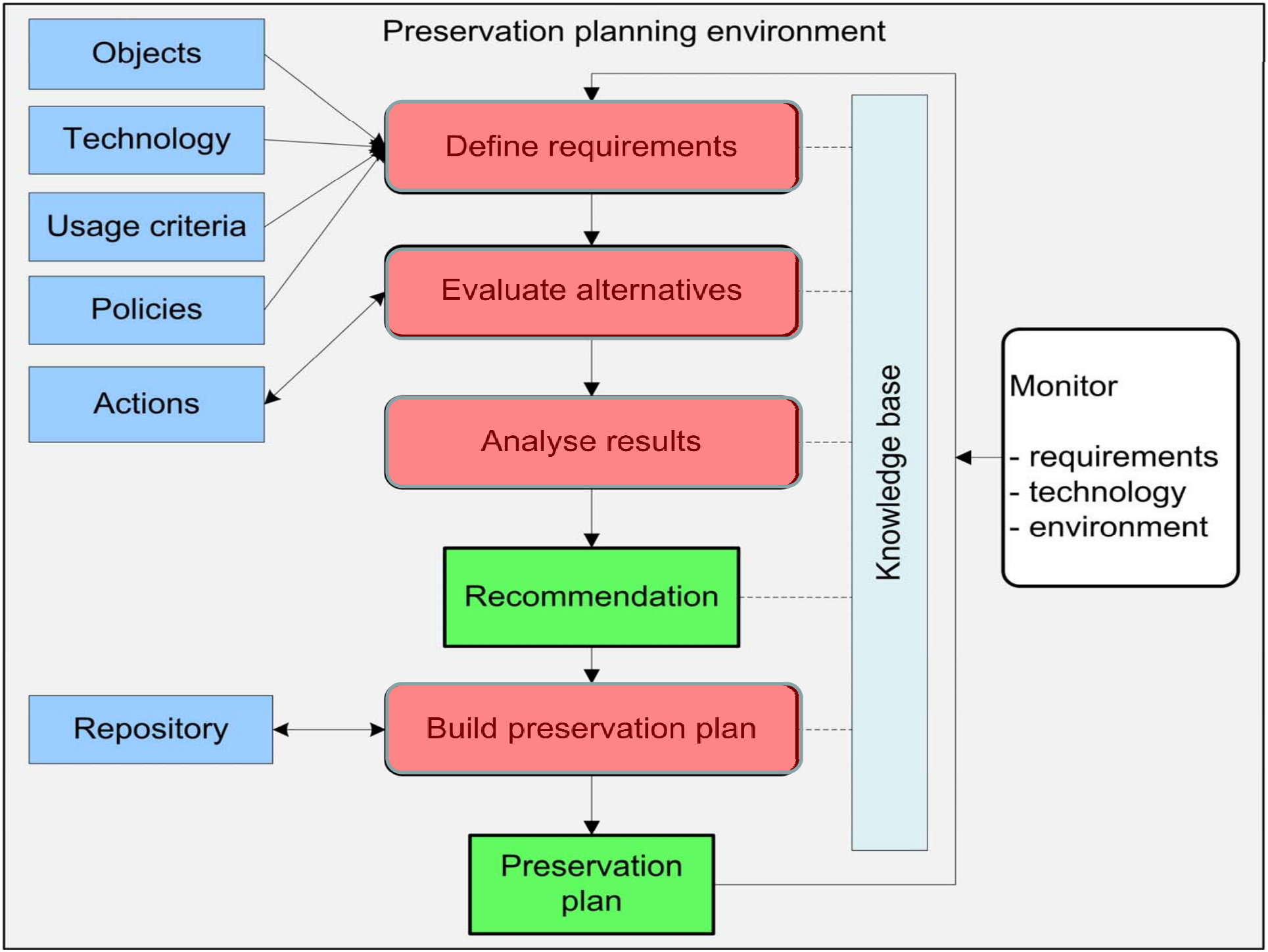
- Monitor environment
- Update preservation plans

A DP decision space

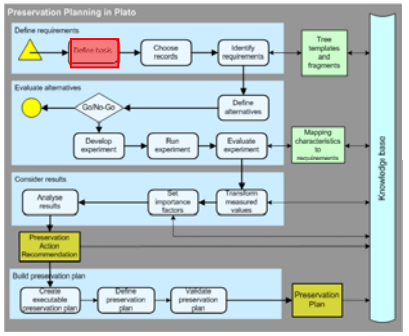


Agenda

- Preservation planning methodology
  - Walk-through
  - Objective Trees
  - Case Studies
  - Tool support
- Exercise
- Summary and Outlook


Preservation planning environment
Objects
Technology
Usage criteria
Policies
Actions
Define requirements
Evaluate alternatives
Analyse results
Recommendation
Build preservation plan
Preservation plan
Repository
Knowledge base
Monitor
- requirements
- technology
- environment

Define basis



- What are the objects?
- What are the fundamental requirements?
  - Authenticity, reliability, integrity, usability
  - Metadata (for different purposes)
- What are the applying policies, legal constraints, regulations…
  - User groups, target community
  - Institutional settings

Potential resources

- Mandate/ vision / mission statements
- Policy documents (if they exist)
- Project plans
- Guidelines
- Procedures/ rules

Preservation policy: examples

- Example policy statements of institutions with a digital preservation programme
  - UK Data Archive
  - National Archives of Australia
  - ISO/TR 18492:2005
    Long-term preservation of electronic document-based information

UK Data Archive

- < UK Data Archive Preservation Policy
- http://www.data-archive.ac.uk/news/publications/UKDAPreservationPolicy0308.pdf
- p. 11: “The UKDA has chosen to implement a preservation strategy based upon open and available file formats, data migration and media refreshment.”

- What does this choice mean in practice? Two examples:
  - Emulation is –apparently– not a preservation strategy that will be chosen; all obsolete files will be migrated.
  - Migration to open file formats will be preferred.

National Archives of Australia

- < An Approach to the Preservation of Digital Records
- http://www.naa.gov.au/images/an-approach-green-paper_tcm2-888.pdf
- p. 14: “The digital preservation program must be able to preserve any digital record that is brought into National Archives’ custody regardless of the application or system it is from or data format it is stored in.”
- What does this choice mean in practice? One example:
  - all records that are accepted, should be preserved, regardless file format, medium, application, etc.
  - transform to open standard + keep ‘original’ format

ISO/TR 18492:2005

- International standard: Long-term preservation of electronic *document-based i*nformation

- p. 12: Migration to standard formats

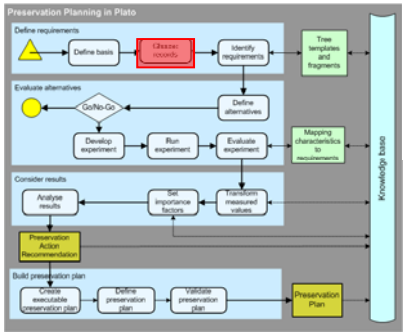
  Storage repositories should consider migrating electronic document-based information from the wide variety of formats used by creators or recipients to a smaller number of “standardized” formats upon their transfer to the custody of the repository.

  “Standardized” formats could be a consensus on formats that are widely used and are likely to cover a majority of a particular class of electronic document-based information. Proprietary file formats should be avoided. Among the technology neutral formats that merit consideration are PDF/A-1, XML, TIFF and JPEG.

Policies

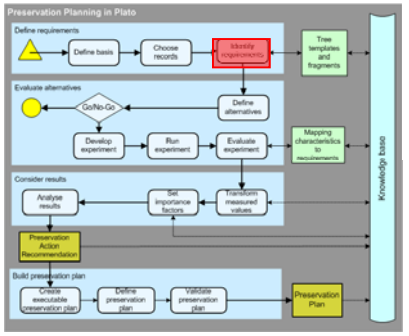
- Framework (requirements) are identified at a high level
- Some requirements can already be explicit. Examples:
  - choice for one strategy
    (e.g. migration to open document format)
  - choice that some types of records/documents can be denied because e.g. an *exotic* file format is used

Choose objects/records



- Representative for the objects in the collection
- Right choice of samples is essential
- They should cover all essential features and characteristics of the collection in question
- As few as possible, as many as needed
- Often between 3-10

Identify requirements



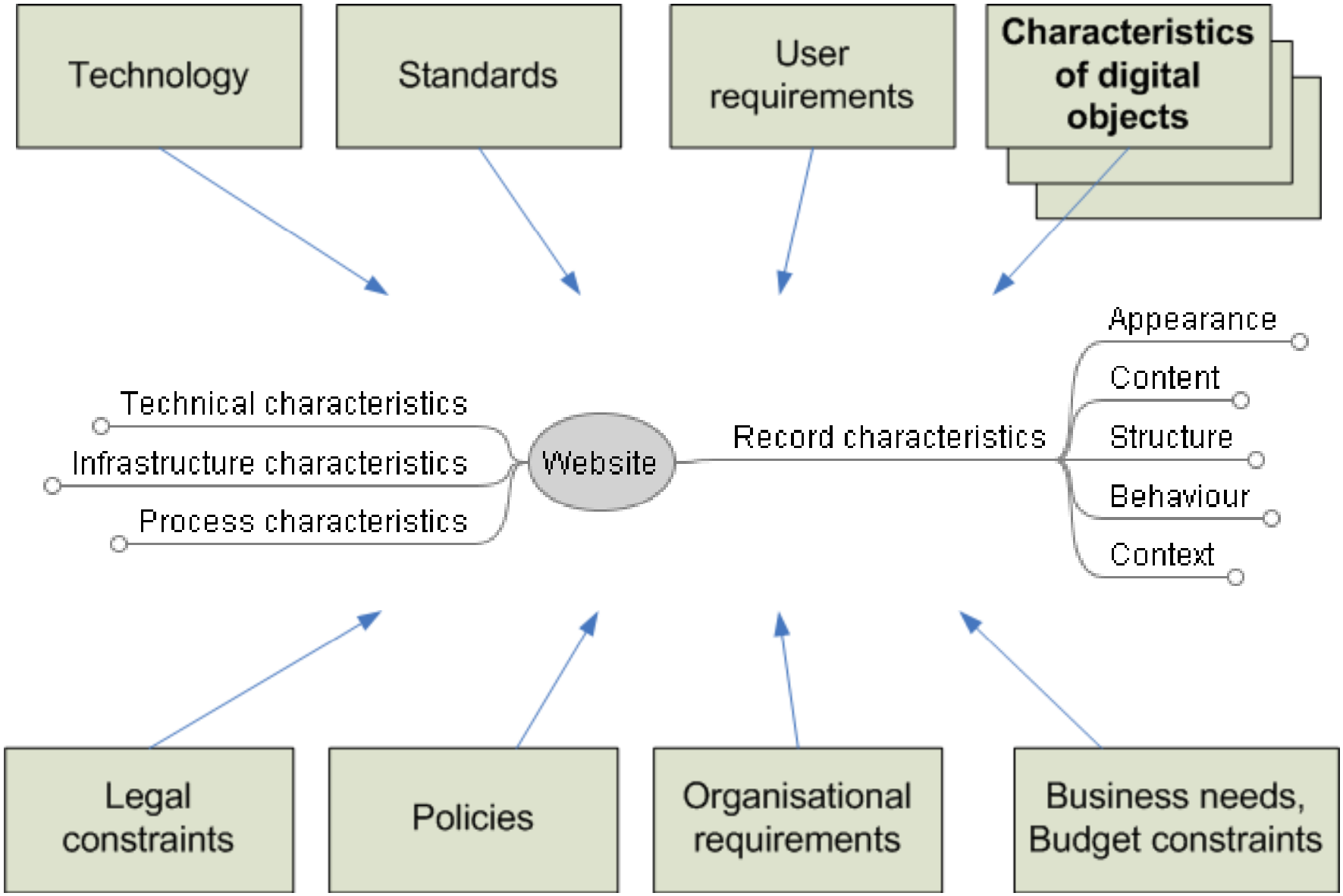
- Define all relevant goals and characteristics (high-level, detail) with respect to a given application domain
- Usually four major groups:
  - object characteristics (content, metadata ...)
  - record characteristics (context, relations, ...)
  - process characteristics (scalability, error detection, ...)
  - costs (set-up, per object, HW/SW, personnel, ...)
- Put the objects in relation to each other (hierarchical)

