– Information Science and Inter-disciplinary Long-term Strategies –

Key to Insight, Consistency, and Sustainability: Conceptual Knowledge Reference Methodology Spanning Prehistory, Archaeology, Natural Sciences, and Humanities

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Common Information

Information: CV, lectures, studies, materials, research, and networking

Curriculum Vitae:

http://www.user.uni-hannover.de/cpr/x/rueckemann/en/

Publications, lectures, and materials:

http://www.user.uni-hannover.de/cpr/x/rueckemann/en/#Publications

http://www.user.uni-hannover.de/cpr/x/frodi/en/#Courses

Congresses and venues:

http://www.user.uni-hannover.de/cpr/x/rwerkr/en/

Research

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The International Conference on Advanced Geographic Information Systems, Applications, and Services (GEOProcessing);
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The Tutorial

Epitome: Topic, focus, and goal

- **Topic and focus:** Inter-disciplinary collaboration tasks, integrating disciplines, need special approaches from information science as well as from informatics and technology. Successful integration requires long-term strategies.
- **Goal:** The goal of this tutorial is an advanced understanding of information science, knowledge, and its contexts in scientific, computational, technical, and management disciplines. Information science comprises the fields of collection, documentation, classification, analysis, manipulation, storage, retrieval, movement, dissemination, and protection of information.
- The key to insight, consistency, and sustainability of conceptual knowledge context for day-to-day application is a solid information science fundament. The tutorial presents a consistent and sustainable conceptual knowledge reference methodology and information science implementation, spanning a practical scenario from prehistory and archaeology to natural sciences and humanities.
- This tutorial addresses to all interested users and creators of knowledge and data, in various disciplines, information science, prehistory, archaeology, geosciences, environmental sciences, social and life sciences, as well as to users of advanced applications and providers of resources and services, e.g, library science and High End Computing. There are no special informatics prerequisites or High End Computing experiences necessary to take part in this tutorial.

Citation/reference: [1]

Way (NOT) to go: Knowledge is Created by Instruments, Artificially . . .

What others do: "Technology can create excellent results with any input and staff."

Let us take a look on what a virtual, "effective" institution will do.

NUTS' initiative:

- **Hire management, administration, data services, 'apps', and excellence is at your hands.**

"N"ewtoneless
"U"niversity
"T"echnology
"S"ervice

NUTS' strategy:

- **Today, long-term knowledge and research are not relevant anymore.**
- **Any result can be created artificially.**
- **All relevant algorithms can automatically be generated.**
- **The key asset of any science is its market strategy.**

NUTS' results and recommendations:

- **Recognise that any past insight and knowledge has shown useless.**
- **Only invest in the upcoming applications and patches and technical staff.**
- **Get rid of activities, which mean years of research and dedication.**
- **Improvement cycles of described procedure need continuous speed up.**

In Contrast: Information, History, and Information Management

Classical, medieval, modern, ...

Prehistory: (... to archaeology)
⇒ "art" to "technology" but **how to understand/contextualise**?

Heron of Alexandria: (greek antique, "Steam Ball")
⇒ "entertainment" but **not used as technology**.

Isidore of Seville: (encyclopedic, broad documentation)
⇒ end of medieval phase, **not further used**.

Polyhistor: (Martin Fogel, broad knowledge)
⇒ broad base, **not further used**.

Last decades / Internet: (knowledge?)
⇒ huge amounts of knowledge lost (besides contrary claims).

In percentage we nearly know nothing about the past.

- Prehistorical, ancient, historical, near past: Realia/contexts are mostly lost.
- Prehistorical, ancient, historical, near past: Documentation is mostly lost.
- Prehistorical, ancient, historical, near past: Technology is not fully understood.
- Context of (past) objects and applications is not available anymore. ...

In Contrast: Information, History, and Information Management

Start-up experiences

- Information Science can provide fundaments and answers.
- Prehistorical . . . and many associated information do have/require special context.
- Knowledge should be addressable by ‘holistic’ approaches.
- Cognition based on prehistorical information is special.
- Content and context of said research targets require special methodologies.
- Methodologies need to enable a plethora of implementations.
- Decision Making needs to address knowledge, special content and context.
- . . .

Information Science

Definition

Information Science: Information science is the science of information in theory and practice.

Fundaments

The essential fundaments of information science are information and philosophy.

Information Science

Focus

Information science investigates the being of information, information related properties, and information processes.

Information science focuses on theory and methodologies and their application in practice, understanding information related problems, preserving, developing, and making use of information.

Information science primarily tackles systemic problems rather than individual pieces of technology within systems.

Information science comprises ...

Information science comprises the fields of collection, documentation, classification, analysis, manipulation, storage, retrieval, movement, dissemination, and protection of information.

Information Science

Associated fields

Information science is associated with psychology, computer science, and technology.

Interlinks

Information science is interlinked with cognitive science, archival science, linguistics, museology, management, mathematics, philosophy, commerce, law, public policy, and social sciences.

Information Science

Information and communication

Information science deals with any information and communication, e.g.:

- *knowledge in organisations,*
- *interaction between people,*
- *information systems,*
- *understanding information systems,*
- *creating, replacing, improving information systems.*

Fundament of Intrinsically Tied Complements

Information Science and the fundament of intrinsically tied complements

- Episteme:

  refers to ' knowledge", "understanding", "science".

- Techne:

  "craft", "art".

- Doxa:

  from "to appear", "to seem", "to accept", "to think".

Way to go: Cultural and Technological Development (Motivation)

Knowledge base:

Knowledge transfer is essential.

Over generations of objects and subjects, this requires:

- Knowledge recognition (expertise).
- Knowledge documentation, for any aspect of nature and society (sciences, literature, technical descriptions, tools, cultural heritage, mythology, songs, media, ...).
- Long-term means.

Assets

Assets

- Knowledge (factual, conceptual, procedural, metacognitive, . . .
- Existing plethora of knowledge and insight.

Information, Sciences, and Knowledge

Fundaments

- The fundaments of terminology and of understanding knowledge are layed out by **Aristotle** [2] [3], being an essential part of **‘Ethics’** [4].
- Information science can very much benefit from Aristotle’s fundaments and a knowledge-centric approach **(Anderson and Krathwohl)** [5] but for building holistic and sustainable solutions they need to go beyond the available technology-based approaches and hypothesis [6] as analysed in **Platons’ Phaidon**.
- In consequence, an updated view on the knowledge complements including the creation of interfaces between methods and applications (e.g., based on the methodology of Knowledge Mapping [7]) is addressed in the following excerpts.

