– Keynote Lecture –

Allow Knowledge to Prevail: All-scientists Sustainable Contributions to Multi-disciplinary Scientific Insight, from Prehistory to Future

The IARIA Annual Congress on Frontiers in Science, Technology, Services, and Applications

(IARIA Congress 2022)

July 24–26, 2022, Nice, France

Dr. rer. nat. Claus-Peter Rückemann[1,2,3]

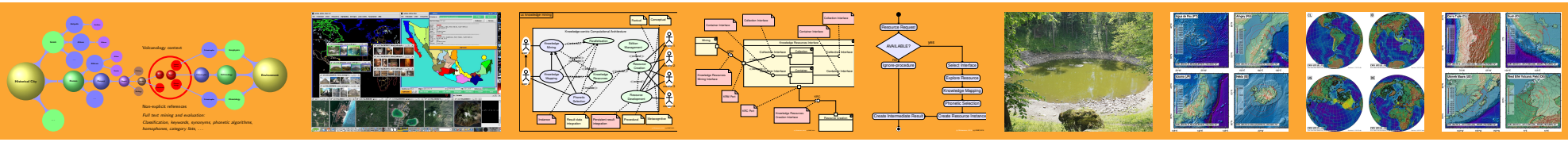
uDIMF

[1] Westfälische Wilhelms-Universität Münster (WWU), Münster, Germany

[2] Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF), Germany

[3] Leibniz Universität Hannover, Hannover, Germany

https://scienceparagon.de/cpr **ruckema(at)uni-muenster.de**



Common Information – The Author

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

Curriculum Vitae:
http://scienceparagon.de/cpr/x/rueckemann/en/
Publications, lectures, and materials:
http://scienceparagon.de/cpr/x/rueckemann/en/#Publications
http://scienceparagon.de/cpr/x/frodi/en/#Courses
Congresses and venues:
http://scienceparagon.de/cpr/x/rwerkr/en/

Research

Dr. Claus-Peter Rückemann
Abteilung für Ur- und Frühgeschichtliche Archäologie, Historisches Seminar
Westfälische Wilhelms-Universität Münster (WWU) and uDIMF
E-Mail: ruckema(at)uni-muenster.de

Chair of the Board of Trustees, Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF);
Chair of the Board on Advanced Computing and Emerging Technologies,
International Academy, Research, and Industry Association;
General Chair and Chair of the Steering Committee of
The International Conference on Advanced Geographic Information Systems, Applications, and Services (GEOProcessing);
General Chair and Chair of the Steering Committee of
The International Conference on Advanced Communications and Computation (INFOCOMP);
Chairman of the International Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS);
Director GEXI Consortium; Head of research LX Foundation; Senior Member of Knowledge in Motion long-term project;
Fellow Member of the Int. HPC and Artificial Intelligence Advisory Council; Member of the Indexing Committee Board, IARIA;
Westfälische Wilhelms-Universität Münster (WWU);
Senior Scientist and Senior Lecturer Information Science, Security, and Computing at Leibniz Univ. Hannover; IARIA Fellow.

Epitome / Abstract

Epitome / abstract

- This talk addresses theoretical and practical aspects of systematical and methodological views on knowledge in science and academic contexts.
- The goal is a base for a fundamental understanding of knowledge and its complements for sustainable employment by all scientists and domains, gaining multi-disciplinary insight, targeting even complex multi-disciplinary scenarios like knowledge integration and coherent conceptual contextualisation.
- This talk provides essential information about the fundamental knowledge complements and component frameworks and delivers references to publications and created implementations and realisations.
- Examples integrate many disciplines and domains, e.g., information science, natural sciences, geology and geophysics, prehistory, archaeology, social sciences, humanities, geography, and geoinformatics.
- Future research will address the continued creation and further development of aforementioned reference implementations and component frameworks.

Citation: *Rückemann, C.-P. (2022): Allow Knowledge to Prevail: All-scientists Sustainable Contributions to Multi-disciplinary Scientific Insight, from Prehistory to Future; Keynote Lecture, The IARIA Annual Congress on Frontiers in Science, Technology, Services, and Applications (IARIA Congress 2022), July 24–26, 2022, Nice, France, URL: https://www.iaria.org/conferences2022/IARIACongress22.html*

Keywords: Prehistory; Archaeology; Natural Sciences; Humanities; Multi-disciplinary Knowledge; Scientific Insight; Chorology; Information Science; Contextualisation; Coherent Conceptual Knowledge; Computation and Processing; Knowledge Complements; Geoscientific Applications; UDC; Big Data; High Performance Computing; Supercomputing; Knowledge Resources; Discovery.

Introduction

Introduction and Motivation

- **Advances:**
  Very little advances in ...
  computing,
  data related disciplines,
  documentation and reuse of experience, using classification and related methods,
  ...
- **Common Views:**
  Very loosely coupled perspectives, synonymously used terms and concepts, little holistic understanding.
- **Awareness and Practice:**
  Who is currently really practicing or considering all best practice, standards, holistic views, and approaches together
  in an integrated way?

Traditional Starting View

Questions

Content First.

But:

- How comes that everything is said to be "content"?
- If "data" is used as synonym for "content", what does that mean?
- Considering the statement

  > *"If you torture the data long enough it will eventually confess." (Ronald Harry Coase)*,

  what can you do that "data" cooperates and supports you on a voluntary, constructive base?
- In what way do data, information, knowledge ... contribute?
- Why are data and content isolated from context, methods, ...?
- In what way does the startup view contribute to sustainability?

Entities

Entities in use

- **Data:**
  Big data, research data, information, ...
- **Classification:**
  Universal Decimal Classification (UDC), Library of Congress Classification, ...
- **Computing:**
  Distributed Computing, High End Computing, High-Performance Computing, Supercomputing, programming ...-solution, Unified Modelling Language (UML), ...
- **Experience:**
  Documentation, recommendation, learning processes, education, cognition, competence, ...
- ...

(Subjective impression: At first, implemented entities alone do not help a lot for understanding the essence of knowledge?)