The Objective Tree

- Tree structure describing requirements and goals
  - A weighted hierarchy of objectives leading into measurable criteria
  - A utility function for each criterion specifies the organisation's assessment for the range of possible values

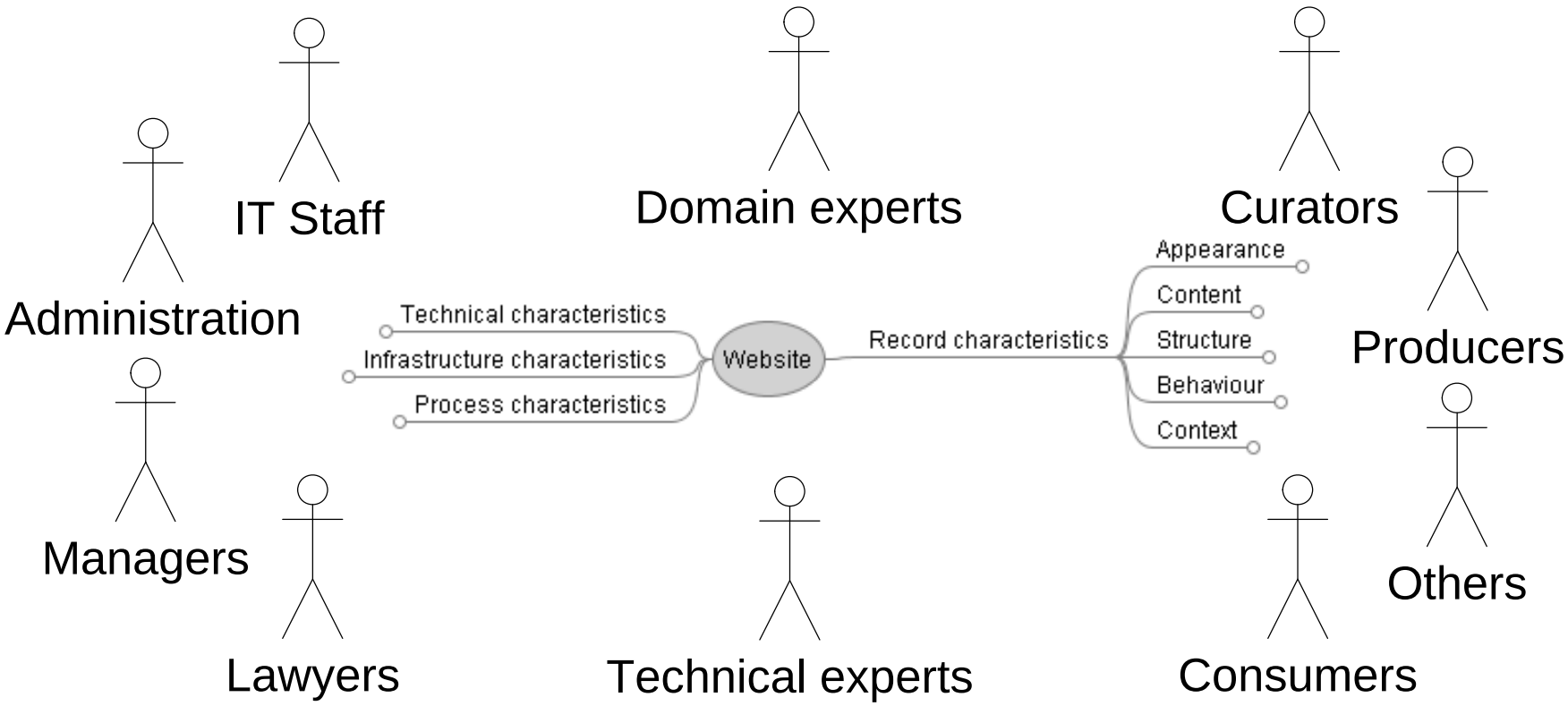
- Created top-down or bottom-up
  - Start from high-level goals and break down to specific criteria
  - Collect criteria and organize in tree structure

Influence Factors

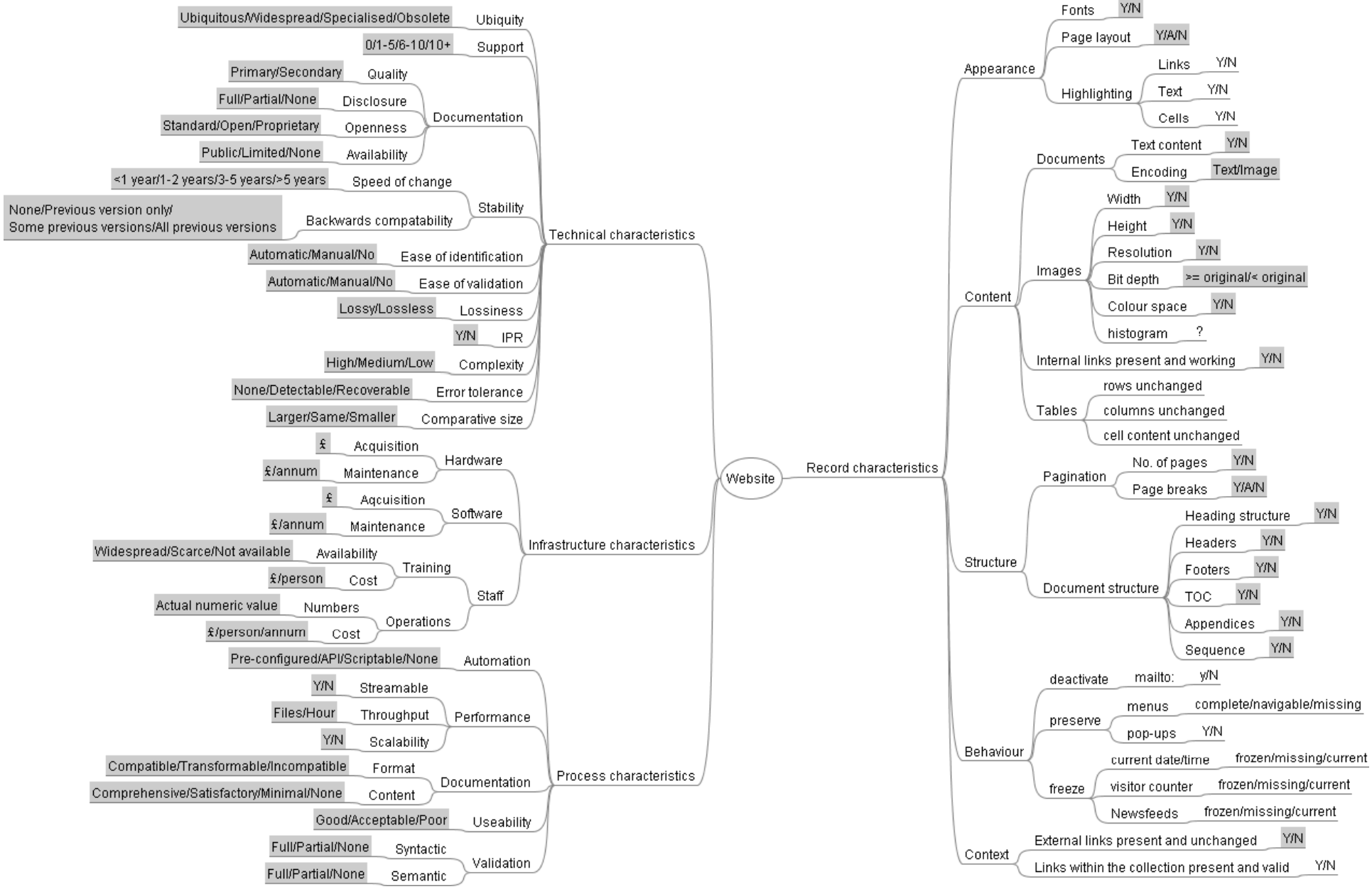


Stakeholders

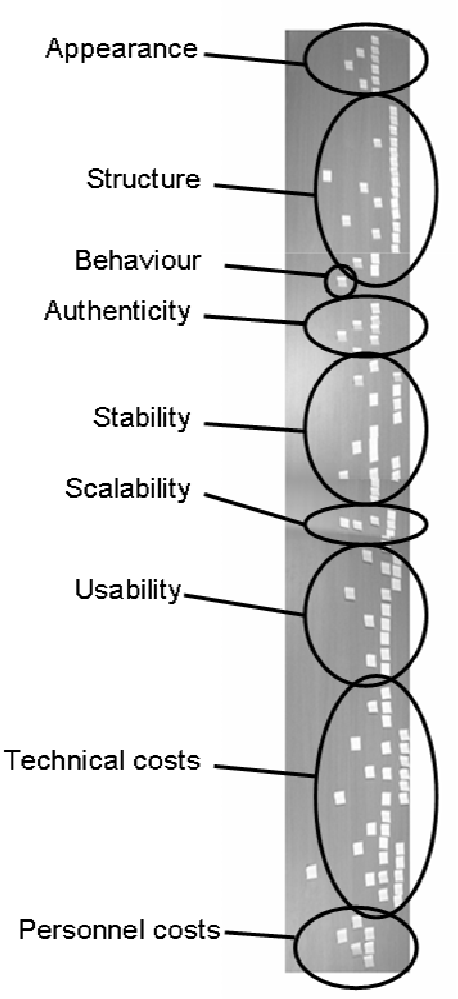
- Input needed from a wide range of persons, depending on the institutional context and the collection