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Background Fundaments

. . . cognition and contextualisation

The implemented method and the integration modules for result **context creation and georeferencing** has been a viable, efficient, and flexible solution in many case scenarios. Implementations are far not trivial but any discipline being able to ask questions as demonstrated should also be able to deploy the methodology and presented components for creating solid fundaments and practical solutions for challenging, complex scenarios, e.g., **classification and dating** of objects [8], **geoscientific prospection, surveying** [9], and **knowledge** [10], **chorological and chronological context** [11], can contribute to the fundaments of archeological and prehistorical **cognition** [12] and **insight** [13] regarding realia and abstract objects, knowledge, and contexts. The presented knowledge-based method and conceptual knowledge framework allow to address context very flexibly, e.g., in order to enable the metacognitive documentation of metacognitive and procedural knowledge of **Geoscientific Information Systems** or Geographic Information System **analysis** [14], filtering **contextualised artistic representations** [15] and **managing object collections** [16]. Knowledge-based approaches can also be beneficial without advanced knowledge resources, e.g., in cases of **realia collections**, information management and service oriented institutions and research data collection, e.g., The Digital Archaeological Record [17] of Digital Antiquity [18]. For example, in focus cases of **archaeology, prehistory, and history context** and georeferencing can further be supported by **facet creation** into more dimensions and also allows the application of a **consistent conceptual base for description** and **fuzziness**, beyond common auxiliaries and georeferencing.

Systematical View on Knowledge: FCPM Complements

Complements of Knowledge and Corresponding Sample Implementations:

(Source: Aristotle; Anderson & Krathwohl; SACINAS Delegates' Summit 2015–2018)

- **Factual Knowledge** ⇔ **Numerical data, data ...**
- Conceptual Knowledge ⇔ Classification ...
- Procedural Knowledge ⇔ Computing ...
- Metacognitive Knowledge ⇔ Experience ...
- ...

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Expertise and Skills: Best Practice and Definitions

Best Practice and Definitions Series

- **Knowledge and Computing**.
- **Data-centric and Big Data** – Science, Society, Law, Industry, and Engineering.
- **Data Sciences** – Beyond Statistics.
- **Data Value**.
- **Formalisation**.
- . . .

Best Practice: Knowledge and Computing

In 80 Words Around The World.

Knowledge and Computing [19] (Delegates and other contributors)

- **"Knowledge is created from a subjective combination of different attainments as there are intuition, experience, information, education, decision, power of persuasion and so on, which are selected, compared and balanced against each other, which are transformed, interpreted, and used in reasoning, also to infer further knowledge. Therefore, not all the knowledge can be explicitly formalised. Knowledge and content are multi- and inter-disciplinary long-term targets and values. In practice, powerful and secure information technology can support knowledge-based works and values."**
- **"Computing means methodologies, technological means, and devices applicable for universal automatic manipulation and processing of data and information. Computing is a practical tool and has well defined purposes and goals."**

Citation: *Rückemann, C.-P.; Hülsmann, F.; Gersbeck-Schierholz, B.; Skurowski, P.; and Staniszewski, M. (2015): Post-Summit Results, Delegates' Summit: Best Practice and Definitions of Knowledge and Computing; Sept. 23, 2015, The Fifth Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 13th Internat. Conf. of Numerical Analysis and Applied Mathematics (ICNAAM), Sept. 23–29, 2015, Rhodes, Greece. URL:* `http://www.user.uni-hannover.de/cpr/x/publ/2015/delegatessummit2015/rueckemann_icnaam2015_summit_summary.pdf`

Delegates and contributors: *Claus-Peter Rückemann, Friedrich Hülsmann, Birgit Gersbeck-Schierholz, Knowledge in Motion / Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF), Germany;Przemysław Skurowski, Michał Staniszewski, Silesian University of Technology, Gliwice, Poland; International EULISP post-graduate participants, ISSC, European Legal Informatics Study Programme, Leibniz Universität Hannover, Germany*

Best Practice: Data-centric and Big Data

In 80 Words Around The World.

Data-centric and Big Data [20] (Delegates and other contributors)

- **"The term data-centric refers to a focus, in which data is most relevant in context with a purpose. Data structuring, data shaping, and long-term aspects are important concerns. Data-centricity concentrates on data-based content and is beneficial for information and knowledge and for emphasizing their value. Technical implementations need to consider distributed data, non-distributed data, and data locality and enable advanced data handling and analysis. Implementations should support separating data from technical implementations as far as possible."**
- **"The term Big Data refers to data of size and/or complexity at the upper limit of what is currently feasible to be handled with storage and computing installations. Big Data can be structured and unstructured. Data use with associated application scenarios can be categorised by volume, velocity, variability, vitality, veracity, value, etc. Driving forces in context with Big Data are advanced data analysis and insight. Disciplines have to define their 'currency' when advancing from Big Data to Value Data."**

Citation: *Rückemann, C.-P., Kovacheva, Z., Schubert, L., Lishchuk, I., Gersbeck-Schierholz, B., and Hülsmann, F. (2016): Post-Summit Results, Delegates' Summit: Best Practice and Definitions of Data-centric and Big Data – Science, Society, Law, Industry, and Engineering; Sept. 19, 2016, The Sixth Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 14th Internat. Conf. of Numerical Analysis and Applied Mathematics (ICNAAM), Sept. 19–25, 2016, Rhodes, Greece. URL:* http://www.user.uni-hannover.de/cpr/x/publ/2016/delegatessummit2016/rueckemann_icnaam2016_summit_summary.pdf

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Best Practice: Data Science

In 80 Words Around The World.

Data Science Definition [21] (Delegates and other contributors)

- **"Qualified Data, especially for an enterprise, represents frozen knowledge or in other words frozen value.
The abilities to understand and manage these data is what we call data science.
Data results from action, hence, data science can be defined secondary to data. The essence of Data Science is to give qualified access to relevant data to owners and users.
Hardware and software and their implementation represent the tertiary level of qualified and high level data."**

Citation: *Rückemann, C.-P., Iakushkin, O. O., Gersbeck-Schierholz, B., Hülsmann, F., Schubert, L., and Lau, O. (2017): Post-Summit Results, Delegates' Summit: Best Practice and Definitions of Data Sciences – Beyond Statistics; Sept. 25, 2017, The Seventh Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 15th Internat. Conf. of Numerical Analysis and Applied Mathematics (ICNAAM), Sept. 25–30, 2017, Thessaloniki, Greece. URL:* `http://www.user.uni-hannover.de/cpr/x/publ/2017/delegatessummit2017/rueckemann_icnaam2017_summit_summary.pdf`

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Best Practice: Data Value

In 80 Words Around The World.