Public Understanding

Knowledge today (Source: Merriam Webster Dictionary)

1 a (1): the fact or condition of knowing something with familiarity gained through experience or association

(2): acquaintance with or understanding of a science, art, or technique

b (1): the fact or condition of being aware of something

(2): the range of one's information or understanding answered to the best of my knowledge

c: the circumstance or condition of apprehending truth or fact through reasoning

d: cognition: the fact or condition of having information or of being learned a person of unusual knowledge

2 a: the sum of what is known: the body of truth, information, and principles acquired by humankind

b: archaic: a branch of learning

...

Definition

Defining knowledge [1] (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."**

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. DOI: 10.15488/3409. URL: https://doi.org/10.15488/3409 (DOI).URL: http://scienceparagon.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*

Systematical View on Knowledge: FCPM Complements

Systematical view on knowledge (complements and examples) [2]:

- **Factual Knowledge** $\Leftrightarrow$ **Numerical data, data ...**
- Conceptual Knowledge $\Leftrightarrow$ Classification ...
- Procedural Knowledge $\Leftrightarrow$ Workflow, computing ...
- Metacognitive Knowledge $\Leftrightarrow$ Experience ...
- Structural Knowledge $\Leftrightarrow$ Standard hybrid formats ...
- ...

Systematical View on Knowledge: FCPM Complements

Systematical view on knowledge (complements and examples) [2]:

- **Factual Knowledge** $\Leftrightarrow$ Numerical data, data ...
- **Conceptual Knowledge** $\Leftrightarrow$ Classification ...
- Procedural Knowledge $\Leftrightarrow$ Workflow, computing ...
- Metacognitive Knowledge $\Leftrightarrow$ Experience ...
- Structural Knowledge $\Leftrightarrow$ Standard hybrid formats ...
- ...

Systematical View on Knowledge: FCPM Complements

Systematical view on knowledge (complements and examples) [2]:

- **Factual Knowledge** $\Leftrightarrow$ **Numerical data, data ...**
- **Conceptual Knowledge** $\Leftrightarrow$ **Classification ...**
- **Procedural Knowledge** $\Leftrightarrow$ **Workflow, computing ...**
- Metacognitive Knowledge $\Leftrightarrow$ Experience ...
- Structural Knowledge $\Leftrightarrow$ Standard hybrid formats ...
- ...

Systematical View on Knowledge: FCPM Complements

Systematical view on knowledge (complements and examples) [2]:

- **Factual Knowledge** $\Leftrightarrow$ Numerical data, data ...
- **Conceptual Knowledge** $\Leftrightarrow$ Classification ...
- **Procedural Knowledge** $\Leftrightarrow$ Workflow, computing ...
- **Metacognitive Knowledge** $\Leftrightarrow$ Experience ...
- Structural Knowledge $\Leftrightarrow$ Standard hybrid formats ...
- ...

Systematical View on Knowledge: FCPM Complements

Systematical view on knowledge (complements and examples) [2]:

- **Factual Knowledge** $\Leftrightarrow$ Numerical data, data ...
- **Conceptual Knowledge** $\Leftrightarrow$ Classification ...
- **Procedural Knowledge** $\Leftrightarrow$ Workflow, computing ...
- **Metacognitive Knowledge** $\Leftrightarrow$ Experience ...
- **Structural Knowledge** $\Leftrightarrow$ Standard hybrid formats ...
- ...

(ongoing; sources: Aristotle; Anderson & Krathwohl [3] ; SACINAS Delegates' Summit 2015–2022 [1] [4] [5] [6] [7] [8]); Gleser [9]

Factual Knowledge

Factual Knowledge Example: Data / Information [10], [2]

```
Vesuvius [Volcanology, Geology, Archaeology]:
         (lat.) Mons Vesuvius.
         (ital.) Vesuvio.
         Volcano, Gulf of Naples, Italy.
         Complex volcano (compound volcano).
         Stratovolcano, large cone (Gran Cono).
         Volcano Type: Somma volcano,
         VNUM: 0101-02=,
         Summit Elevation: 1281\UD{m}. ...
         ...
         Syn.: Vesaevus, Vesevus, Vesbius, Vesvius
         s. volcano, super volcano, compound volcano
         s. also Pompeji, Herculaneum, seismology
         ...
         compare La Soufrière, Mt. Scenery, Soufriere
         ...
         %%IML: UDC:[911.2+55]:[57+930.85]:[902]"63"(4+37+23+24)
          =12=14
         %%IML: GoogleMapsLocation: http://maps.google.de/maps?hl=
          de&gl=de&vpsrc=0&ie=UTF8&ll=40.821961,14.428868&spn
          =0.018804,0.028238&t=h&z=15
```

Conceptual Knowledge

Conceptual Knowledge Example: Universal Decimal Classification, [2]

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. "Facetted" and "multi-disciplinary" is synonym to the UDC, `http://www.udcc.org`.

UDC Standard Operation / Symbols (besides place, time, nationality, language, form, and characteristics)