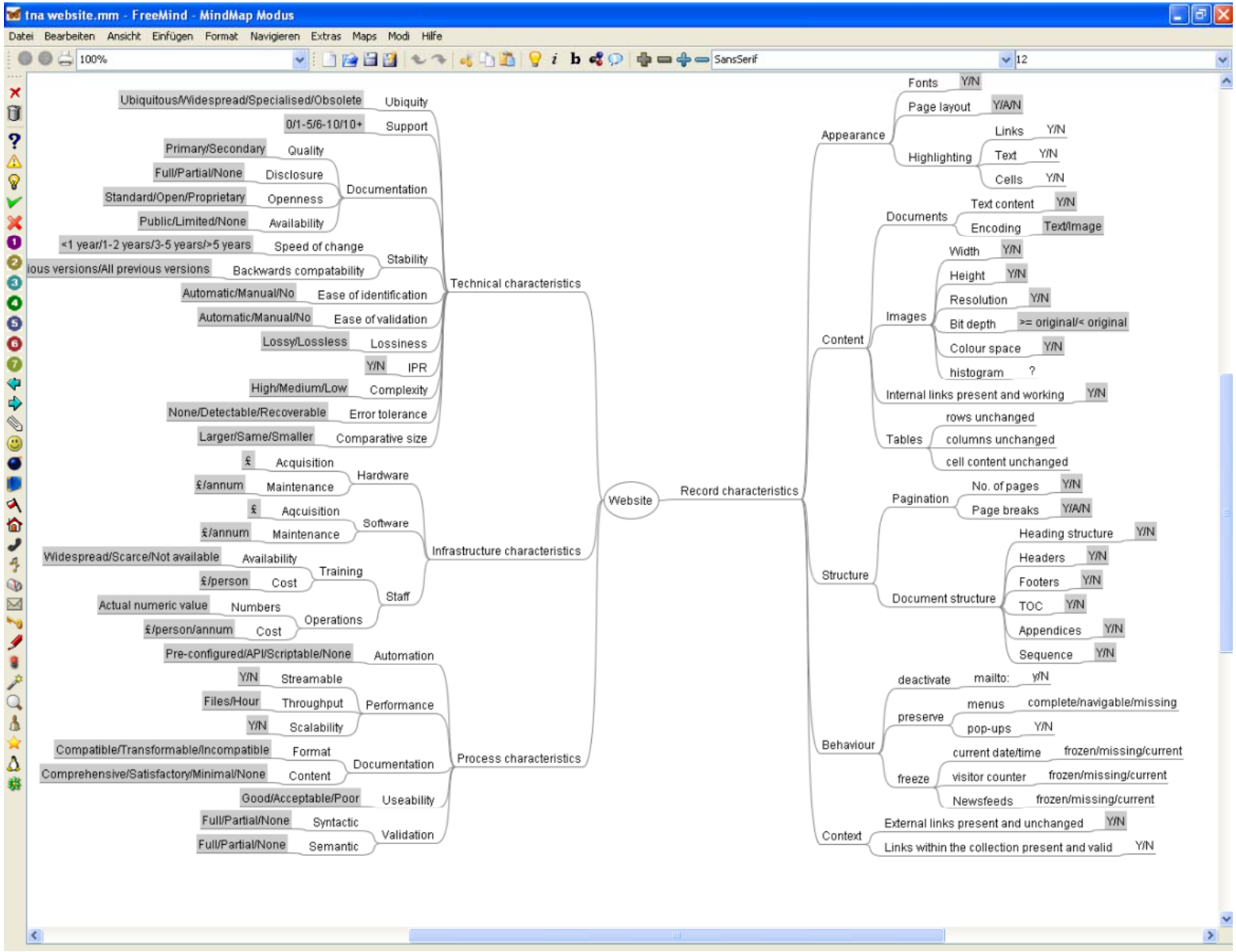
The Objective Tree



Analog…


Appearance
Structure
Behaviour
Authenticity
Stability
Scalability
Usability
Technical costs
Personnel costs

… or born-digital



User perspective

- Goal of digital preservation is to serve (future) users in providing usable and authentic information
- What are needs/requirements of users?
  - easy access
  - knowledge about origin of documents/ to be able to interpret them
  - to use them to their own convenience
- Example requirements
  - some users prefer that all information is presented in a uniform way
  - some users prefer that they can search full-text in documents (consequence: don’t migrate texts to image files)
  - …

Essential characteristics of ‘digital objects’

- What needs to be preserved?
  - Authenticity
  - Reliability
  - Integrity
  - Usability
  - Accuracy

  - Content
  - Context
  - Structure
  - Appearance
  - Behaviour

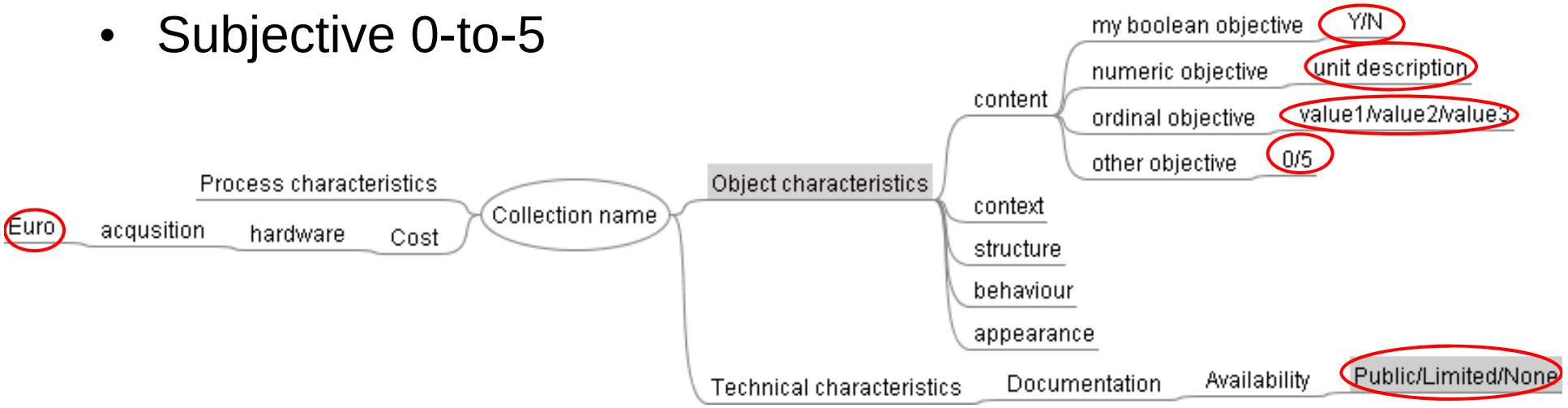
Assign Measurable Units

- Leaf criteria should be objectively measurable
  - Seconds per object
  - Euro per object
  - Bits of colour depth
- Subjective scales where necessary
  - Adoption of file format
  - Amount of (expected) support

➢ Quantitative results

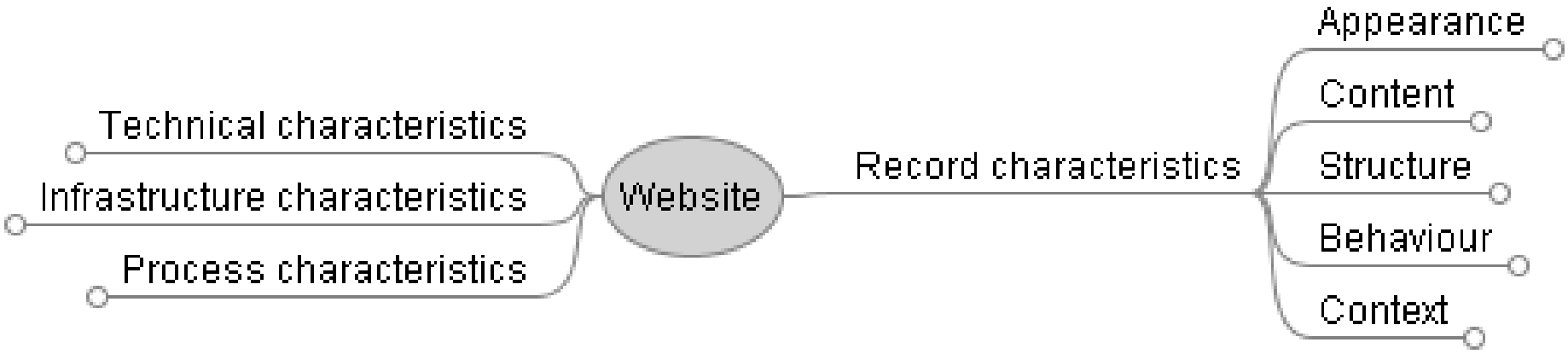
Types of scales

- Numeric
- Yes/No (Y/N)
- Yes/Acceptable/No (Y/A/N)
- Ordinal: define the possible values
- Subjective 0-to-5