Data Value Definition [22] (Delegates and other contributors)

"Data value is the primary ranked value in scenarios comprised of data and computing context. In general, processing of data, is the cause for computing. In consequence, data, including algorithms and other factual, procedural, and further knowledge, have to be ranked primary on the scale of values whereas machinery for processing data, including computing, are providing means of secondary ranked value. In addition, further values, including economic values, can be associated with consecutive deployment of data and machinery."

This is unaffected by varying views and attributions, including quality. Nevertheless, different views can scale values.

Citation: *Rückemann, Claus-Peter; Pavani, Raffaella; Schubert, Lutz; Gersbeck-Schierholz, Birgit; Hülsmann, Friedrich; Lau, Olaf; and Hofmeister, Martin (2018): Post-Summit Results, Delegates' Summit: Best Practice and Definitions of Data Value; Sept. 13, 2018, The Eighth Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 16th Internat. Conf. of Numerical Analysis and Applied Mathematics (ICNAAM), Sept. 13–18, 2018, Rhodos, Greece.*
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Best Practice: Formalisation

In 80 Words Around The World.

Formalisation Definition [23] (Delegates and other contributors)

"Formalisation is the process of creating a defined set of rules, allowing a formal system to infer theorems from axioms. Formal systems may represent well-defined systems of abstract thought. Description and analysis of any detail of any more or less complex system and physical background essentially require a formalisation process. The process includes abstraction and reduction of knowledge, keeping the preconditioned importance of respective context. Consequently, formalisation should be created and context observed by educated experts within the respective discipline."

All mathematical-machine based systems, e.g., computers, are formal systems.
Ideologies should be kept outside of formalisation.

Citation: *Rückemann, Claus-Peter; Pavani, Raffaella; Gersbeck-Schierholz, Birgit; Tsitsipas, Athanasios; Schubert, Lutz; Hülsmann, Friedrich; Lau, Olaf; and Hofmeister, Martin (2019): Post-Summit Results, Delegates' Summit: Best Practice and Definitions of Formalisation and Formalism; Sept. 25, 2019, The Ninth Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 17th Internat. Conf. of Numerical Analysis and Appl. Math. (ICNAAM), Sept. 23–28, 2019, Rhodos, Greece. URL:* `http://www.user.uni-hannover.de/cpr/x/publ/2019/delegatessummit2019/rueckemann_icnaam2019_summit_summary.pdf`, *URL:* `https://doi.org/10.15488/5241` *(DOI).*

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URL: http://www.user.uni-hannover.de/cpr/x/publ/2015/delegatessummit2015/rueckemann_icnaam2015_summit_summary.pdf,
URL: https://www.tib.eu/en/search/id/datacite%3Adoi~10.15488%252F3409/Best-Practice-and-Defnitions-of-Knowledge-and-Computing/,
URL: https://doi.org/10.15488/3409 (DOI).

Application Scenarios

Application scenarios

- Knowledge creation.
- Valorisation.
- Integration.
- ...

Understanding Knowledge

Where knowledge is ...

Knowledge is created from a subjective combination of different attainments as there are intuition, experience, information, education, decision, power of persuasion and so on, which are selected, compared and balanced against each other, which are transformed and interpreted.

And the consequences ...

Authentic knowledge therefore does not exist, it always has to be enlived again. Knowledge must not be confused with information or data which can be stored. Knowledge cannot be stored nor can it simply exist, neither in the Internet, nor in computers, databases, programs or books.

Knowledge and Application

Processes

- Knowledge base creation,
- Knowledge base transfer over generations,
- Documentation of requirements respective algorithms,
- Documentation of context respective architectures,
- Usage development within tender processes.

Knowledge: Prejudice and getting the right meaning

Wrong terms can be very persistent:

- Sunrise (earth is flat?),
- Sunset (from dusk till dawn?),
- Malaria (and prejudice – ahead of scientific results?).
- ...

Knowledge: Perception

Examples

- Depiction, traffic signs and their description different.
- Companies do try critical products in countries with reduced privacy perception.
- Overall personal security will mean insecurity for society.
- Color perception is different by society.

Description

- "*Standardisation*" and "*internationalisation*".
- Foreign word "*privacy*".
- Trend for *hidden security*.
- Words for new colors have been *added* to languages and perception.

Knowledge: Cultural Background

International and other differences

- Privacy perception,
- Different terminology,
- Legal regulations,
- Legal frameworks.

Selection on Structure, Content, Context, and Computing

Theory and practice

- Structural deficits.
- Content can be described and even signed to a certain extend.
- Context cannot be handled to a comparable extent. (Users can sign a PDF document, but what about signing it's context?)
- Long-term issues are mostly out of sight. (What will signature validity mean to archiving and reuse?)
- What does this in general mean to long-term knowledge-based processes?

Application Scenarios in Research and Education

Application scenarios and decision making support

Following case studies show simplified, practical application scenarios for

- separating essential knowledge
  (e.g., knowledge resources, structure)
- creating knowledge based components
  (e.g., Active Source)
- supporting increased decision potential
  (e.g., UDC classification)
- integrating high end resources
  (e.g., compute and storage)

Examples for Multi-Disciplinary Use

Multi-disciplinary status excerpts

- Medical informatics,
- Geoinformatics,
- Legal informatics,
- Geoforensics,
- Prehistory, contextualisation, and cognition,
- Archaeology and digital archaeology,
- Medical geology,
- Digital forensics,
- . . .

Prehistory

Content, context

- Information on realia is often lost.
- Information on context is often lost, isolated, or scattered.
- Historical sources cannot be used in the vast majority of cases.
- Language-based context is rarely available/preserved.
- Contextualisation is difficult to achieve.
- Cognition and insight require/allow multi-disciplinary approaches.
- Cognition and insight can foster inter-/trans-disciplinary achievements.
- Realia objects often require special precautions and long-term documentation – and are beyond classical written sources.
- All participating disciplines, services, and resources have to be prepared for challenges as big data, critical data, accessibility, longevity, and usability. . . .

. . . digital and long-term issues

- Even best practice cannot fully preserve realia and data context.
- Context is often destroyed.
- Long-term issues.
- Currently neither a standard being used for one discipline nor an international standard. . . .

