

Delegates' Summit:

– Best Practice and Definitions –

Artificial Intelligence & Quality, Quality & Artificial Intelligence

September 16, 2025

The 15th Symposium on
Advanced Computation and Information in Natural and Applied Sciences (SACINAS)
The International Conference on Numerical Analysis and Applied Mathematics (ICNAAM 2025)
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Dr. rer. nat. Claus-Peter Rückemann^{1,2,3,4}

¹ Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF), Germany

² Universität Münster, Münster, Germany

³ Chair of the Board on Advanced Computing and Emerging Technologies of the
International Academy, Research, and Industry Association

⁴ Leibniz Universität Hannover, Hannover, Germany

<https://scienceparagon.de/cpr>

[ruckema\(at\)uni-muenster.de](mailto:ruckema(at)uni-muenster.de)



Abstract / Epitome

Abstract / Epitome

This comprehensive summary contains the committee of participants and contributors, the contributions, statements, summit results (p. 23), and references for the Delegates' Summit on Best Practice and Definitions: Artificial Intelligence & Quality, Quality & Artificial Intelligence, part of the Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS).

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Post-Summit Results (Artificial Intelligence & Quality, Quality & Artificial Intelligence)

Delegates' Summit: Best Practice & Definitions of ...

Delegates and Contributors (authors)

- **Claus-Peter Rückemann**, (moderator/editor), Knowledge in Motion, DIMF / Universität Münster / Leibniz Universität Hannover, Germany
- **Kalinka Kaloyanova**, Sofia University “St. Kliment Ohridski”, Faculty of Mathematics and Informatics, Sofia, Bulgaria / Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Sofia, Bulgaria
- **Birgit Frida Stefanie Gersbeck (†)**, Knowledge in Motion, DIMF, Germany

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Program: <http://icnaam.org>

Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Knowledge and Computing (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., Skurowski, P., Staniszewski, M., Hülsmann, F., and Gersbeck-Schierholz, B. (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: https://scienceparagon.de/cpr/af/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

Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Data-centric and Big Data (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: https://scienceparagon.de/cpr/aw/publ/2016/delegatessummit2016/rueckemann_icnaam2016_summit_summary.pdf

Delegates and contributors: Claus-Peter Rückemann, Knowledge in Motion / Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF), Germany; Zlatica 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, Friedrich Hülsmann, Knowledge in Motion / Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF), Germany

Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Data Science Definition (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: https://scienceparagon.de/cpr/x/publ/2017/delegatessummit2017/rueckemann_icnaam2017_summit_summary.pdf

Delegates and contributors: Claus-Peter Rückemann, Knowledge in Motion / Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF), Germany; Oleg O. Iakushkin, Department of Computer Modelling and Multiprocessor Systems at the Faculty of Applied Mathematics and Control Processes, Saint-Petersburg State University, Russia; 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; Lutz Schubert, IOMI, University of Ulm, Germany; Olaf Lau, Knowledge in Motion / Unabhängiges Deutsches Institut für Multi-disziplinäre Forschung (DIMF), Germany.

Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Data Value Definition (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, Rhodes, Greece.

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Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Formalisation Definition (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: https://scienceparagon.de/cpr/a/publ/2019/delegatessummit2019/rueckemann_icnaam2019_summit_summary.pdf, URL: <https://doi.org/10.15488/5241> (DOI).

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Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Structure and Cognostic Addressing Definition (Delegates and other contributors)

“Structure is an organisation of interrelated entities in a material or non-material object or system, on homogeneous intrinsic levels. Structure should be addressed by super- and sub-levels. Cognostic addressing applies to the wish to gain essential properties in science and scholarship in general, such as correlation, interrelation, and coherence and leads to a fundamental understanding. Cognostic identification, addressing, and continuous refinement of structures are essential prerequisites of creating new insight. In future, we consequently propose the term ‘*nucleal cognstructure*’”.

Structure can mean features and facilities. Links between knowledge and cognostics are unpredictable, especially by artificial and automated means in general. Structure can be deployed by methods, e.g., matching predefinable models, patterns, and precision. In practical programming many practicists prefer to define structure and cognostic addressing by formal aspects only.