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

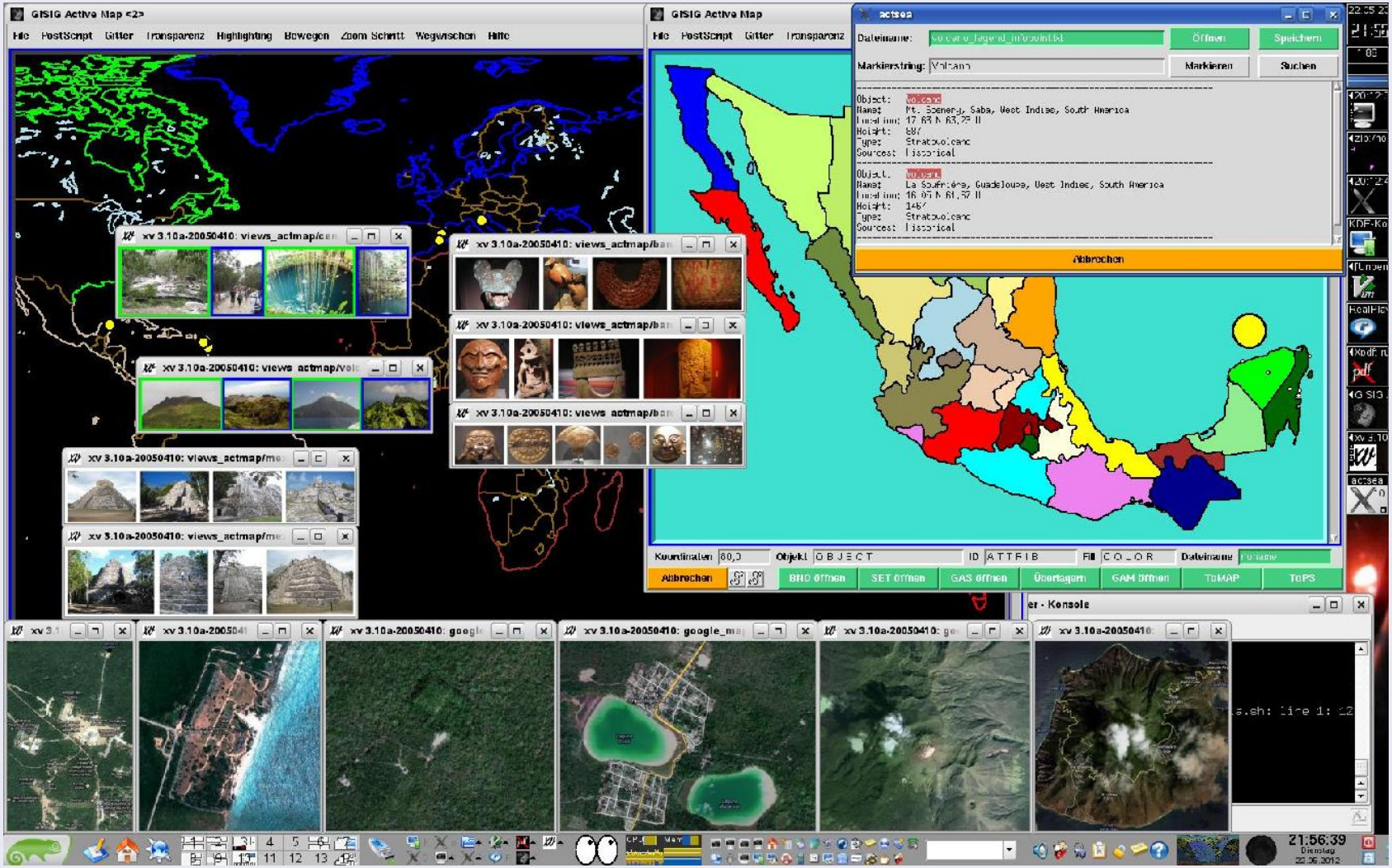
Simple UDC Examples – consistent due to UDC releases / editions

```
1 (0.02/.08)          Special auxiliary subdivision for document form
2 =1/=8               Natural languages
3 =9/=93              Artificial languages
4 59+636              Zoology and animal breeding
5 (7):(4)             Europe referring to America
6 311:[622+669](485)  statistics of mining and metallurgy in Sweden
```

Here, all small unsorted excerpts of the knowledge resources objects only refer to main UDC-based classes, which for this part of the publication are taken from the Multilingual Universal Decimal Classification Summary (UDCC Publication No. 088) [11, 12] released by the UDC Consortium under the Creative Commons Attribution Share Alike 3.0 license [13] (first release 2009, subsequent update 2012).

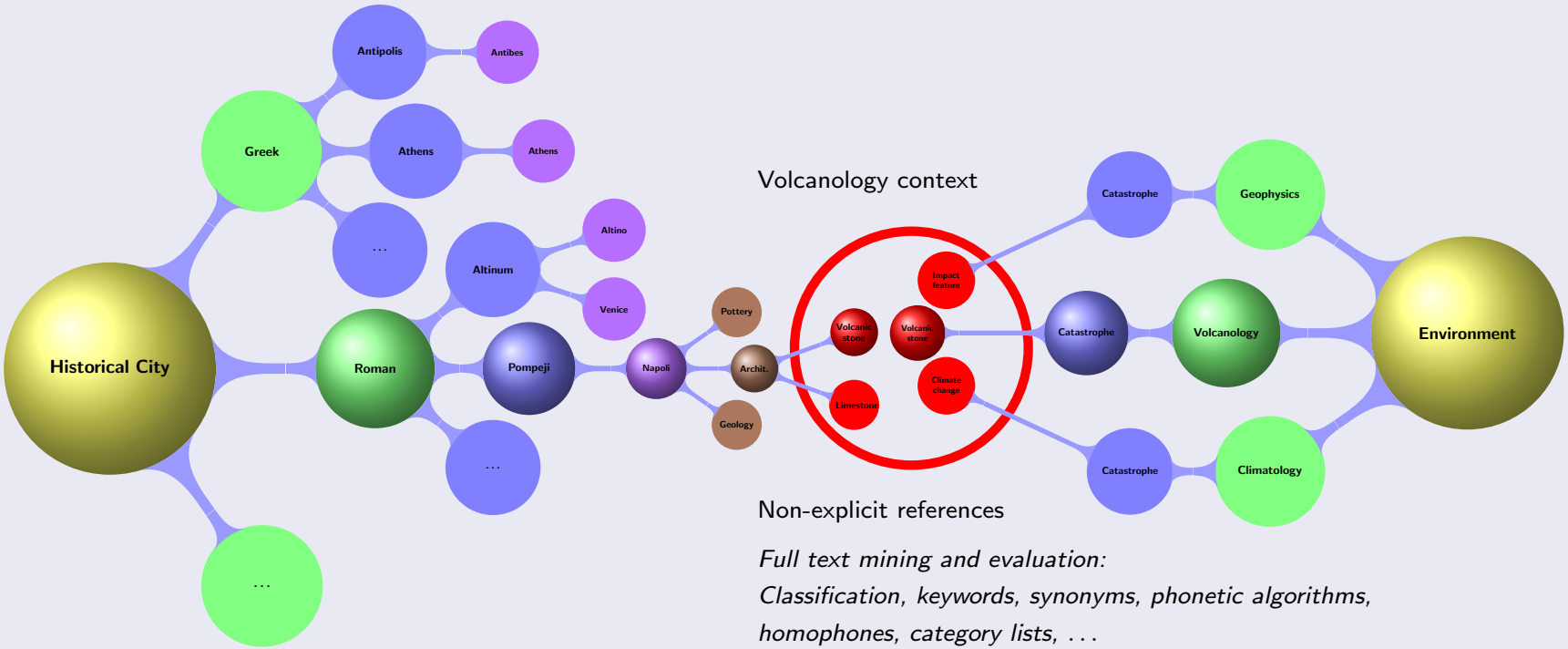
Procedural Knowledge: Integrated Information and Computing System