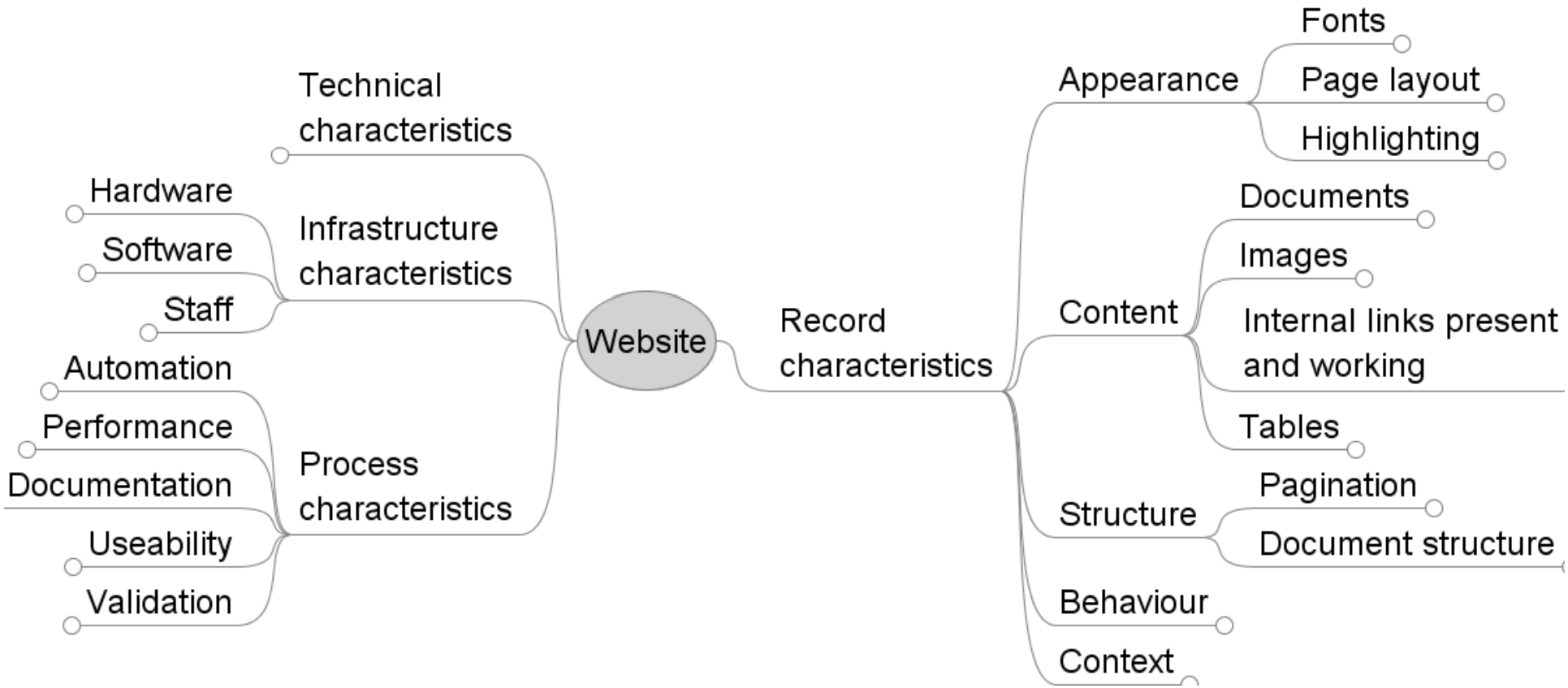


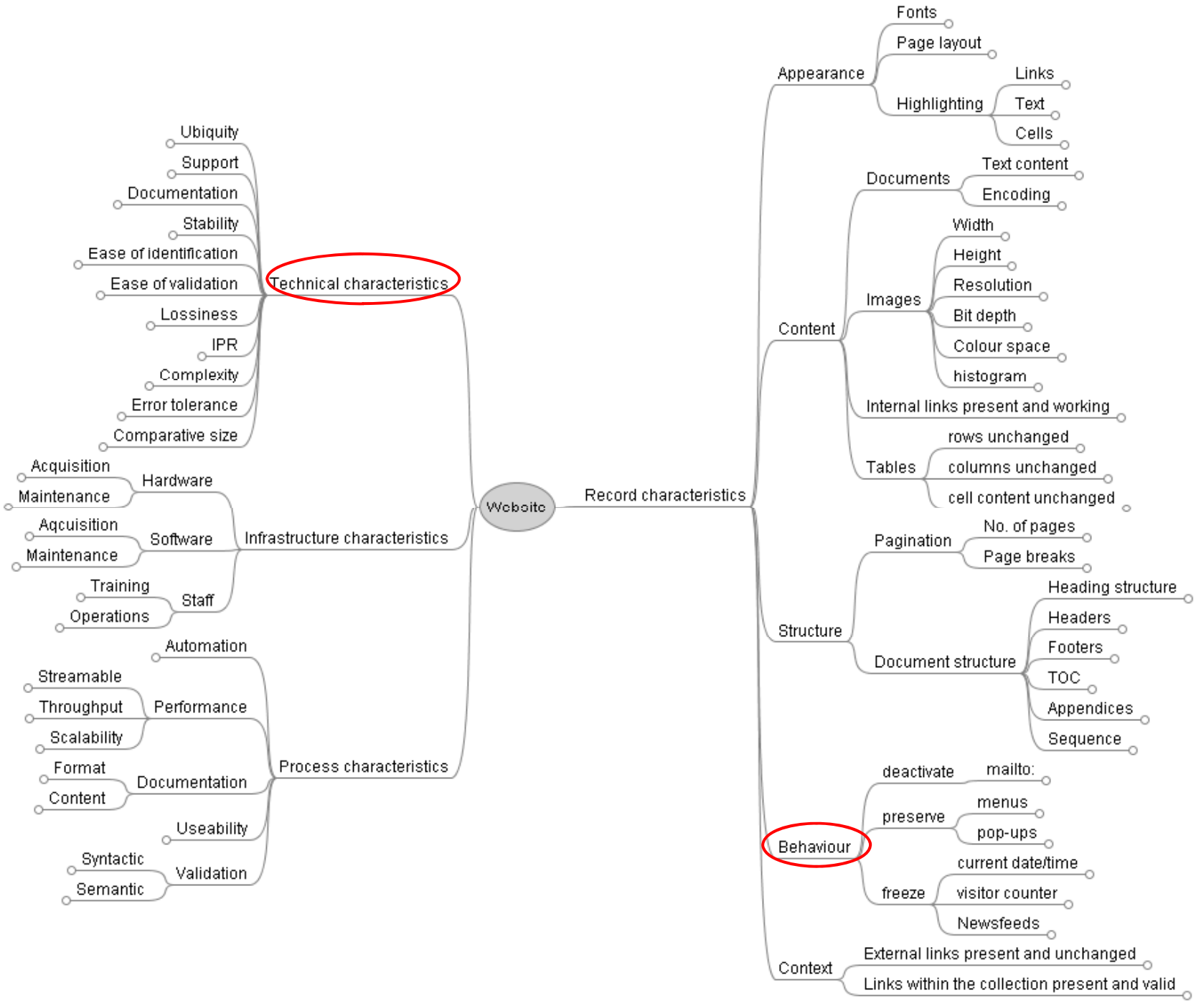
Case Study: Web archiving

- Static web pages from the public domain
- Includes documents in formats such as doc, pdf
- Images
- No interactive content shall be preserved

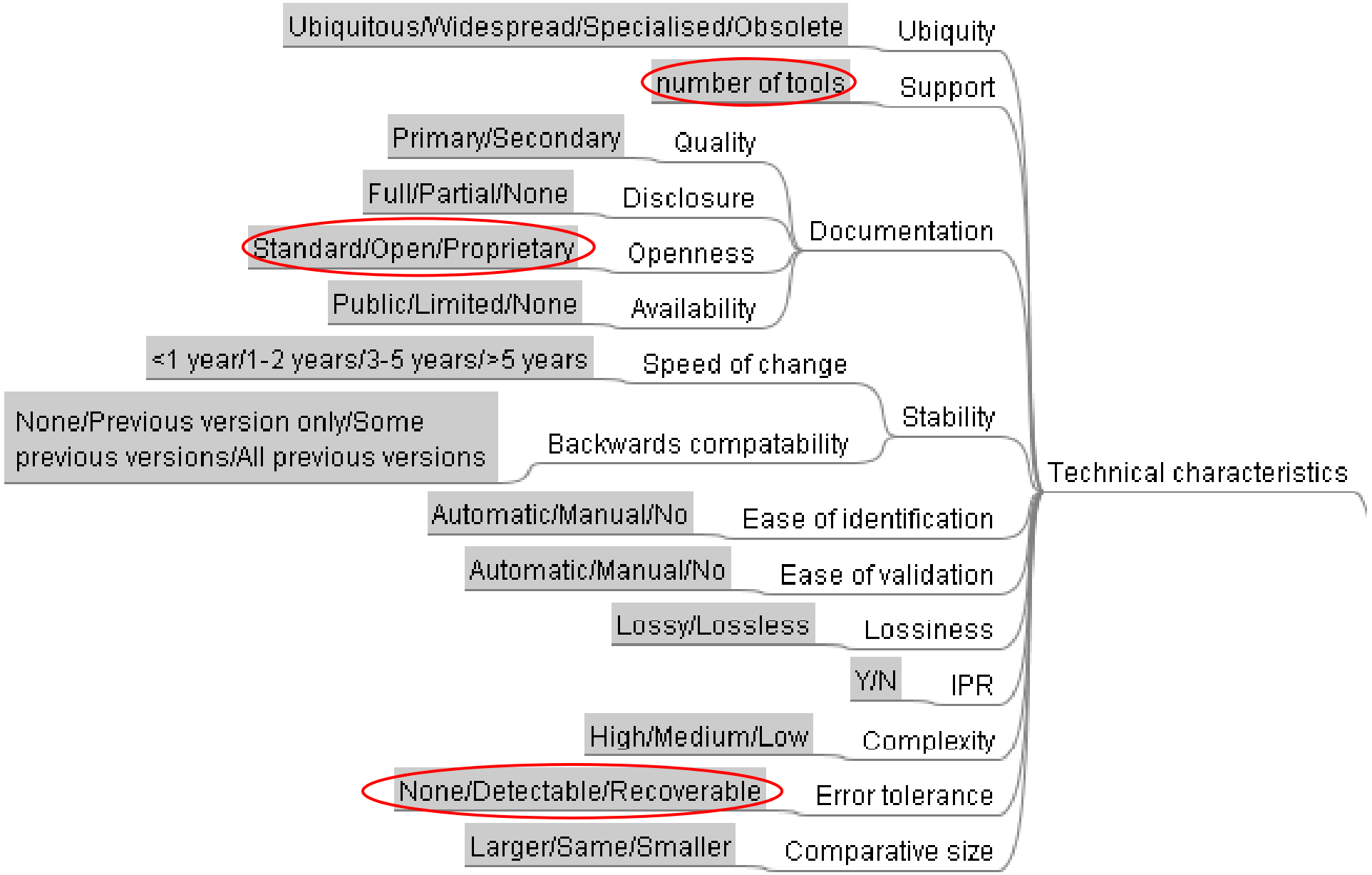


A bit more detail…

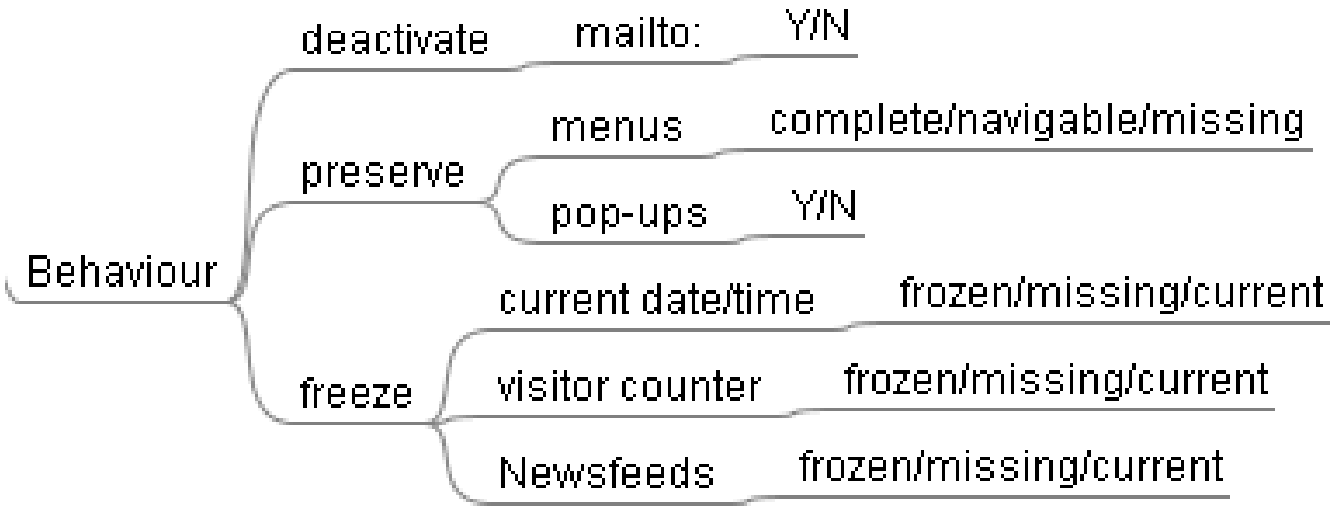



Website
Technical characteristics
Ubiquity
Support
Documentation
Stability
Ease of identification
Ease of validation
Lossiness
IPR
Complexity
Error tolerance
Comparative size
Infrastructure characteristics
Hardware
Acquisition
Maintenance
Software
Aqcuisition
Maintenance
Staff
Training
Operations
Process characteristics
Automation
Performance
Streamable
Throughput
Scalability
Documentation
Format
Content
Useability
Validation
Syntactic
Semantic
Record characteristics
Appearance
Fonts
Page layout
Highlighting
Links
Text
Cells
Content
Documents
Text content
Encoding
Images
Width
Height
Resolution
Bit depth
Colour space
histogram
Internal links present and working
Tables
rows unchanged
columns unchanged
cell content unchanged
Structure
Pagination
No. of pages
Page breaks
Document structure
Heading structure
Headers
Footers
TOC
Appendices
Sequence
Behaviour
deactivate
mailto:
preserve
menus
pop-ups
freeze
current date/time
visitor counter
Newsfeeds
Context
External links present and unchanged
Links within the collection present and valid