Archaeology

Content, context

- Overall information is widely distributed.
- Sometimes very difficult and a long lasting challenge not only to create information but even to get access to a few suitable information sources.
- Digital and realia objects.
- All participating disciplines, services, and resources have to be prepared for challenges as big data, critical data, accessibility, longevity, and usability.

. . . digital and long-term issues

- Even best practice cannot fully preserve realia and data context.
- Context is often destroyed.
- Long-term issues.
- Currently neither a standard being used for one discipline nor an international standard.
- . . .

Prehistory, Archaeology, . . .

Specialties and Goals

- Prehistory – natural sciences, realia sources, logos, . . .
- Archaeology – historical sources, realia sources, . . .
- Need integrated knowledge base for prehistory, archaeology, natural sciences, and humanities.
- Necessary to collect data from central data centers or registers.

  Examples prehistorical, archaeological, and geophysical data:
  - North American Database of Archaeological Geophysics (NADAG).
  - Center for Advanced Spatial Technologies (CAST).
  - Archaeology Data Service (ADS).
  - Records as with Center of Digital Antiquity.
  - Records as with the Digital Archaeological Record (tDAR).
- Knowledge based approaches.
- Integration methodologies (e.g., superordinate knowledge methodologies, "collaboration house" framework) can support many relevant aspects.

Medicine

. . . digital and long-term issues

- Documentation.
- Natural sciences data integration?
- Catalogs (International Classification / Catalog of Diseases, ICD).
- Classification (Universal Decimal Classification, UDC).
- Data security.
- Privacy.
- Anonymity.
- . . .

Libraries

. . . digital and long-term issues

- Documentation.
- Catalogues.
- Classification (Universal Decimal Classification, UDC). Today about 150000 libraries are using UDC classification and implementing information systems herewith.
- Referencing.
- Search.
- Licensing.

Decision Making

Basics of Decision Making (“DM”)

Decision making is the fundamental base for any process as well as decision making is a process and result itself.

Nevertheless it is very common

- … to have deficits in decision making processes.
- … to underestimate the value of knowledge creation.
- … to have opposition due to historical and social development.

Aware of!

- No decision is an influence to the “selection”, too!
- To shorten planned decision making processes means significant interaction.

About Decisions

Lemma 1:

- **It is easy to do any decision without expertise.**

Lemma 2:

- A decision (making process) should be **fast and perfectly correct**.

  In case a decision cannot be fast **and** perfect,
  it should be fast **or** perfect.

  In **no** case should a decision be slow and wrong.

Base for Decision

Essential relation:

Decision making! $\Longleftrightarrow$ **Selection making!**

Essential complement to decision:

Making a choice!

Problem Analysis

Description:

- Performance analysis (current status / resulting status),
- Problem / target identification (e.g., deviations from performance standard, causes, change of distinctive feature),
- Problem / target description,
- Distinguishing marks between what has been effected by a cause and what has not,
- Deduction of causes from relevant changes found with the problem analysis (identification),
- Cause to a problem is most likely the one that exactly explains the sum of facts.

Example Decision Making Process

Description:

- Establishing the objectives,
- Classification of objectives,
- Place classified objectives in order of importance,
- Development of alternative actions,
- Evaluation of alternatives against all the objectives,
- The tentative decision is that alternative being is able to achieve all the objectives,
- Evaluation of the tentative decision for possible consequences,
- Take decisive actions, take additional actions (prevent adverse consequences from becoming problems)
- Start problem analysis and decision making process iteratively,
- Steps for decision model in order to determine an optimal production plan and reduce conflict potential.

Decision Planning Process

Description:

For best practice, introduce a decision planning process to important decisions in order to result in the following benefits:

1. **Establish independent goals.**
   That means a conscious and directed series of choices.
2. **Aim to a standard of measurement.**
   The measurement should provide information on the distance to the goal.
3. **Convert values to action.**
   The resulting information should be used to support the planning.
4. **Commit limited resources in an orderly way.**
   Planning and commitments for any kind of resources, e.g., staff, money, time.

Example Decision Making Phases

Phases:

Orientation stage: Starting with kick-off or warm-up, exchange with all parties.

Conflict stage: Dispute, arguments, working on common denominators and positions.

Emergence stage: Vague positions and opinions being discussed.

Reinforcement stage: Decision making and justification.

Selected Decision Making Techniques

Techniques:

Rational decision making: List the pro and contra (advantages and disadvantages) of each option. Contrast the costs and benefits of alternatives.

Elimination by aspects: Choosing alternatives by "mathematical psychology". Covert elimination process, comparing the available alternatives by aspects. Choose an aspect and eliminate the alternatives without the aspect. Repeat until one alternative remains.

Simple prioritisation: Choosing an alternative showing the highest probability-weighted utility from all alternatives, resulting from the decision analysis process.

Satisficing: The examination of alternatives is stopped as soon as an acceptable alternative is found.

Instruments

Instruments, factual, conceptual, procedural, . . .

- Knowledge Resources, . . .
- Universal Decimal Classification (UDC), . . .
- Unified Modeling Language (UML), . . .
- High End Computing (HEC), . . .
- Open Archives Initiative (OAI) and OAI-Protocol for Metadata Harvesting (OAI-PMH), . . .
- . . .

Knowledge and Conceptual Implementations

Universal Decimal Classification (UDC)

The Universal Decimal Classification (UDC) is a general plan for the knowledge classification. UDC is a hierarchical decimal classification system that divides the main knowledge fields into 10 main categories (numbered from 0 to 9). Each field is in turn divided into 10 subfields, each subfield is inturn divided into 10 subsubfields, and so on. A more extensive classification code in general describes a more specific subject.

Faceted and multi-disciplinary context

"Facetted" and "multi-disciplinary" is synonym to the Universal Decimal Classification (UDC), `http://www.udcc.org`. UDC uses a "(...)" notation in order to indicate aspect. These descriptions are called facets. In multi-disciplinary object context a faceted classification does provide advantages over enumerative concepts.
The classification deployed for a universal documentation must be able to describe any object with any relation, structure, and level of detail. Objects include any media, textual documents, illustrations, photos, maps, videos, sound recordings, as well as realia, physical objects such as museum objects.