Program / Workflow Code (© CPR / LX / GEXI) [14]



Knowledge Discovery Example: Computing object carousel connections

Historical city and environment object carousels, trees with computed references [15]



Carousel links, calculated via non-explicit references of comparable objects (red) from knowledge resources within trees. Starting topics are identified by large golden bullets. The two fitting lines within the object carousels are `Historical City : Roman : Pompeji : Napoli : Architecture : Volcanic stone` and `Environment : Volcanology : Catastrophe : Volcanic stone`. Fitting object term for historical city and environment is `Volcanic stone`. Excerpt of associated multi-disciplinary branch level objects: `Limestone`, `Impact feature`, `Climate change`.

Metacognitive Knowledge

Metacognitive Knowledge Example: Experience / Documentation [2]

- **Metacognitive knowledge:**

  Metacognitive knowledge can relate to any of factual, conceptual, and procedural knowledge.

- **Cognition:**

  cognitio(-), from cognoscere (Latin) :: get to know.
  The mental action or process of acquiring knowledge and understanding through thought, experience, and the senses (Source: Oxford dictionary).

- **Analogy:**

  ἀναλογία, analogia (Greek) :: proportion.
  A cognitive process of transferring information or meaning from a particular subject (the analogue or source) to another (the target).

- ...

Structural Knowledge

Examples of categories . . . [2]

material structures are **natural objects** such as biological organisms, minerals, and chemicals and **man-made** objects such as architectural buildings and machinery.

abstract structures are any (knowledge/information/data) structures in information science, used in theory and practice.

structure types are hierarchies or lattices.

Example from discipline's view . . .

Logic, philosophy: Structure is essential in logic, e.g., structure of arguments. An argument consists of one or more premises from which a conclusion is inferred. Basic inferences are deduction and induction.

. . .

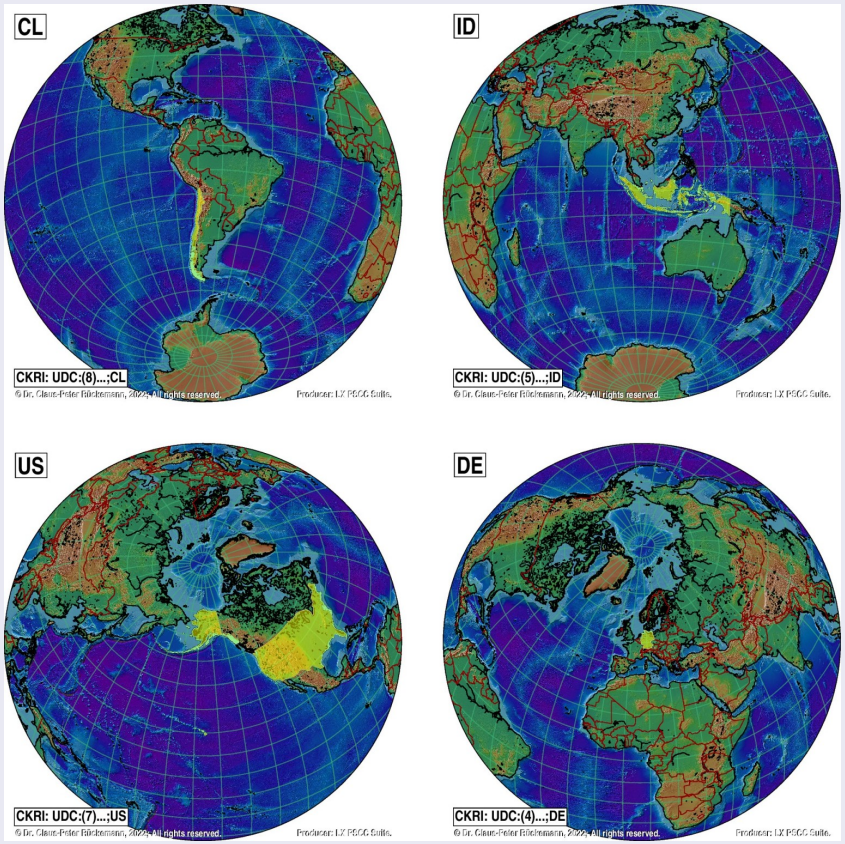
Methodological implementation and realisation [18, 19]