File format characteristics

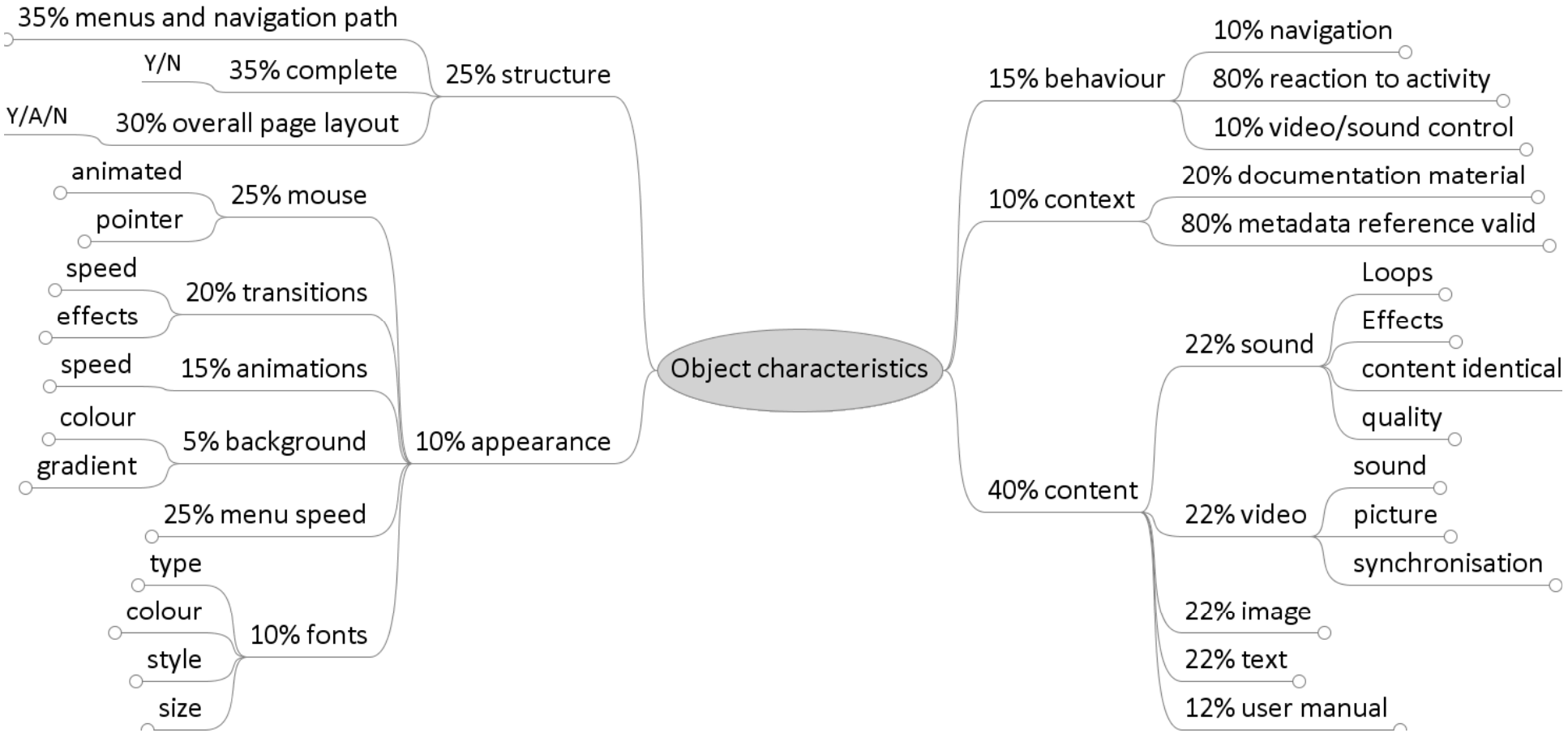


Behaviour



- Visitor counter and similar things can be
  - Frozen at the point of harvesting
  - Left out
  - Still counting while being accessed in the archive (Is this desirable?)

Interactive multimedia



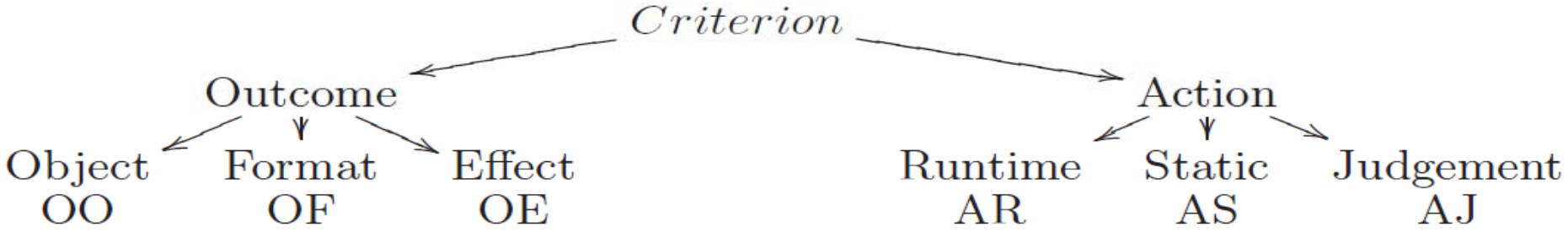
Behaviour

- Interactive presentations exhibit two facets
  - Graph-like navigation structure
  - Navigation along the paths

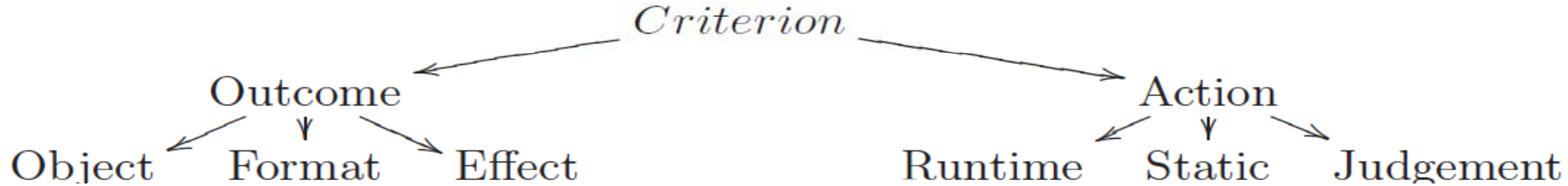
Node	Scale	Restriction
Object characteristics		
behaviour		
navigation	Ordinal	interactive and integrated/navigatable/none
reaction to activity		
mouse		
position	Boolean	
clicks	Boolean	
keyboard	Boolean	
video/sound control		
structure		
menus and navigation path	Ordinal	complete and free/partial (linear)/none
complete	Boolean	
overall page layout	Ordinal	Y/A/N

Decision criteria

- **Each criterion concerns either the action or its outcome**
- **Outcome**
  - **Object** (authenticity, editability, …)
  - **Format** (licensing, standardisation, complexity…)
  - **Effect** (Costs…)
- **Action**
  - **Runtime** properties (performance, stability, logging…)
  - **Static** (price, license…)
  - **Judgement** (configuration interface usability…)



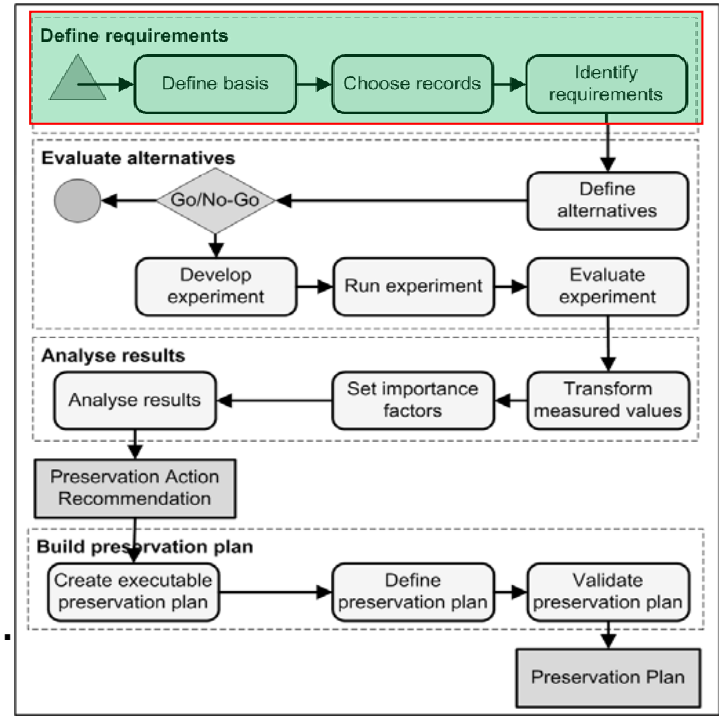
Criteria and measurements



Category	Example	Data collection and measurement	Tools
Outcome Object	Image pixelwise identical Footnotes preserved	Measurements of output and input, comparison	XCL, FITS, JHove, ImageMagick...
Outcome Format	Format is ISO standardised	Measurements of the output, Trusted external data sources	DROID, PRONOM, P2/MiniREEF
Outcome effect	Annual bitstream preservation costs (€)	Measurements of the output, external data sources, models (LIFE)...	LIFE model
Action runtime	Throughput (MB per millisecond), Memory usage	Measurements taken in controlled experimentation	MiniMEE
Action static	License costs per CPU (€), Open Source License	Trusted external data sources, manual evaluation, sharing	P2/MiniREEF, manual
Action judgement	Configuration interface usability	Manual judgement, sharing	

Results of Phase 1

- Defined and documented the context of a preservation problem
  - Which types of objects
  - Which environment
  - What are the obligations and constraints
- Defined and documented representative samples for performing experiments
- Defined and documented goals and requirements



... 10 minutes break ...

→ An arctic mountain adventure

→ Requirements

→ Exercise

Practice time!

A digital preservation scenario

Context: National library

- We are a national library
- Legal mandate: Make publicly available the cultural heritage of our times to the people, free of charge, barrier-free, now **and in the future**
- Legal mandate and budgeting might not fit together perfectly
- Find optimal solution given the constraints
- Be able to prove that we did everything to our best knowledge and using state-of-the-art technology

Scanned newspapers archive

- One of the (many) collections we have is a set of newspaper scans
- ~8.000.000 GIF images, mostly black-and-white or grayscale
- Different size, resolution, age, created with different tools,…
- Should be preserved in an openly specified format, cheap but safe, and easily accessible to the public (online)