Conceptual Knowledge Implementations, Components, Resources

Contributions, components, and resources

- The **Universal Decimal Classification** (UDC) [24] is the world's foremost document indexing language in the form of a multi-lingual classification scheme covering all fields of knowledge and constitutes a sophisticated indexing and retrieval tool. The UDC is designed for subject description and indexing of content of information resources irrespective of the carrier, form, format, and language. UDC is an **analytico-synthetic and facetted classification**.
- UDC schedules are organised as a **coherent system of knowledge** with associative relationships and references between concepts and related fields.
- UDC-based references in this publication are taken from the multi-lingual UDC summary [24] released by the UDC Consortium (Creative Commons lic.) [25].
- **Facets can be created with any auxiliary tables.** Means to achieve overall efficient realisations, even for complex scenarios: Principles of **Superordinate Knowledge**, integrating arbitrary knowledge. Core assembly elements of Superordinate Knowledge are **methodology, implementation, and realisation** [26].
- Comprehensive focussed subsets of conceptual knowledge provide excellent **modular, standardised complements for information systems component** impl., e.g., environmental information management & computation [27].
- Following references' excerpts from The Prehistory and Archaeology Knowledge Archive (PAKA), DIMF, 2020.

Conceptual Knowledge References: Universal, Main

Conceptual knowledge references, universal, main (EN, excerpt) [28]

Code / Sign Ref.	*Verbal Description (EN)*
UDC:0	Science and Knowledge. Organization. Computer Science. Information. Documentation. Librarianship. Institutions. Publications
UDC:1	Philosophy. Psychology
UDC:2	Religion. Theology
UDC:3	Social Sciences
UDC:5	Mathematics. Natural Sciences
UDC:6	Applied Sciences. Medicine, Technology
UDC:7	The Arts. Entertainment. Sport
UDC:8	Linguistics. Literature
UDC:9	Geography. Biography. History

Conceptual Knowledge References: Documentation and Computer Science

Conceptual knowledge references: Computer science and technology (EN, excerpt)

Code / Sign Ref.	*Verbal Description (EN)*
UDC:004.2	Computer architecture
UDC:004.3	Computer hardware
UDC:004.31	Processing units. Processing circuits
UDC:004.33	Memory units. Storage units
UDC:004.382.2	Supercomputers
UDC:004.4	Software
UDC:004.414	Definition phase of system and software engineering
UDC:004.414.2	Computer system analysis and design
UDC:004.414.3	Software requirements analysis
UDC:004.415	Development phase of system and software engineering
UDC:004.415.5	Software quality assurance
UDC:004.416	System and software maintenance
UDC:004.42	Computer programming
UDC:004.423	Syntax and semantics of programs
UDC:004.43	Computer languages
UDC:004.43.C	C programming language
UDC:004.43.C++	C++ programming language
UDC:004.43.FOR	FORTRAN programming language
UDC:004.431	Low level languages
UDC:004.432	High level languages
UDC:004.451	Operating systems
UDC:004.62	Data handling
UDC:004.7	Computer networks
UDC:004.71	Computer communication hardware
UDC:004.738.5	Internet
UDC:004.774	HTTP application. World Wide Web in the strict sense. Web resources / content
UDC:004.82	Knowledge representation
UDC:004.89	Artificial intelligence application systems. Intelligent knowledge-based systems
UDC:004.932	Image processing
UDC:004.94	Simulation

Conceptual Knowledge References: Archaeology, Prehistory, Geography

Conceptual knowledge references: Archaeology, prehistory, . . . (EN, excerpt) [29]

Code / Sign Ref.	*Verbal Description (EN)*
UDC:902	Archaeology
UDC:903	Prehistory. Prehistoric remains, artefacts, antiquities
UDC:904	Cultural remains of historical times
UDC:908	Area studies. Study of a locality
UDC:91	Geography. Exploration of the Earth and of individual countries. Travel. Regional geography
UDC:912	Nonliterary, nontextual representations of a region
UDC:92	Biographical studies. Genealogy. Heraldry. Flags
UDC:93/94	History
UDC:94	General history

Conceptual Knowledge References: Mathematics and Natural Sciences

Conceptual knowledge references: Mathematics, natural sciences (EN, excerpt) [30]

Code / Sign Ref.	*Verbal Description (EN)*
UDC:51	Mathematics
UDC:52	Astronomy. Astrophysics. Space research. Geodesy
UDC:53	Physics
UDC:54	Chemistry. Crystallography. Mineralogy
UDC:55	Earth Sciences. Geological sciences
UDC:550.3	Geophysics
UDC:551	General geology. Meteorology. Climatology. Historical geology. Stratigraphy. Palaeogeography
UDC:551.21	Vulcanicity. Vulcanism. Volcanoes. Eruptive phenomena. Eruptions
UDC:551.7	Historical geology. Stratigraphy. Palaeogeography
UDC:551.8	Palaeogeography
UDC:551.24	Geotectonics
UDC:56	Palaeontology
UDC:57	Biological sciences in general
UDC:58	Botany
UDC:59	Zoology

Conceptual Knowledge References: Auxiliaries of Time

Conceptual knowledge references: Auxiliaries of time (EN, excerpt) [31]

Code / Sign Ref.	*Verbal Description (EN)*
UDC: "0"	First millennium CE
UDC: "1"	Second millennium CE
UDC: "2"	Third millennium CE
UDC: "3/7"	Time divisions other than dates in Christian (Gregorian) reckoning
UDC: "3"	Conventional time divisions and subdivisions: numbered, named, etc.
UDC: "4"	Duration. Time-span. Period. Term. Ages and age-groups
UDC: "5"	Periodicity. Frequency. Recurrence at specified intervals.
UDC: "6"	Geological, archaeological and cultural time divisions
UDC: "61/62"	Geological time division. Geochronology
UDC: "61"	Precambrian (more than 542 MYBP) (supereon)
UDC: "62"	Phanerozoic (542 MYBP to present) (eon)
UDC: "621"	Palaeozoic / Paleozoic (542-251 MYBP) (era)
UDC: "622"	Mesozoic (251-65.5 MYBP) (era)
UDC: "628"	Cenozoic (65.5 MYBP to present) (era)
UDC: "63"	Archaeological, prehistoric, protohistoric periods and ages
UDC: "67/69"	Time reckonings: universal, secular, non-Christian religious
UDC: "67"	Universal time reckoning. Before Present
UDC: "68"	Secular time reckonings other than universal and the Christian (Gregorian) calendar
UDC: "69"	Dates and time units in non-Christian (non-Gregorian) religious time reckonings
UDC: "7"	Phenomena in time. Phenomenology of time

Conceptual Knowledge References: Auxiliaries of Spatial Features and Place

Conceptual knowledge references: Auxiliaries of spatial features/place (UDC (1/9)) (EN, excerpt) [32]