Methodological implementation and realisation

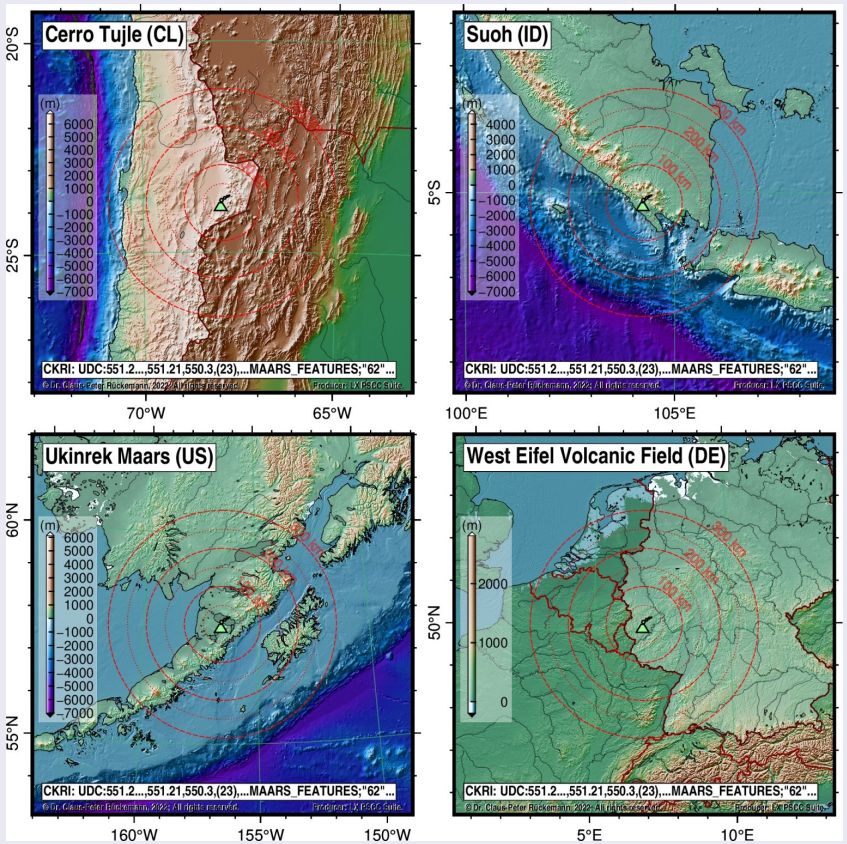
- Methodological implementation and realisation are based on the **Conceptual Knowledge Reference Implementation (CKRI)** [16] and respective contextualisation.
- Components outside the core scope of this knowledge focussed geoscientific, prehistoric, and archaeological research are employed and can be extended via the **Component Reference Implementations (CRI) frame** [17]. Both provide sustainable fundaments for highest levels of reproducibility and standardisation.
- Universally consistent multi-disciplinary conceptual knowledge is based on the Conceptual Knowledge Reference Implementation (CKRI) [16] and implemented via UDC code references.
- CKRI is provided in development stage editions, prehistory-protohistory and archaeology E.0.4.6, natural sciences E.0.2.8).

Methodological implementation and realisation

Example: Resulting symbolic representation of features groups [18, 19] [20, 21, 22] [23, 24]



(a) Generated symbolic representation of country ident. contexts.



(b) Generated symbolic representation of object AoI contexts.

Figure: Resulting symbolic representation of a volcanological features group (maars) based on the coherent conceptual knowledge integration (excerpt). Sequence of procedural steps for larger scale and smaller scale contextualisation, including country identification contexts (a) and AoI contexts (b). Generated representations include integrated CKRI references, projection of topographic and bathymetric results, and further knowledge for respective areas.

Benefits and Drawbacks

Benefits and Drawbacks

- Knowledge is supported on a **more holistic base**.
- **Experience: All scientists and domains** have (themselves) shown of being able to contribute on all knowledge complements.
- **Natural complexity** of knowledge **can contribute** to solutions.
- **Tasks** (creation, provisioning, consumption etc.) can be served **on non-technical data-centric level**.
- **Systematic application** of methods.
- **Long-term use** is supported.
- **Multi- and interdisciplinary** creation and work are supported. ...
- **Further telic and atelic efforts (e.g., reference implementations from disciplines)** required and enabled.
- **Education and learning** processes required.
- **Appropriate (best) practice** required.
- **Continuous, ongoing, further development** required. ...

Allow Knowledge to Prevail . . .

Allow Knowledge to Prevail in most cases means . . .

- Knowledge is made up from the **complements of computing, data, experience, classification,** . . .
- The complements should be **preserved** (e.g., with long-term resources and research data management).
- Preserved knowledge should be prepared to be continuously scientifically **revisited, revaluated, recontextualised**.
- The holistic knowledge view should be **trained**.
- The holistic knowledge view should be **fostered**.
- The holistic knowledge view should be '**funded**'.
- Believe in tools and technology without working on 'knowledge' and 'data' is rarely a great achievement.
- (In general, **quality** (of data) is hermetic and has to be defined, always, for any case.)

Conclusions

Lessons Learned and Conclusions

- **Beware of knowledge/science/disciplines/... cargo cult practice.**
- All scientists should **educate** themselves regarding **knowledge complements**.
- Any 'knowledge' can be handled in an **appropriate** way.
- Systematical view enables **options for priorities/integration**.
- **Targets: Sustainable Reference Implementations, Research Knowledge ((Data)) Management** and long-term projects.
- **Long-term documentation** (which does not necessarily mean textual papers only) is required.
- **Long-term funding** (of endeavouring scientists) is 'reasonable'.

What we should epitomise, practice and 'walk the talk', means:

Not being restricted to do what (technical) tools can do but being able to do what is scientifically possible!

Knowledge First!

Networking

References

Bibliography / References

Reference section containing all the cited and used references and publications on further reading.

[1] C.-P. Rückemann, F. Hülsmann, B. Gersbeck-Schierholz, P. Skurowski, and M. Staniszewski, *Knowledge and Computing*. Post-Summit Results, Delegates' Summit: Best Practice and Definitions of Knowledge and Computing, Sept. 23, 2015, The Fifth Symp. on Adv. Comp. and Inf. in Natural and Applied Sciences (SACINAS), The 13th Int. Conf. of Num. Analysis and Appl. Math. (ICNAAM), Sept. 23–29, 2015, Rhodes, Greece, 2015, pp. 1–7, DOI: 10.15488/3409.

[2] C.-P. Rückemann, *Fundamental Aspects of Information Science, Security, and Computing (Univ. Lecture)*. ISSC, EULISP Lecture Notes, European Legal Informatics Study Programme, Institut für Rechtsinformatik (IRI), Leibniz Universität Hannover, 2022, 800 + D Pages, URL: http://www.eulisp.eu [accessed: 2022-07-10].

[3] L. W. Anderson and D. R. Krathwohl, Eds., *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. Allyn & Bacon, Boston, MA (Pearson Education Group), USA, 2001, ISBN: 978-0801319037.