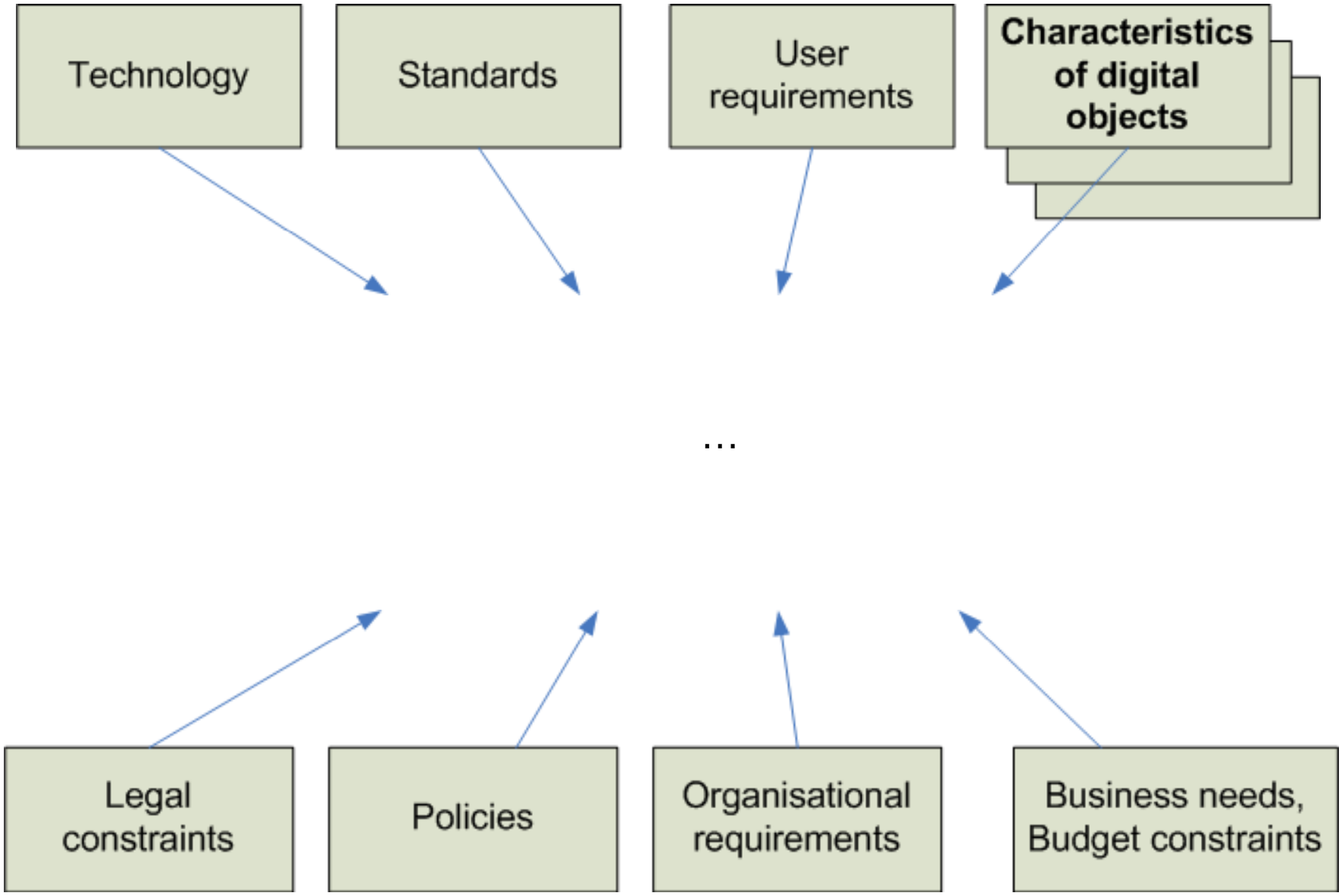
Create a preservation plan

- Define the scope, the scenario, the constraints
- Describe the content we have to care for
- Specify our requirements
- Shortlist of potential alternative strategies
- Evaluate them
- Select the best and implement it
- Monitor it closely to detect deviations

Create a preservation plan

- Today… part 1
  - Define the scope, the scenario, the constraints
  - Describe the content we have to care for
  - Specify high-level requirements
- Next week… part 2
  - Revisit requirements
  - Evaluate alternatives and analyse results
  - Define the preservation plan

Requirements definition

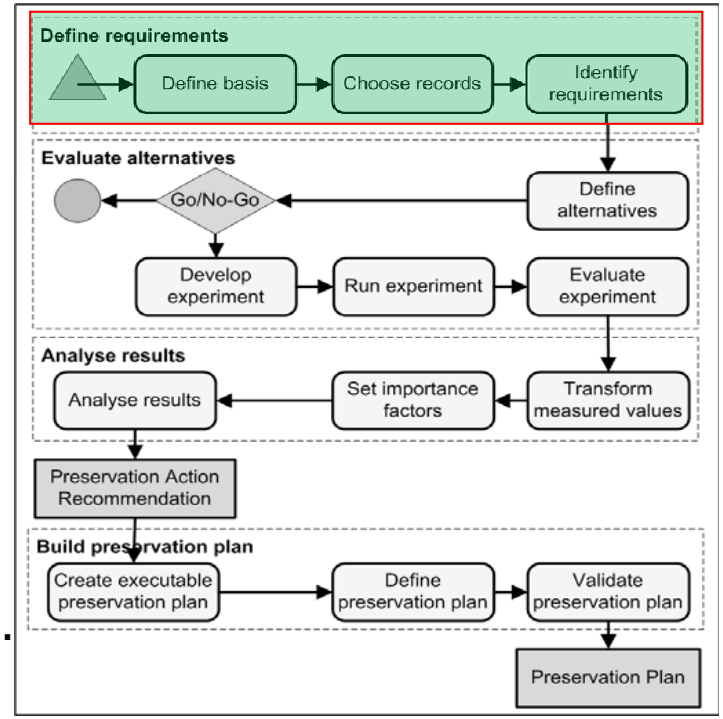


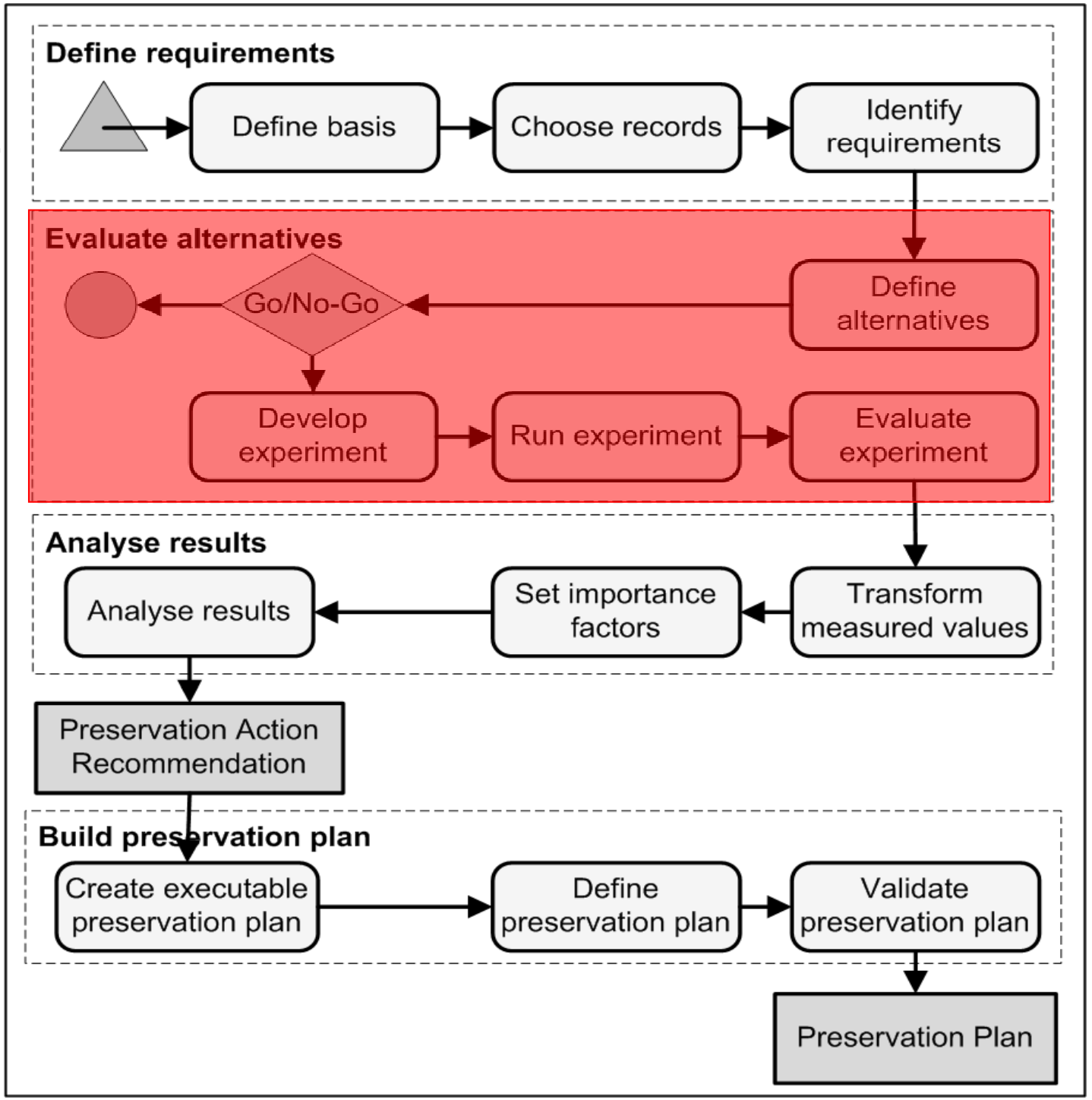
Requirements definition

…

Results of Phase 1

- Defined and documented the context of a preservation problem
  - Which types of objects
  - Which environment
  - What are the obligations and constraints
- Defined and documented representative samples for performing experiments
- Defined and documented goals and requirements

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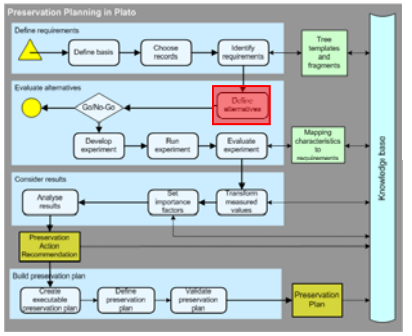
Define alternatives



- Given the type of objects and requirements, what strategies would be best suitable/are possible?
  - Migration
  - Emulation
  - Both
  - Other?
- For each alternative precise definition of
  - Which tool (OS, version,...)
  - Which functions of the tool in which order
  - Which parameters

Service discovery

PLANETS Preservation Planning Tool *(Plato)*

[logout kulovits] [help]

Project | Define Requirements ::: Evaluate Requirements ::: Consider Results | Polar bear image archive

Define the alternatives of the Project

ID	Name	Description	Remove
196616	TIFF (tool A)	Convert to TIFF using the well-tested and expensive tool 'A'	Remove
196613	TIFF (tool B)	Convert to TIFF/4 using this new tool named 'B'	Remove
196614	GIF (tool C)	Convert to GIF using the well-tested tool 'C'	Remove
196615	PNG (tool D)	Convert to PNG using the well-tested tool 'D'	Remove

Add new Alternative

Save | Discard changes | Proceed

Create alternatives from applicable services

Sample record #1 has format JPEG File Interchange Format, 1.01.
You can look up services that are able to handle this object type in the following registries:

Planets Preservation Action Tool registry

Show Preservation Services

Planets Service Registry

Show Preservation Services

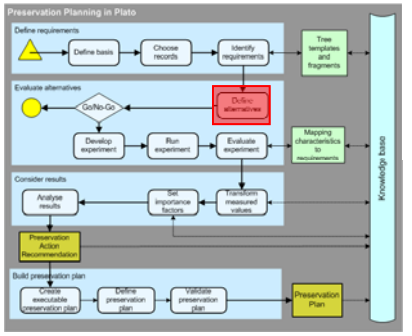
CRiB Service Registry

Show Preservation Services

	Preservation Action	Target Format	Info
☐	JPG > BMP	Windows Bitmap, version 3.0	JPG>BMP
☑	JPG > TIF	Tagged Image File Format, version 3	JPG>BMP>TIF
☐	JPG > TIF #2	Tagged Image File Format, version 3	JPG>TIF
☑	JPG > TIF_2	Tagged Image File Format, version 3	JPG>TIF_2
☐	JPG > PNG	Portable Network Graphics, version 1.0	JPG>PNG
☐	JPG > JP2	JPEG 2000	JPG>JP2

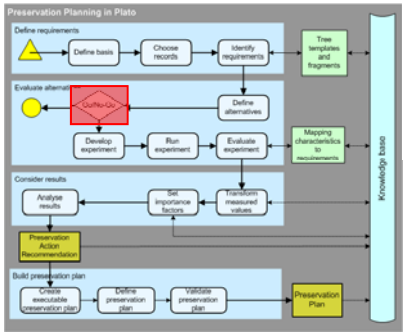
Create alternatives for selected services

Specify resources



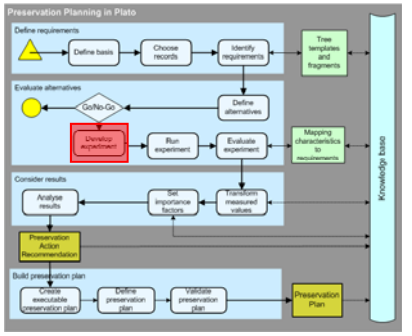
- Detailed design and overview of the resources for each alternative
  - human resources (qualification, roles, responsibility, …)
  - technical requirements (hardware and software components)
  - time (time to set-up, run experiment,...)
  - cost (costs of the experiments,...)