Citation: Rückemann, Claus-Peter; Pavani, Raffaella; Kovacheva, Zlatinka; Gersbeck-Schierholz, Birgit; Hülsmann, Friedrich; and Naydenova, Ina (2021): *Post-Summit Results, Delegates' Summit: Best Practice and Definitions – Concepts of Cognostic Addressing Structured and Non-structured Data*; Sept. 20, 2021, The Eleventh Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 19th Internat. Conf. of Numerical Analysis and Appl. Math. (ICNAAM), Sept. 20–26, 2021, Rhodos, Greece. URL: https://scienceparagon.de/cpr/a/publ/2021/delegatessummit2021/rueckemann_icnaam2021_summit_summary.pdf, URL: <https://doi.org/10.15488/11338> (DOI).

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Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Quality of Knowledge and Quality of Data (Delegates and other contributors)

“Knowledge can be approached being a complex non-technical asset of complements (DOI:10.15488/3409). Data are “things given”. ‘Data’ cannot be ‘turned’ into ‘information’ or ‘knowledge’. Quality is a secondary virtue. Often, quality approaches and practice result from hermeticism. From the beginning on, quality of data requires well-defined methods and transparent, precise, consistent, holistic, sufficiently complete specifications and documentation of contexts and purposes to be reproducible and measured for a scenario. Quality of knowledge requires consideration of non-technical contexts accordingly.

Formalisation and abstraction need to be documented and referenced to knowledge complements and data. Discovery levels need to be documented and referenced to knowledge complements and data. Trying to ‘turn’ data into ‘information’ or ‘knowledge’ consequently leads to arbitrary results and arbitrary organisational states. Fundaments of ‘quality’ and its measures are arbitrary. High quality for a defined scenario can mean no quality or even wrong for other scenarios. The contextual nature of data quality requires scenario-dependent consideration of contexts, including measurability and re-interpretation, e.g., regarding criteria of ISO 8000-2:2020.

Citation: Rückemann, Claus-Peter; Kaloyanova, Kalinka; Kovacheva, Zlatinka; Naydenova, Ina; Hülsmann, Friedrich; Gersbeck-Schierholz, Birgit (2022): *Post-Summit Results, Delegates' Summit: Best Practice and Definitions – Quality of Knowledge and Quality of Data*; Sept. 19, 2022, *The Twelfth Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS)*, *The 20th Internat. Conf. of Numerical Analysis and Appl. Math. (ICNAAM)*, Sept. 19–25, 2022, Heraklion, Crete, Greece.
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Delegates and contributors: Claus-Peter Rückemann, *Knowledge in Motion / Unabh. Deutsches Inst. für Multi-disziplin. Forschung (DIMF)*, Germany; Kalinka Kaloyanova, *Faculty of Mathematics and Informatics, Sofia University “St. Kliment Ohridski”, Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Bulgaria*; Zlatinka Kovacheva, *Institute of Mathematics and Informatics, Bulgarian Academy of Sciences / University of Mining and Geology, Sofia, Bulgaria*; Ina Naydenova, *Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Bulgaria*; Friedrich Hülsmann, *Knowledge in Motion / Unabh. Deutsches Inst. für Multi-disziplin. Forschung (DIMF)*, Germany; Birgit Gersbeck-Schierholz, *Knowledge in Motion / Unabh. Deutsches Inst. für Multi-disziplin. Forschung (DIMF)*, Germany. **All rights are retained by the authors.**

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Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Algorithm and Algorithm Signification (Delegates and other contributors)

“An algorithm is a process or set of rules to be followed in problem-solving operations. Its specification may be associated with a number of priorities, conditions, and dependencies in contexts and use cases. Algorithms, formalisation, contexts, and data inherently depend. Algorithm creation and employment should follow fundamental, clearly defined rules. An algorithm gets signification by precise employment in a defined, formalised context. Algorithms can enable implementations and realisations with focus on procedural knowledge complements, e.g., in scientific research and analysis.