[4] C.-P. Rückemann, Z. Kovacheva, L. Schubert, I. Lishchuk, B. Gersbeck-Schierholz, and F. Hülsmann, *Best Practice and Definitions of Data-centric and Big Data – Science, Society, Law, Industry, and Engineering*. Post-Summit Results, Delegates' Summit: Best Practice and Definitions of Data-centric and Big Data – Science, Society, Law, Industry, and Engineering, September 19, 2016, The Sixth Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 14th International

Conference of Numerical Analysis and Applied Mathematics (ICNAAM), September 19–25, 2016, Rhodes, Greece, 2016, delegates and other contributors: Claus-Peter Rückemann, Westfälische Wilhelms-Universität Münster (WWU) / Leibniz Universität Hannover / North-German Supercomputing Alliance (HLRN), Germany; Zlatinka Kovacheva, Middle East College, Department of Mathematics and Applied Sciences, Muscat, Oman; Lutz Schubert, University of Ulm, Germany; Iryna Lishchuk, Leibniz Universität Hannover, Institut für Rechtsinformatik, Germany; Birgit Gersbeck-Schierholz, Knowledge in Motion / Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF), Germany; Friedrich Hülsmann, Knowledge in Motion / Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF), Germany; DOI: 10.15488/3410, URL: http://www.icnaam.org/sites/default/files/Preliminary_Program_of_ICNAAM_2016.pdf, URL: http://history.icnaam.org/icnaam_2016/sites/default/files/Preliminary_Program_ICNAAM_2016_68th.pdf, URL: http://www.user.uni-hannover.de/cpr/x/publ/2016/delegatessummit2016/rueckemann_icnaam2016_summit_summary.pdf, URL: https://www.tib.eu/en/search/id/datacite%3Adoi~10.15488%252F3410/Best-Practice-and-Definitions-of-Data-centric-and/ (TIB.eu), URL: https://doi.org/10.15488/3410 (DOI).

[5] C.-P. Rückemann, O. O. Iakushkin, B. Gersbeck-Schierholz, F. Hülsmann, L. Schubert, and O. Lau, "Best Practice and Definitions of Data Sciences – Beyond Statistics," 2017, Delegates' Summit, The 7th Symp. on Adv. Comp. & Inf. in Nat. & Appl. Sci. (SACINAS), The 15th Int. Conf. of Num. Analysis & Appl. Math. (ICNAAM), Sept. 25–30, 2017, Thessaloniki, Greece, URL:

http://www.user.uni-hannover.de/cpr/x/publ/2017/delegatessummit2017/rueckemann_icnaam2017_summit_summary.pdf [accessed: 2017-11-04].

[6] C.-P. Rückemann, R. Pavani, L. Schubert, B. Gersbeck-Schierholz, F. Hülsmann, O. Lau, and M. Hofmeister, *Best Practice and Definitions of Data Value*. Post-Summit Results, Delegates' Summit: Best Practice and Definitions of Data Value, September 13, 2018, The Eighth Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 16th International Conference of Numerical Analysis and Applied Mathematics (ICNAAM), September 13–18, 2018, Rhodes, Greece, 2018, delegates and other contributors: Claus-Peter Rückemann, Westfälische Wilhelms-Universität Münster (WWU) / Knowledge in Motion, Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF) / Leibniz Universität Hannover / North-German Supercomputing Alliance (HLRN), Germany; Raffaella Pavani, Department of Mathematics, Politecnico di Milano, Italy; Lutz Schubert, IOMI, University of Ulm, Germany; Birgit Gersbeck-Schierholz, Knowledge in Motion, Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF), Germany; Friedrich Hülsmann, Knowledge in Motion, Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF), Germany; Lau, Olaf, Knowledge in Motion, Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF), Germany; Hofmeister, Martin, Knowledge in Motion, Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF), Germany; DOI: 10.15488/3639, URL: http://history.icnaam.org/icnaam_2018/icnaam.org/sites/default/files/Preliminary%20Program%20of%20ICNAAM%202018_Web_version_70.pdf, URL: http://icnaam.org/sites/default/files/Preliminary%20Program%20of%

20ICNAAM%202018_ver_70.pdf, URL: http://www.user.uni-hannover.de/cpr/x/publ/2018/delegatessummit2018/rueckemann_icnaam2018_summit_summary.pdf, URL: https://www.tib.eu/en/search/id/datacite%3Adoi~10.15488%252F3639/Best-Practice-and-Definitions-of-Data-Value/ (TIB.eu), URL: https://doi.org/10.15488/3639 (DOI).

[7] C.-P. Rückemann, R. Pavani, B. Gersbeck-Schierholz, A. Tsitsipas, L. Schubert, F. Hülsmann, O. Lau, and M. Hofmeister, *Best Practice and Definitions of Formalisation and Formalism*. Post-Summit Results, Delegates' Summit: The Ninth Symp. on Adv. Comp. and Inf. in Natural and Applied Sciences (SACINAS), The 17th Int. Conf. of Num. Analysis and Appl. Math. (ICNAAM), Sept. 23–28, 2019, Rhodes, Greece, 2019, pp. 1–16, DOI: 10.15488/5241.

[8] C.-P. Rückemann, R. Pavani, Z. Kovacheva, B. Gersbeck-Schierholz, F. Hülsmann, and I. Naydenova, *Best Practice and Definitions – Concepts of Cognostic Addressing Structured and Non-structured Data*. Post-Summit Results, Delegates' Summit: Best Practice and Definitions – Concepts of Cognostic Addressing Structured and Non-structured Data, September 20, 2021, The Eleventh Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 19th International Conference of Numerical Analysis and Applied Mathematics (ICNAAM), September 20–26, 2021, Rhodes, Greece, 2021, delegates and other contributors: Claus-Peter Rückemann, Westfälische Wilhelms-Universität Münster (WWU), Germany / Knowledge in Motion, Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF), Germany

/ Leibniz Universität Hannover, Germany; Raffaella Pavani, Department of Mathematics, Politecnico di Milano, Italy; Zlatinka Kovacheva, Institute of Mathematics and Informatics, Bulgarian Academy of Sciences / University of Mining and Geology, Sofia, Bulgaria; Birgit Gersbeck-Schierholz, Knowledge in Motion, Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF), Germany; Friedrich Hülsmann, Knowledge in Motion, Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF), Germany; Ina Naydenova, Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Sofia, Bulgaria; DOI: 10.15488/11338, URL: http://www.scienceparagon.de/cpr/x/publ/2021/delegatessummit2021/rueckemann_icnaam2021_summit_summary.pdf [accessed: 2022-07-10].