Code / Sign Ref.	*Verbal Description (EN)*
UDC:(1)	Place and space in general. Localization. Orientation
UDC:(2)	Physiographic designation
UDC:(3)	Places of the ancient and mediaeval world
UDC:(31)	Ancient China and Japan
UDC:(32)	Ancient Egypt
UDC:(33)	Ancient Roman Province of Judaea. The Holy Land. Region of the Israelites
UDC:(34)	Ancient India
UDC:(35)	Medo-Persia
UDC:(36)	Regions of the so-called barbarians
UDC:(37)	Italia. Ancient Rome and Italy
UDC:(38)	Ancient Greece
UDC:(399)	Other regions. Ancient geographical divisions other than those of classical antiquity
UDC:(4)	Europe
UDC:(5)	Asia
UDC:(6)	Africa
UDC:(7)	North and Central America
UDC:(8)	South America
UDC:(9)	States and regions of the South Pacific and Australia. Arctic. Antarctic

Conceptual Knowledge References: Auxiliaries of Spatial Features and Place

Conceptual knowledge references: Auxiliaries of spatial features/place (UDC (1/9)), (1) details, (EN, excerpt) [32]

Code / Sign Ref.	*Verbal Description (EN)*
UDC:(1/9)	Common auxiliaries of place.
UDC:(1)	Place and space in general. Localization. Orientation
UDC:(100)	Universal as to place. International. All countries in general
UDC:(1-0/-9)	Special auxiliary subdivision for boundaries and spatial forms of various kinds
UDC:(1-0)	Zones
UDC:(1-1)	Orientation. Points of the compass. Relative position
UDC:(1-2)	Lowest administrative units. Localities
UDC:(1-3)	Larger unit within the state
UDC:(1-4)	Units of highest (state) level. Nations. States. Confederations
UDC:(1-5)	Dependent or semi-dependent territories
UDC:(1-6)	States or groupings of states from various points of view
UDC:(1-7)	Places and areas according to privacy, publicness and other special features
UDC:(1-8)	Location. Source. Transit. Destination
UDC:(1-9)	Regionalization according to specialized points of view

Conceptual Knowledge References: Physiographic designation

Conceptual knowledge references: Physiographic designation (EN, excerpt)

Code / Sign Ref.	*Verbal Description (EN)*
UDC:(2)	Physiographic designation
UDC:(20)	Ecosphere
UDC:(21)	Surface of the Earth in general. Land areas in particular. Natural zones and regions
UDC:(23)	Above sea level. Surface relief. Above ground generally. Mountains
UDC:(24)	Below sea level. Underground. Subterranean
UDC:(25)	Natural flat ground (at, above or below sea level). The ground in its natural condition, cultivated or inhabited
UDC:(26)	Oceans, seas and interconnections
UDC:(28)	Inland waters
UDC:(29)	The world according to physiographic features
UDC:(3/9)	Individual places of the ancient and modern world

Conceptual Knowledge References: Documentation and Form

Conceptual knowledge references: Documentation and form (EN, excerpt)

Code / Sign Ref.	*Verbal Description (EN)*
UDC:(0.02)	Documents according to physical, external form
UDC:(0.03)	Documents according to method of production
UDC:(0.034)	Machine-readable documents
UDC:(0.04)	Documents according to stage of production
UDC:(0.05)	Documents for particular kinds of user
UDC:(0.06)	Documents according to level of presentation and availability
UDC:(0.07)	Supplementary matter issued with a document
UDC:(0.08)	Separately issued supplements or parts of documents
UDC:(01)	Bibliographies
UDC:(02)	Books in general
UDC:(03)	Reference works
UDC:(04)	Non-serial separates. Separata
UDC:(041)	Pamphlets. Brochures
UDC:(042)	Addresses. Lectures. Speeches
UDC:(043)	Theses. Dissertations
UDC:(044)	Personal documents. Correspondence. Letters. Circulars
UDC:(045)	Articles in serials, collections etc. Contributions
UDC:(046)	Newspaper articles
UDC:(047)	Reports. Notices. Bulletins
UDC:(048)	Bibliographic descriptions. Abstracts. Summaries. Surveys
UDC:(049)	Other non-serial separates
UDC:(05)	Serial publications. Periodicals
UDC:(06)	Documents relating to societies, associations, organizations
UDC:(07)	Documents for instruction, teaching, study, training
UDC:(08)	Collected and polygraphic works. Forms. Lists. Illustrations. Business publ.
UDC:(09)	Presentation in historical form. Legal and historical sources
UDC:(091)	Presentation in chronological, historical form. Historical presentation.
UDC:(092)	Biographical presentation
UDC:(093)	Historical sources
UDC:(094)	Legal sources. Legal documents

Conceptual Knowledge References: Documentation and Language

Conceptual Knowledge References: Languages, natural and artificial (EN, excerpt)

Code / Sign Ref.	*Verbal Description (EN)*
UDC:=1	Indo-European languages of Europe
UDC:=11	Germanic languages
UDC:=12	Italic languages
UDC:=13	Romance languages
UDC:=14	Greek (Hellenic)
UDC:=15	Celtic languages
UDC:=16	Slavic languages
UDC:=17	Baltic languages
UDC:=2	Indo-Iranian, Nuristani (Kafiri) and dead Indo-European languages
UDC:=21	Indic languages
UDC:=29	Dead Indo-European languages (not listed elsewhere)
UDC:=3	Dead languages of unknown affiliation. Caucasian languages
UDC:=35	Caucasian languages
UDC:=4	Afro-Asiatic, Nilo-Saharan, Congo-Kordofanian, Khoisan languages
UDC:=5	Ural-Altaic, Palaeo-Siberian, Eskimo-Aleut, Dravidian and Sino-Tibetan
UDC:=521	Japanese
UDC:=531	Korean
UDC:=541	Ainu
UDC:=6	Austro-Asiatic languages. Austronesian languages
UDC:=7	Indo-Pacific (non-Austronesian) languages. Australian languages
UDC:=8	American indigenous languages
UDC:=81	Indigenous languages of Canada, USA and Northern-Central Mexico
UDC:=82	Indigenous languages of western North American Coast, Mexico and Yucatán
UDC:=84	Ge-Pano-Carib languages. Macro-Chibchan languages
UDC:=85	Andean languages. Equatorial languages
UDC:=86	Chaco languages. Patagonian and Fuegian languages
UDC:=88	Isolated, unclassified Central and South American indigenous languages
UDC:=9	Artificial languages
UDC:=92	Artificial languages for use among human beings. Int. aux. languages (interlanguages)
UDC:=93	Artificial languages used to instruct machines. Programming/computer languages