Algorithm processes, e.g., linear, branched, and cyclic, can be defined as finite sequences of instructions, which can be repeated and employed for scientific research, from investigation of new phenomena, analysis and description of results during continuous development of scientific insights to automation. Targets of implementation can be definiteness, effectiveness, discreteness, massiveness, and finiteness. Scientific algorithm creation and employment should follow methodological and systematical principles and be based on fact-based, precise, formalised, reproducible, consistent, logically and context-correct fundaments. A respective problem should be identified and understood before creating an algorithm-based feasible solution. Mostly every scientific discipline relies on creation and employment of algorithms. Some earliest known principles of algorithms are described in Aristotle's major works of the *Organon*, the *instrument*, and his *Physics* as well as works by Eratosthenes, and by Euclid. An algorithm is not defined by its realisation, e.g., not by informatics or programming. Especially, it is not relevant for its essence by which implementation an algorithm is executed, e.g., by analog or digital means. An algorithm is per se not 'intelligent'. An algorithm, in its primordial signification can by definition not be controlled. Besides, we have to be beware of the fact that from time to time and for various reasons, interest groups claim the intention to control algorithms.

Citation: Rückemann, Claus-Peter; Kovacheva, Zlatinka; Kharchenko, Oksana; Gersbeck-Schierholz, Birgit; Hülsmann, Friedrich; (2023): Post-Summit Results, Delegates' Summit: Best Practice and Definitions – Algorithm and Algorithm Signification; (Sept. 11, 2023, The 14th Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 21st Internat. Conf. of Numerical Analysis and Appl. Math. (ICNAAM), Sept. 11–17, 2023, Heraklion, Crete, Greece.
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Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Imaging and Memory (Delegates and other contributors)

“Imaging and memory are widely essential fundamentals, from philosophy to many other sciences. Imaging is the general process of creating images of material or non-material objects, e.g., by non-material and material means, in mind or by otherwise physical implementation. Memory is a faculty of the mind by which knowledge is dealt with, e.g., remembered, coded, preserved, contextualised, and reused. Imaging, a process of image creation, focusses on metacognitive knowledge, intrinsically interlinked with all knowledge complements.

Associated processes are practised from the earliest times to present societies worldwide. Memory related knowledge can rarely be contextualised without multi-disciplinary understanding. Imaging in natural sciences and archaeology can be expressed via physical and non-physical objects, relics, and artefacts. Imaging is to some extent affiliated with the term 'magic'. Memory practice and support are often based on or associated with realia objects. Memory is endlessly more than the sum of formalised knowledge. Imaging and memory are massively interdependent. Realisations of imaging processes, images, can reflect personality and be considered original creations. Research on consistency and signification of knowledge facets and memory is essential for knowledge preservation, long-term analysis, and interpretation, e.g., for historico-cultural contexts, and advanced future forms of knowledge addressing, preservation, and management.

Citation: Rückemann, Claus-Peter; Gersbeck, Birgit Frida Stefanie; Lishchuk, Iryna; Kaloyanova, Kalinka; Naydenova, Ina; Kovacheva, Zlatinka; Kharchenko, Oksana; Hülsmann, Friedrich; Schubert, Lutz: (2024): Post-Summit Results, Delegates' Summit: Best Practice and Definitions – Imaging and Memory; Sept. 11, 2024, The 14th Symposium on Advanced Computation and Information in Natural and Applied Sciences (SACINAS), The 22nd Internat. Conf. of Numerical Analysis and Appl. Math. (ICNAAM), Sept. 11–17, 2024, Heraklion, Crete, Greece.