[9] R. Gleser, *Rekonstruktion der Vergangenheit: Zur methodischen Eigenart prähistorischen Erkennens*. mentis, Paderborn, 2018, pp. 199–237, (title in English: Reconstruction of the Past: On the Methodical Peculiarity of Prehistorical Cognition), in: A.-S. Naujoks, J. Stelling, and O. R. Scholz (eds.), Von der Quelle zur Theorie. Vom Verhältnis zwischen Objektivität und Subjektivität in den historischen Wissenschaften, ISBN: 978-3-95743-136-3.

[10] "The Prehistory and Archaeology Knowledge Archive (PAKA) license," 2021, (release 2021), Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF): All rights reserved. Rights retain to the contributing creators.

[11] "Multilingual Universal Decimal Classification Summary," 2012, UDC Consortium, 2012, Web resource, v. 1.1. The Hague: UDC Consortium (UDCC

Publication No. 088), URL: http://www.udcc.org/udcsummary/php/index.php [accessed: 2022-07-10].

[12] "UDC Online," 2022, URL: http://www.udc-hub.com/ [accessed: 2022-07-10].

[13] "Creative Commons Attribution Share Alike 3.0 license," 2012, URL: http://creativecommons.org/licenses/by-sa/3.0/ [accessed: 2022-07-10], (first release 2009, subsequent update 2012).

[14] C.-P. Rückemann, "Archaeological and Geoscientific Objects used with Integrated Systems and Scientific Supercomputing Resources," *Int. Jour. on Adv. in Systems and Measurements*, vol. 6, no. 1&2, pp. 200–213, 2013, ISSN: 1942-261x, URL: http://www.thinkmind.org/download.php?articleid=sysmea_v6_n12_2013_15 [accessed: 2022-07-10].

[15] C.-P. Rückemann, "Long-term Sustainable Knowledge Classification with Scientific Computing: The Multi-disciplinary View on Natural Sciences and Humanities," *International Journal on Advances in Software*, vol. 7, no. 1&2, pp. 302–317, 2014, ISSN: 1942-2628, URL: http://www.thinkmind.org/index.php?view=article&articleid=soft_v2_n23_2009_1/ [accessed: 2022-07-10], URL: http://www.iariajournals.org/software/ [accessed: 2022-07-10].

[16] C.-P. Rückemann, "Towards Conceptual Knowledge Reference Implementations for Context Integration and Contextualisation of Prehistory's and Natural Sciences'

Multi-disciplinary Contexts," *International Journal on Advances in Systems and Measurements*, vol. 14, no. 1&2, pp. 113–124, 2021, ISSN: 1942-261x, LCCN: 2008212470 (Library of Congress), URL: http://www.iariajournals.org/systems_and_measurements [accessed: 2022-07-10].

[17] C.-P. Rückemann, "Towards a Component Reference Implementations Frame for Achieving Multi-disciplinary Coherent Conceptual and Chorological Contextualisation in Prehistory and Prehistoric Archaeology," *International Journal on Advances in Systems and Measurements*, vol. 14, no. 1&2, pp. 103–112, 2021, ISSN: 1942-261x, LCCN: 2008212470 (Library of Congress), URL: http://www.iariajournals.org/systems_and_measurements [accessed: 2022-07-10].

[18] C.-P. Rückemann, "Procedural Component Framework Implementation and Realisation for Creation of a Multi-disciplinary Coherent Conceptual Knowledge-based Holocene-prehistoric Inventory of Volcanological Features Groups," in *Proceedings of The Twelfth International Conference on Advanced Communications and Computation (INFOCOMP 2022), June 26 – 30, 2022, Porto, Portugal*. XPS Press, Wilmington, Delaware, USA, 2022, pages 8–14, ISSN: 2308-3484, ISBN: 978-1-61208-961-4, URL: https://www.thinkmind.org/articles/infocomp_2022_1_40_60019.pdf [accessed: 2022-07-10].

[19] C.-P. Rückemann, "Creating a Holocene-prehistoric Inventory of Volcanological Features Groups: Towards Sustainable Multi-disciplinary Context Integration in

Prehistory and Archaeology Based on the Methodology of Coherent Conceptual Knowledge Contextualisation," in *Proceedings of The Fourteenth International Conference on Advanced Geographic Information Systems, Applications, and Services (GEOProcessing 2022), June 26 – 30, 2022, Porto, Portugal*. XPS Press, Wilmington, Delaware, USA, 2022, pages 62–67, ISSN: 2308-393X, ISBN-13: 978-1-61208-983-6, URL: https://www.thinkmind.org/index.php?view=article&articleid=geoprocessing_2022_1_150_30091 [accessed: 2022-07-10].

[20] P. Wessel, "The Digital Chart of the World for GMT 6 or later," 2022, URL: ftp://ftp.soest.hawaii.edu/gmt [accessed: 2022-07-10], URL: http://www.soest.hawaii.edu/pwessel/dcw/ [accessed: 2022-07-10].

[21] P. Wessel, "Global Self-consistent Hierarchical High-resolution Geography," 2017, URL: ftp://ftp.soest.hawaii.edu/gmt [accessed: 2022-07-10], URL: http://www.soest.hawaii.edu/pwessel/gshhg/ [accessed: 2022-07-10].

[22] P. Wessel, W. H. F. Smith, R. Scharroo, J. Luis, and F. Wobbe, "The Generic Mapping Tools (GMT)," 2020, URL: http://www.generic-mapping-tools.org/ [accessed: 2022-07-10], URL: http://gmt.soest.hawaii.edu/ [accessed: 2022-07-10].

[23] P. Wessel, M. Jones, F. Esteban, C.-P. Rückemann, J. Robbins, and J. Luis, "GMT Community Meeting Notes 2021," 2021, The Generic Mapping Tools, GMT Community Meeting, Dec. 16, 2021, GMT Community Forum, URL: http://forum.generic-mapping.tools.org [accessed: 2022-07-10].