Conceptual Knowledge References: Creating Groups and References

UDC Operations

Standardised operations with UDC are, e.g.,

Operation	Symbol
Addition	"+"
Consecutive extension	"/"
Relation	":"
Subgrouping	"[]"
Non-UDC notation	"*"
Alphabetic extension	"A-Z"

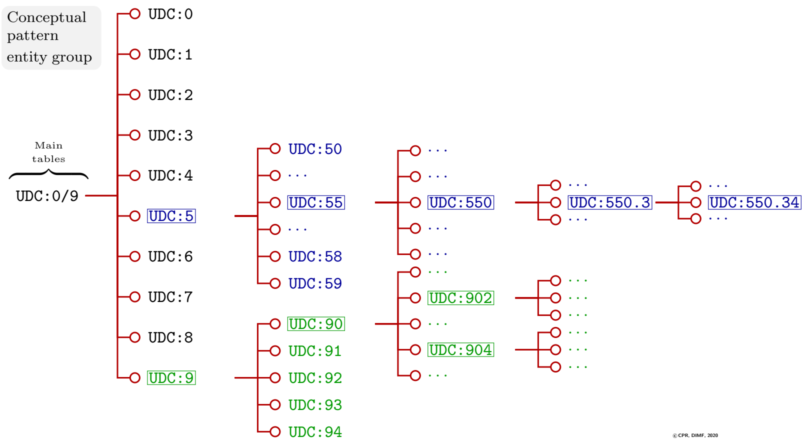
besides place, time, nationality, language, form, and characteristics.

Examples

```
(0.02/.08)                 Special auxiliary subdivision for document form
=1/=8                      Natural languages
=1/=2                      Indo-European languages
=9/=93                     Artificial languages
59+636                     Zoology and animal breeding
(7):(4)                    Europe referring to America
311:[622+669](485)         statistics of mining and metallurgy in Sweden
004.382.2:[902+550.8] CPR  Supercomputers ref. to archaeology and geosciences, CPR author
```

Conceptual Knowledge Reference Forks: Case Implementation

Conceptual Knowledge Forks Diagram



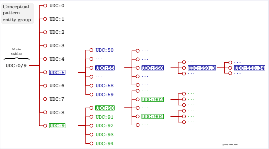
[33]

Conceptual Knowledge Reference Forks: Case Implementation

Conceptual Knowledge Forks Diagram

Code / Sign Ref.	*Verbal Description (EN)*
UDC:5	Mathematics and natural sciences
UDC:51	Mathematics
UDC:53	Physics
UDC:55	Earth Sciences. Geological sciences
UDC:550	Earth sciences
UDC:550.3	Geophysics
UDC:550.34	Seismology. Earthquakes in general ⇐
UDC:551.2	Internal geodynamics (endogenous processes)
UDC:551.24	Geotectonics
UDC:9	Geography. Biography. History
UDC:902	Archaeology
UDC:903	Prehistory. Prehistoric remains, artefacts, antiquities
UDC:904	Cultural remains of historical times

(a) Relevant UDC references for entity groups 5 and 9 (excerpts).



(b) Primary, decimal (UDC) conceptual knowledge forks diagram (excerpt).

Figure : Conceptual Knowledge Pattern Matching: (a) relevant UDC reference implementations ([24]) and (b) respective matching process, illustrating discovery paths in the decimally organised structure of conceptual knowledge, starting with main tables.

[33]

Integration, Conceptual, Factual, . . .: Structure-base Multi-line Case

Multi-line case

A different kind of complexity is what we commonly face in context of knowledge resources, same task and still with arbitrary length and arbitrary number of objects and entities with multi-line formatting to be preserved.

```
Nisyros                    [Volcanology, Geology]:
                           Volcano, Type: Strato volcano, Island.
                           Status: Historical, Summit Elevation: 698\UD{
                            m}. ...
                           VNUM: 0102-05=, ...,
                           Craters: ..., ...
                           %%IML: UDC:[550.3],[930.85],[911.2]
                           %%IML: media:...{UDC:
                            [550.3+551.21],[911.2](4+38+23)}...jpg
                           Stefanos Crater, Nisyros, Greece.
                           LATLON: 36.578345,27.1680696
                           %%IML: GoogleMapsLocation: https://www.google
                            .com/...@36.578345,27.1680696,337m/...
                           Little Polyvotis Crater, Nisyros, Greece.
                           LATLON: 36.5834105,27.1660736 ...
```

Knowledge resources' object ('Nisyros'): Multi-line formatting, conceptual knowledge, media object entities, and georeferences (excerpt).

Procedural Knowledge: Modeling and applications

Unified Modeling Language (UML)

The Unified Modeling Language (UML) can be used for various purposes with information sciences, software development, and even independent from information sciences, e.g. in economics and business context:

- "business model"
- classes
- messages, objects in their timing sequence
  - coarse overview
  - dynamic
  - parallel processes
  - distributed systems

Procedural Knowledge: UML Diagrams

UML Diagrams

- Use-case diagram
- Class diagram
- Package diagram
- Interaction diagram
- State diagram
- Activity diagram
- Implementation diagram

Use-case Diagram, Class Diagram, Package Diagram

Use-case diagram

Diagram: Use-Case

Phase: Requirements, predefinition, application design – building, delivery

Operational area: business processes, common

Class diagram

Diagram: class diagram

Phase: predefinition, application design – building

Operational area: anywhere, the class diagram is the most important UML diagram.

Package diagram

Diagram: package diagram

Phase: application design – building

Operational area: overall orientation purposes, which classes in which modules. partitioning into sub-projects, libraries, translation units.

Use-case Diagram, Class Diagram, Package Diagram

Use-case diagram

Diagram: Use-Case

Phase: Requirements, predefinition, application design – building, delivery

Operational area: business processes, common

Class diagram

Diagram: class diagram

Phase: predefinition, application design – building

Operational area: anywhere, the class diagram is the most important UML diagram.

Package diagram

Diagram: package diagram

Phase: application design – building

Operational area: overall orientation purposes, which classes in which modules, partitioning into sub-projects, libraries, translation units.

Use-case Diagram, Class Diagram, Package Diagram

Use-case diagram

Diagram: Use-Case
Phase: Requirements, predefinition, application design – building, delivery
Operational area: business processes, common

Class diagram

Diagram: class diagram
Phase: predefinition, application design – building
Operational area: anywhere, the class diagram is the most important UML diagram.