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Delegates and contributors: Claus-Peter Rückemann, *Knowledge in Motion / Unabhäng. Deutsches Inst. für Multi-disziplin. Forschung (DIMF)*, Germany; Birgit Frida Stefanie Gersbeck, *Knowledge in Motion / Unabhäng. Deutsches Inst. für Multi-disziplin. Forschung (DIMF)*, Germany; Ilyna Lishchuk, *Leibniz Universität Hannover, Medizinische Hochschule Hannover*, Germany; Kalinka Kaloyanova, *Sofia University "St. Kliment Ohridski", Faculty of Mathematics and Informatics, Sofia*, Bulgaria; Ina Naydenova, *Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Sofia*, Bulgaria; Zlatinka Kovacheva, *Institute of Mathematics and Informatics, Bulgarian Academy of Sciences / University of Mining and Geology, Sofia*, Bulgaria; Oksana Kharchenko, *Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Bulgaria*; Friedrich Hülsmann, *Knowledge in Motion / Unabhäng. Deutsches Inst. für Multi-disziplin. Forschung (DIMF)*, Germany; Lutz Schubert, *University of Cologne, Germany*. **All rights are retained by the authors.**

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Recall: Last Years' Post-Summit Results

In 80 Words Around The World.

Complements of Knowledge and Corresponding Sample Implementations:

- | | | |
|----------------------------------|---|------------------------------------|
| • Factual Knowledge | ⇔ | Numerical data, data ... |
| • Conceptual Knowledge | ⇔ | Classification ... |
| • Procedural Knowledge | ⇔ | Computing ... |
| • Metacognitive Knowledge | ⇔ | Experience ... |
| • Structural Knowledge | ⇔ | Standard hybrid formats ... |
| • ... | | |

(Sources/references: SACINAS Delegates' Summit, 2015–2024; Rückemann, Keynote on Structured Data Comprehension, MIM 2021 [1] [2]; Knowledge Mapping, 2018 [3]; Aristotle, 350 B.C.E. / Platon's Phaidon, [4] [5] [6]; Anderson & Krathwohl, 2001 [7]); Rückemann, Coherent Knowledge Solutions From Prehistory to Future, Lawrence Livermore National Laboratories (LLNL), ML4I 2021 [8]

Best Practice and Definitions: ... (1/4)

In 80 Words Around The World.

Case: Information science, natural sciences, prehistory, universal applications

Source: Claus-Peter Rückemann (KiM, DIMF)

- **Artificial Intelligence && Quality, Quality && Artificial Intelligence:**

Intelligence and knowledge are inherently non-technical terms. Quality is a secondary virtue, often resulting from hermeticism and soft criteria, defined by extrinsic properties. From methodological knowledge perspective, qualities of knowledge complements correspond with the range/group of possible 'AI' results. The quality of an individual 'AI' result entity may be primarily entangled with certain knowledge complements. Signification is scenario dependent: Q&&A: Quality regarding 'AI' input: Critical for results/group. A&&Q: Quality regarding 'AI' output: May pretend general quality from non-holistic views.

An expansion of the above 'AI' is the term Artificial Instruments, considered fact-based and more sustainable, instead of terms like Artificial 'Intelligence'. Referenced terms were matter of previous research: quality (DOI:10.15488/12666), knowledge complements (DOI:10.15488/3409) and (DOI:10.15488/11338).

"To err is human, to deterministically fail is artificial." (CPR 2025-08-19)

Best Practice and Definitions: ... (2/4)

In 80 Words Around The World.

Case: Informational point of view of practical implementation

Source: Kalinka Kaloyanova

- **Artificial Intelligence & Quality, Quality & Artificial Intelligence:**

High-quality AI requires accurate, clean, complete data; reliable models; ethical compliance; security and human oversight. Fairness, transparency, and accountability in processing are required.

Continuous feedback, strong governance, and user training help ensure the use of effective AI systems in many applications.

Alternatively, AI improves quality by enabling automation, precision, and predictive analytics. Aligning AI with quality goals, integrating it into workflows, not just for analytics but also for data preprocessing, ensures data integrity and improves adaptation of AI across industries.

Best Practice and Definitions: ... (3/4)

In 80 Words Around The World.