Go/No-Go



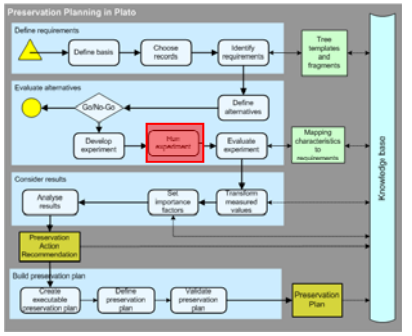
- Deliberate step for taking a decision whether it will be useful and cost-effective to continue the procedure, given
  - The resources to be spent (people, money)
  - The availability of tools and solutions,
  - The expected result(s).
- Review of the experiment/ evaluation process design so far
  - Is the design complete, correct and optimal?
- Need to document the decision
- If insufficient: can it be redressed or not?

Develop experiment



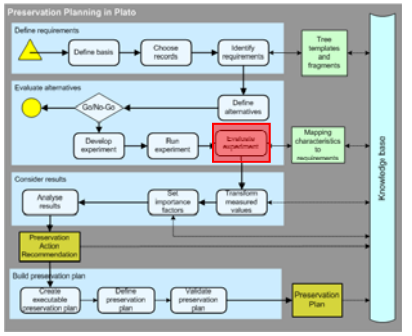
- Formulate for each evaluation or experiment or preservation process detailed
  - Development plan
    - steps to build and test software components
    - procedures and preparation
    - parameter settings for integrating preservation services
  - Test plan (mechanisms how to)
  - Evaluation/experiment plan (workflow/sequence of activities)

Run experiment

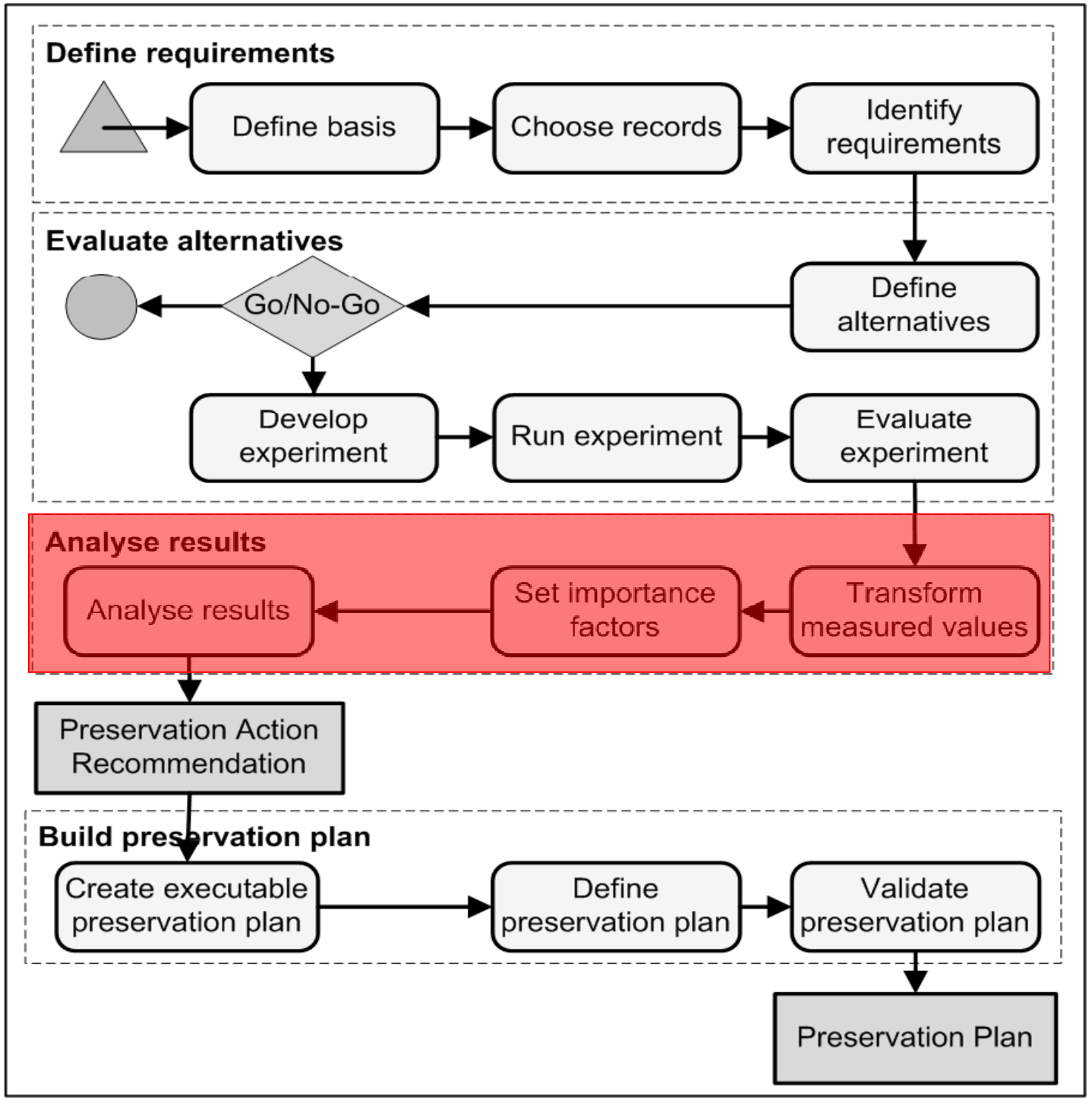


- Before conducting an evaluation or running an experiment, the experiment process as designed has to be tested
  - It may lead to re-design or even termination of the evaluation/ experiment process
- The results will be evaluated in the next stage
- The whole process needs to be documented

Evaluate experiment



- Evaluate the outcome of each alternative for each leaf of the objective tree
- The evaluation will identify
  - Need for repeating the process
  - Unexpected (or undesired) results
- Includes both technical and intellectual aspects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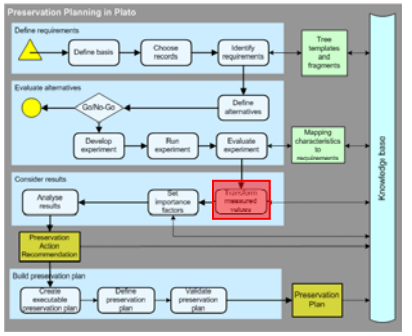
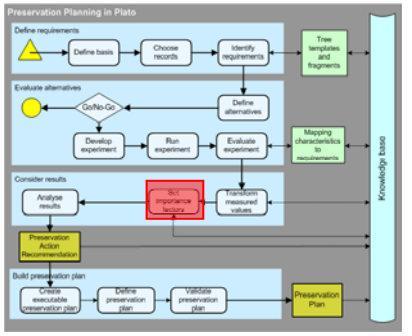
Transform measured values

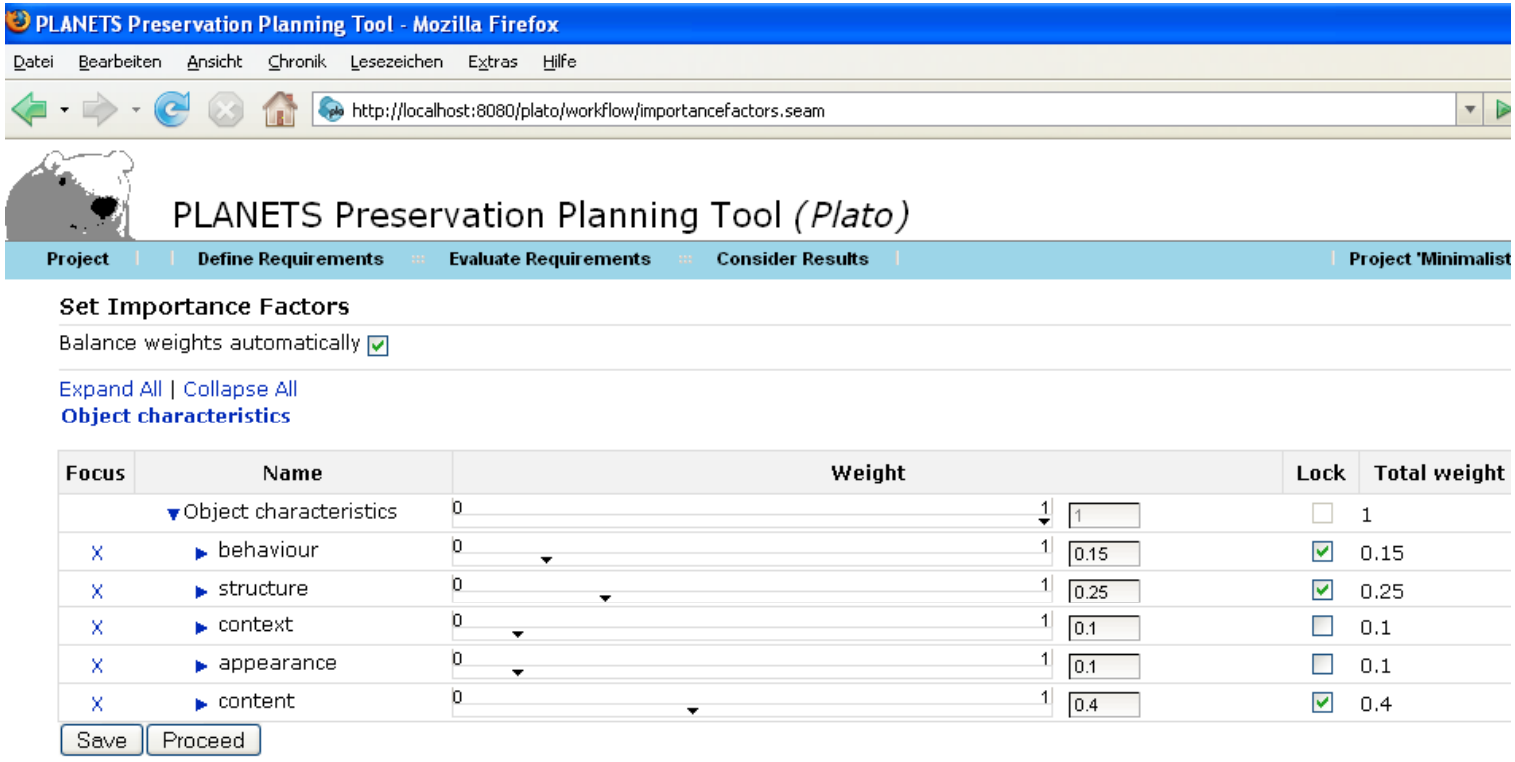


- Measures come in seconds, euro, bits, goodness values,…
- Need to make them comparable
- Transform measured values to uniform scale
- Transformation tables for each leaf criterion
- Linear transformation, logarithmic, special scale
- Scale 1-5 plus "not-acceptable"

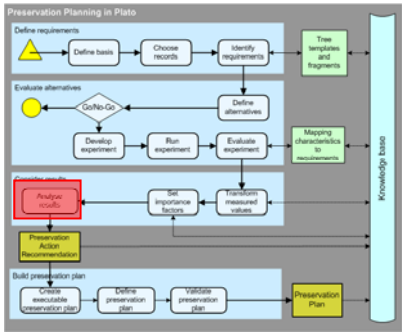
Set importance factors



- Definition which criteria are more important
- Depends on individual preferences and requirements
- Influence on the final ranking
- Aggregation of weights