Package diagram

Diagram: package diagram
Phase: application design – building
Operational area: overall orientation purposes, which classes in which modules. partitioning into sub-projects, libraries, translation units.

Interaction Diagram and State Diagram

Interaction diagram

Diagram: interaction diagram

Phase: Requirements, predefinition, application design – building, delivery

Operational area: shows the message flow an therefore the cooperation of objects in timing sequence.

Special interaction diagrams are:

- Sequence diagram: timing call structure with few classes.
- Collaboration diagram: timing call structure with few messages.

State diagram

Diagram: state diagram

Phase: Requirements, predefinition, application design – building, delivery

Operational area: presentation of dynamical behaviour

Interaction Diagram and State Diagram

Interaction diagram

Diagram: interaction diagram

Phase: Requirements, predefinition, application design – building, delivery

Operational area: shows the message flow an therefore the cooperation of objects in timing sequence.

Special interaction diagrams are:

- Sequence diagram: timing call structure with few classes.
- Collaboration diagram: timing call structure with few messages.

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Diagram: state diagram

Phase: Requirements, predefinition, application design – building, delivery

Operational area: presentation of dynamical behaviour

Activity diagram and Implementation Diagram

Activity diagram

Diagram: activity diagram

Phase: predefinition, application design – building

Operational area: various purposes.

Implementation diagram

Diagram: Implementation diagram

Phase: predefinition, application design – building, delivery

Operational area: especially for presentation of distributed applications and components; in general: presentation of implementation aspects (translations units, executable programs, hardware structure)

Special implementation diagrams are:

- component diagram: coherence of software.
- deployment diagram: hardware structure.

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Procedural Knowledge and Implementation: High End Computing

Basics and prerequisites

- Real goals. Define the goals, different views.
- Need for basic understanding and knowledge base for HEC.
- Prominent HEC and collaboration aspects decision making processes are necessary for.
- Separate the topics (disciplines, resources, ...).
- Gather the real requirements for the analysis.
- Up-to-date resource policies in theory and practice.
- Interesting fields of application are processes within disciplines.
- Future deployment of integration and classification with components of complex systems.

Procedural Knowledge and Implementation: HEC Decision and Computing

Components (all areas, no sort order):

- Architecture,
- Operating System,
- Applications,
- Programming languages,
- Tools,
- System modeling,
- Vendors,
- Strategy,
- Targets,
- Staff,
- Operation,
- Services,
- System management,
- Complex licensing,
- Policies,
- Governance,
- ...

Procedural Knowledge and Implementation: HEC Decision and Computing

Components (all areas, no sort order):

- Components (all areas) with strong focus on
- Applicability, efficiency,
- Architecture applicability,
- Operating System applicability,
- Efficient applications,
- Programming languages,
- Tools,
- System modeling,
- Vendors,
- Strategy,
- Targets,
- Staff,
- Operation,
- Services,
- System management,
- Complex licensing,
- Policies,
- Governance,
- ...

Decision Making and High End Computing

Process fundamentals:

- Knowledge and experience are more important than hierarchy.
- Find the essential information.
- Rational problem analysis and decision planning.
- Add forensics to all possible information.
- The decision making process needs to define the focus.
- The decision making process needs to define goals.
- There should be only one final instance for selection processes.
- Multiple views for a process must be allowed and supported.
- Define results.
- Define service and responsibilities.
- List requirements and parts.
- Tools are needed for making the selection.
- Keep the tools simple.
- Best practice should be used in order to support the process.

Decision Making and High End Computing

Essential aspects:

- Dissemination.
- Scientific research and consultancy.
- Service and operation.
- Transparency for legal issues.
- Written definition of goals, acknowledged by all parties.
- Quality of Data counts, aware of long-term usage.
- Support structuring the application scenarios with architecture/disciplines.
- Support essential knowledge to be long-term persistent (structure, UDC, OEN, CEN, ...).
- Try to support dynamical application scenarios.
- Acknowledge that for some party prestige and presentation might be an aspect with any system.

Decision Subjects

Decision on:

- User (scientific and industry) requirements,
- Content,
- Context,
- Operation lifecycle,
- Staff and operation,
- Services,
- Architecture (specification, networks),
- Policies,
- Goals (of the system/service),
- Dissemination,
- (Funding).

Instruments and Obstacles

Obstacles reducing success and efficiency with the processes

- Time consumption (e.g., staff, project timelines),
- Documentation (e.g., low percentage of reusability),
- Classification (e.g., limited views),
- Tools (e.g., changing repeatedly),
- "Standards" (e.g., changing repeatedly),
- ...
- Different perception of goals, strategies, and completeness.

Complementary to Instruments

Structure

- Must be able to contain and refer to any content.

Full text and keywords

- Groups, regular expressions, search functions, . . .

Soundex

- Algorithm for calculating codes from text strings, representing phonetic properties.
- Originally only used for names, in Englisch.
- The original algorithm mainly encodes consonants.
- Goal is to encode homophones with the same representation, minor spelling differences do result in the same representation.
- Various modifications for any language, topics, any kind of words, support for many programming environments.
- . . .

Complementary to Instruments: Helpers – you always need

Staff and resources

- **Quantity of Staff and Resources depends.**
- **‘Quality’ of Data (QoD) can optimise requirements for staff and resources.**

Lessons Learned

Lessons learned:

- Prehistory and geosciences, natural sciences, humanities: Conceptual knowledge approaches enable sustainable long-term knowledge development and integration.
- Universal context documentation (multi-disciplinary context, multi-lingual, attributation, time, space, relocation, ...).
- Improve long-term creation of knowledge complements.
- Provide consistency due to edition practice.
- Improve factual 'Quality' of Data.
- Foster the use of universal conceptual knowledge framework implementations for multi- and inter-disciplinary research.
- Foster the creation and application of best practice.
- Create knowledge-centric, modular implementations.
- Enable contextualisation and cognitive insight: Create and provide instruments based on knowledge-based standards.

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Conclusions

Information Science and inter-disciplinary long-term strategies

- Foster insight, consistency, sustainability.
- Deploy logic/logos.
- Conceptual knowledge references.
- Scientific research, fundamental, epistemological background.
- Disciplines providing a higher potential of creating insight from multi-disciplinary scientific research can gather even greater benefits – prehistory, archaeology, natural sciences, humanities.

Knowledge complements are the assets of information science!

Applications:

Provide solutions to application scenarios!

Instruments:

Provide fundaments for creating instruments!

Networking

Thank you for your attention!

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