[24] J. Luis, P. Wessel, D. Tian, C.-P. Rückemann, J. Robbins, F. Esteban, W. J. Leong, and M. Jones, "GMT Community Meeting Notes 2022," 2022, The Generic Mapping Tools, GMT Community Meeting, Apr. 7, 2022, GMT Community Forum, URL: http://forum.generic-mapping.tools.org [accessed: 2022-07-10].

[25] C.-P. Rückemann, "Prehistory's and Natural Sciences' Multi-disciplinary Contexts: Contextualisation and Context Integration Based on Universal Conceptual Knowledge," in *Proceedings of The Eleventh International Conference on Advanced Communications and Computation (INFOCOMP 2020), May 30 – June 3, 2021, Valencia, Spain*. XPS Press, Wilmington, Delaware, USA, 2021, ISSN: 2308-3484, ISBN: 978-1-61208-865-5, URL: http://www.thinkmind.org/download.php?articleid=infocomp_2021_1_20_60011.

[26] C.-P. Rückemann, "Information Science Approaches to Sustainable Structures: Rhodos Case Results From Knowledge and Mining," in *The Tenth Symposium on Advanced Computation and Information in Natural and Applied Sciences, Proceedings of The 18th International Conference of Numerical Analysis and Applied Mathematics (ICNAAM), September 18–23, 2020, Rhodes, Greece, Proceedings of the American Institute of Physics (AIP), AIP Conference Proceedings, Volume 2425* , vol. 2425, no. 1. AIP Press, American Institute of Physics, Melville, New York, USA, Apr. 2022, pp. 030 002–1 – 030 002–4, iSBN-13: 978-0-7354-4182-8, ISSN: 0094-243X (American Institute of Physics Conference Proceedings, print), ISSN: 1551-7616 (online) (eISSN), DOI: 10.1063/5.0081480, URL: http://dx.doi.org/10.1063/5.0081480 (DOI) [accessed: 2022-07-10].

[27] C.-P. Rückemann, "Keynote Lecture: Allow Knowledge to Prevail: Advanced Computing, Data, Experience, and the Universal Decimal Classification," *May 28, 2017, The Seventh International Conference on Advanced Communications and Computation (INFOCOMP 2017), The International Symposium on Modeling and Optimization (MODOPT 2017), The Thirteenth Advanced International Conference on Telecommunications (AICT 2017), The Twelfth International Conference on Internet and Web Applications and Services (ICIW 2017), The Twelfth International Conference on Internet Monitoring and Protection (ICIMP 2017), The Sixth International Conference on Smart Cities, Systems, Devices and Technologies (SMART 2017), The International Symposium on Emerging Frontiers of Urban Computing and Smart Cities (URBAN COMPUTING 2017), The Seventh International Conference on Advances in Information Mining and Management (IMMM 2017), The International Symposium on Designing, Validating, and Using Datasets (DATASETS 2017), The Seventh International Conference on Mobile Services, Resources, and Users (MOBILITY 2017), The Third International Conference on Smart Portable, Wearable, Implantable and Disability-oriented Devices and Systems (SPWID 2017), The Second International Conference on Advances in Computation, Communications and Services (ACCSE 2017) / DataSys, May 25–29, 2017, Venice, Italy, [Lecture]*, 2017, uRL: http://www.iaria.org/conferences2017/DataSys17.html [accessed: 2022-07-10], URL: http://www.iaria.org/conferences2017/INFOCOMP17.html [accessed: 2022-07-10], URL: http://www.iaria.org/conferences2017/ProgramINFOCOMP17.html (Programme) [accessed: 2022-07-10], URL:

http://www.iaria.org/conferences2017/filesINFOCOMP17/ClausPeterRueckemann_infocomp2017_invitedtalk_AllowKnowledgeToPrevail.pdf [accessed: 2022-07-10].

[28] C.-P. Rückemann, "Keynote Lecture: The Multi-disciplinary Case of Prehistorical Insight: Information Science at the Edge of Structured Data Comprehension," *The XI-th International Conference - Mathematics of Informational Modeling, Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, July 1–2, 2021, Varna, Bulgaria, URL:* http://math.bas.bg *[accessed: 2022-07-10]*, 2021.

[29] C.-P. Rückemann, "Coherent Knowledge Solutions From Prehistory to Future – Towards Coherent Multi-disciplinary Knowledge Reference Implementation Blueprints for Industrial Learning: Insight from Consistent Coherent Conceptual Integration of Prehistory, Archaeology, Natural Sciences, and Humanities," *ML4I – Machine Learning for Industry Forum 2021; hosted by the High-Performance Computing Innovation Center (HPCIC) and Data Science Institute (DSI), at the Lawrence Livermore National Laboratory (LLNL), August 10–12, 2021, Livermore, California, U.S.A., (Invited Speech), URL:* http://www.llnl.gov, 2021.

[30] C.-P. Rückemann, "The Information Science Paragon: Allow Knowledge to Prevail, from Prehistory to Future – Approaches to Universality, Consistency, and Long-term Sustainability," *The International Journal "Information Models and Analyses" (IJ IMA)*, vol. 9, no. 3, pp. 203–226, 2020, Markov, K. (ed.), ISSN: 1314-6416 (print), Submitted accepted article: November 18, 2020, Publication date: August 17, 2021, URL: http://www.foibg.com/ijima/vol09/ijima09-03-p01.pdf [accessed: 2022-07-10].

[31] C.-P. Rückemann, "Progressive Advancement of Knowledge Resources and Mining: Integrating Content Factor and Comparative Analysis Methods for Dynamical Classification and Concordances," *Int. Journal on Adv. in Systems and Measurements*, vol. 11, no. 1&2, 2018, ISSN: 1942-261x, URL: http://www.thinkmind.org/index.php?view=article&articleid=sysmea_v11_n12_2018_5/ [accessed: 2022-07-10].

[32] C.-P. Rückemann, "Creating New Views and Insights by Computing Spatial Cogwheel Modules for Knowledge Integration," *Int. Journ. on Adv. in Intell. Syst.*, vol. 10, no. 3&4, pp. 314–326, 2017, ISSN: 1942-2679, URL: http://www.thinkmind.org/index.php?view=article&articleid=intsys_v10_n34_2017_13/ [accessed: 2022-07-10].