Analyse results



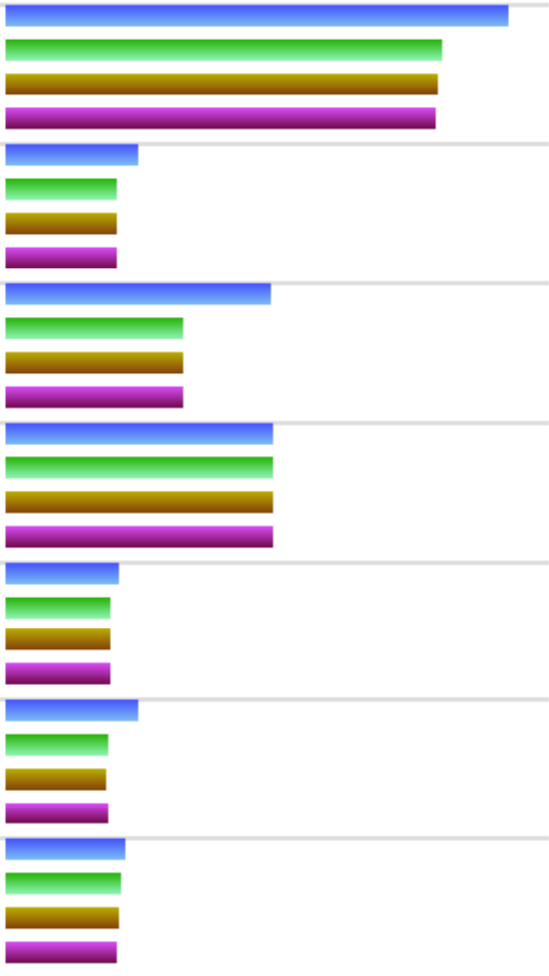
- Aggregate Values
  - Multiply the transformed measured values in the leaf nodes with the leaf weights
  - Sum up the transformed weighted values over all branches of the tree
  - Creates performance values for each alternative on each of the sub-criteria identified

Analyse results

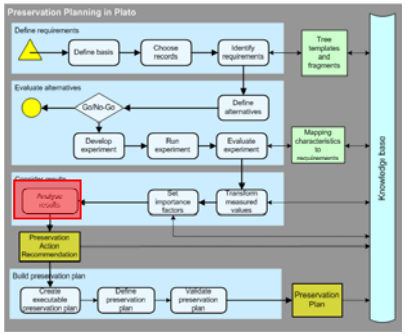
Results: Weighted sum

Result-Tree with all Alternatives, Aggregation method: Weighted sum.
This tree contains only strategies that do not have knock-out evaluation criteria; see above

Node		Results
Scans	Keep status quo:	4.70
	ImageMagick - TIFF to JP2:	4.09
	Kakadu - TIFF to JP2:	4.06
	GeoJasper - TIFF to JP2:	4.03
Object characteristics	Keep status quo:	1.25
	ImageMagick - TIFF to JP2:	1.04
	Kakadu - TIFF to JP2:	1.04
	GeoJasper - TIFF to JP2:	1.04
Content	Keep status quo:	2.50
	ImageMagick - TIFF to JP2:	1.68
	Kakadu - TIFF to JP2:	1.68
	GeoJasper - TIFF to JP2:	1.68
Context	Keep status quo:	2.50
	ImageMagick - TIFF to JP2:	2.50
	Kakadu - TIFF to JP2:	2.50
	GeoJasper - TIFF to JP2:	2.50
Technical characteristics	Keep status quo:	1.06
	ImageMagick - TIFF to JP2:	0.98
	Kakadu - TIFF to JP2:	0.98
	GeoJasper - TIFF to JP2:	0.98
Costs	Keep status quo:	1.25
	ImageMagick - TIFF to JP2:	0.97
	Kakadu - TIFF to JP2:	0.95
	GeoJasper - TIFF to JP2:	0.97
Process characteristics	Keep status quo:	1.14
	ImageMagick - TIFF to JP2:	1.10
	Kakadu - TIFF to JP2:	1.08
	GeoJasper - TIFF to JP2:	1.04

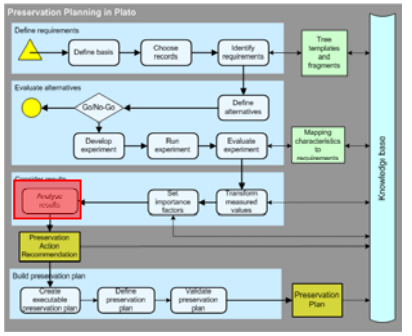


Analyse results



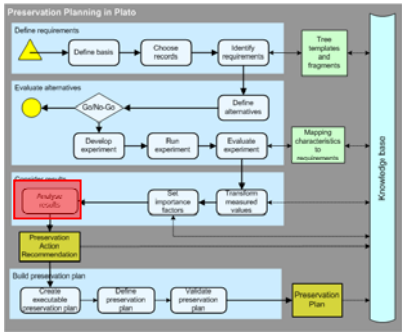
- Single performance value for each alternative to rank the alternatives
- Single performance values for each alternative for each sub-set of criteria to identify the best combination of alternatives
- Sensitivity Analysis: Analysis of the influence of small changes in the weight on the final value
- Basis for making Informed, well-documented, repeatable, accountable decisions

Analyse results

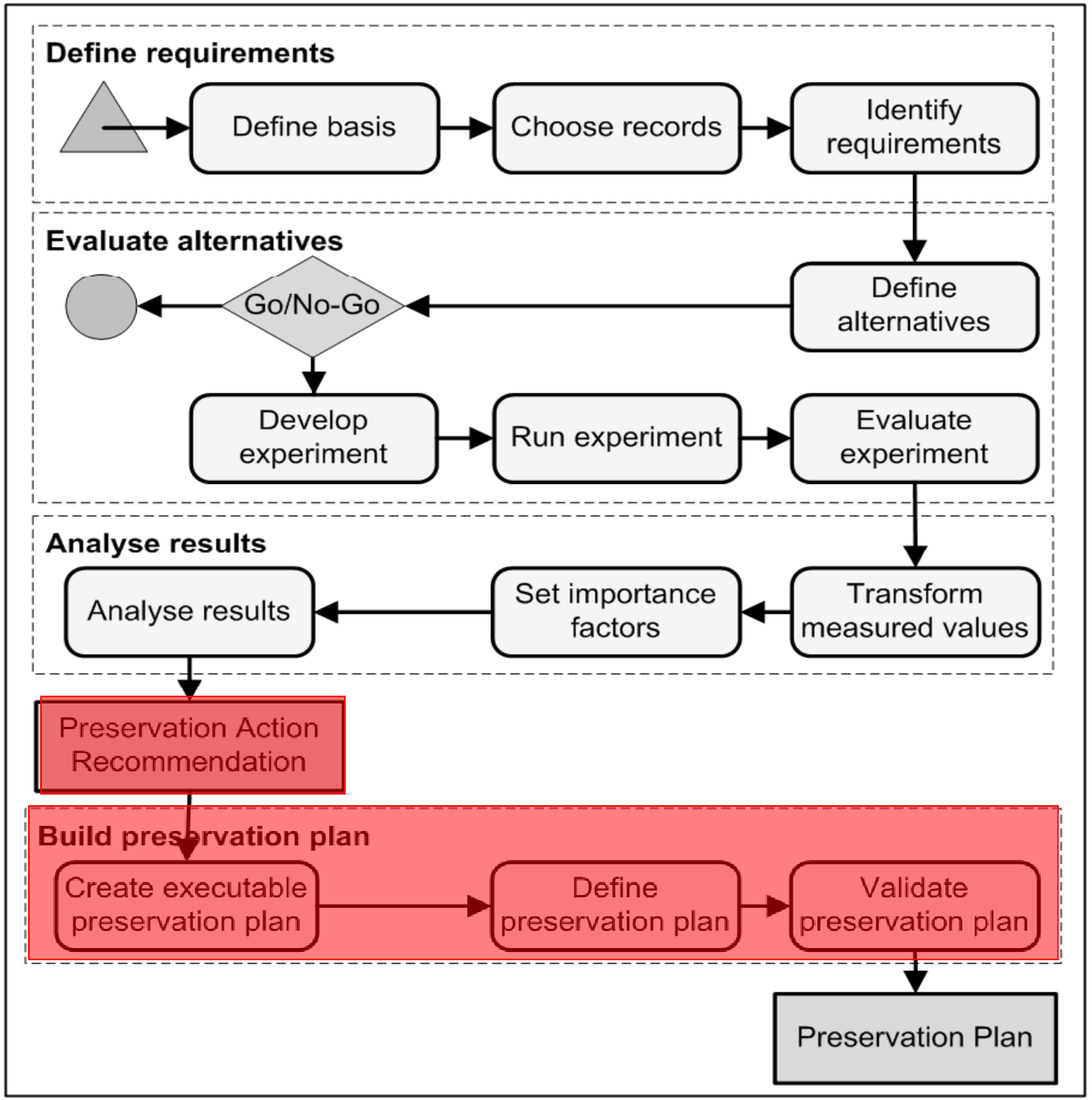


- Rank alternatives according to overall utility value at root
- Performance of each alternative
  - overall
  - for each sub-criterion (branch)
- Allows performance measurement of combinations of strategies
- Final sensitivity analysis against minor fluctuations in
  - measured values
  - importance factors

Analyse results



- The review of the results may help to refine
  - The evaluation process/procedure
  - The preservation planning environment itself
  - The evaluation metrics
  - Understanding of the essential characteristics of the objects,
  - and identify further evaluations, experiments
- The review should take into account all previous work done in the preservation planning environment
- The review should look at both the technical and intellectual aspects of digital objects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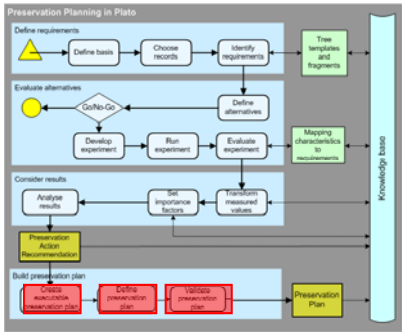

- Create executable elements of preservation plan
  - Sequence of preservation actions to call, parameters, …
  - Automatic steps + manual interventions where required
  - Automatic verification of results during deployment

- Define preservation plan
  - Create PP based on evidence produced during the PP process
  - Verify completeness of PP

- Seek approval and validation of PP
  - Management activity according to OAIS
  - Sign and deploy

Conclusions

- A simple, methodologically sound model to specify and document requirements
- Repeatable and documented evaluation for informed and accountable decisions
- Set of templates to assist institutions
- Generic workflow that can easily be integrated in different institutional settings
- **Plato**:
  Tool support to perform solid, well-documented analysis
- Provides basic preservation plan

http://www.ifs.tuwien.ac.at/dp/plato

Questions?

... And a little bit of READING for next week:

- **“From TIFF to JPEG 2000?“**
  http://www.dlib.org/dlib/november09/kulovits/11kulovits.html

- **Next week: Presentation of the exercise topics!**
- (Digital Preservation UE, 2.0)

Thank you for your attention!

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www.ifs.tuwien.ac.at/~becker
www.ifs.tuwien.ac.at/dp/plato