Case: Biology

Source: Birgit Frida Stefanie Gersbeck (†) (KiM, DIMF) [9]

- **Artificial Intelligence & Quality, Quality & Artificial Intelligence:**

There is no artificial way to realise real biological intelligence-related processes. For scientific biological application scenarios, there is no general quality measure. Deploying AI as a tool for specific tasks in biology requires individual definitions of quality. This includes different requirements of different measures for domain to AI and for AI to domain processes. Results of non-biological processes are not inherently intelligent but, e.g., deterministic, random, or arbitrary. In any way, the creators of respective processes should be made responsible.

A different term (instrument/tool) should be used instead of 'Intelligence' (in AI) when used in technical contexts, due to the impossibility of reasonably emulation the unquantifiable complexity of intelligence related biological aspects and processes [9].

Best Practice and Definitions

In 80 Words Around The World.

Statements on Artificial Intelligence / Quality

(Delegates and other contributors)

- **What are definitions and considerations / preconditions / dependencies for both view directions (&& indicating logical AND):
“Artificial Intelligence && Quality” and
“Quality && Artificial Intelligence”.**
- **How should ‘AI’ be understood for the cases?**
- **How should ‘quality’ be understood for the cases?**
- **What are inherent characteristics?**
- **What are intrinsic properties of respective properties?**
- **Which Best Practice can be summarised for cases?**
- **What is required regarding knowledge and its complements in future approaches?**
- **Next Delegates’ Summit Contexts:
Best Practice and Definitions [topics]
aware of “Science Under Direction”.**

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Networking and Outlook



Thank you for your attention!

**Wish you an inspiring conference
and a pleasant stay on Crete!**

**Looking forward to seeing you again next year for the
Symposium on Advanced Computation and Information!**

Post-Summit Notes

In 80 Words Around The World.

Artificial Intelligence & Quality, Quality & Artificial Intelligence (Delegates and other contributors)

Proposed requirements for future:

- Modularisation and classification input data pools required for improved adaptability of Artificial Instruments for different purposes, disciplines, domains.

Artificial Intelligence & Quality, Quality & Artificial Intelligence (Delegates and other contributors)

Fundamental limitations regarding Artificial Instruments, which cannot to be overcome, each of which is limiting:

- **Formalisation:** inherent with abstraction and reduction.
- **Complexity:** only very simple models for, e.g., various different neural network models.
- **Logic:** Algebraic logic units / processors only, so far non other, e.g., syllogistic, logic.
- **Model:** Turing implementation fundamental limitations, e.g., infinite memory requirements ('busy beaver' type tests etc.).
- . . .

Post-Summit Results

In 80 Words Around The World.

Artificial Intelligence && Quality, Quality && Artificial Intelligence (Delegates and other contributors)

“Intelligence and knowledge are inherently non-technical terms. Quality is a secondary virtue, often resulting from hermeticism and soft criteria, defined by extrinsic properties. From methodological knowledge perspective, qualities of knowledge complements correspond with the range/group of possible ‘AI’ results. The quality of an individual ‘AI’ result entity may be primarily entangled with certain knowledge complements. Signification is scenario dependent, Q&&A and A&&Q, as inherent quality is not bijectively independent. Fundamental limitations regarding ‘AI’ implementation are formalisation, complexity, logic, and models.

Signification is scenario dependent: Q&&A: Quality regarding ‘AI’ input: Critical for results/group. A&&Q: Quality regarding ‘AI’ output: May pretend general quality from non-holistic views. There is no artificial way to realise real biological intelligence-related processes. For scientific scenarios, there is no general quality measure. In any way, the providers/creators of ‘AI’ realisations should be made responsible. Fairness, transparency, and accountability in processing are required. Aligning ‘AI’ with quality goals, integrating it into workflows, not just for analytics but also for data preprocessing, can ensure data integrity and improve adaptation of ‘AI’ across industries. An expansion of the above ‘AI’ is the term Artificial Instruments, considered fact-based and more sustainable, instead of terms like Artificial ‘Intelligence’. Referenced terms were matter of previous research: quality (DOI:10.15488/12666), knowledge complements (DOI:10.15488/3409) and (DOI:10.15488/11338). “To err is human, to deterministically fail is artificial.” (CPR 2025-08-19)

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