“Critical review” and “Verification” cannot be used synonymously. A plea for a differentiated and precise use of the terms.

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Abstract Verification is a term originating from quality management. ISO 9000:2005 defines: “confirmation, through the provision of objective evidence, that specified requirements have been fulfilled”. Objective evidence in this context is “data supporting the existence or verity of something”. The term “verification” was transferred to ISO 14025 and applied for handling the underlying LCA in Type III environmental declarations. Based on this application the term has been transformed by and by into a kind of synonym for critical reviews of LCA. Since these terms have been defined in different contexts and by different communities their applications are prone to misunderstanding with respect to the exact content and/or activities intended. Since the philosophy of the terms critical review and verification is different they should not be used synonymously. In future review of ISO 14025 a clear distinction between verifiable requirements and aspects that need to be critically reviewed should be provided. This differentiation should also be communicated into the standardization projects referring to ISO 14025 in order to avoid the same misunderstandings there.

1 Relevance of the subject

Verification is a tem originally coined for Quality Management Systems (QMS) and also applied for Environmental Management systems (EMS). In ISO 9000:2005 [1] it is defined as:

“confirmation, through the provision of objective evidence, that specified requirements have been fulfilled”

This term was transferred to ISO 14025 [2] and applied for handling life cycle assessment (LCA) in Type III environmental declarations. With reference to ISO 14040 [3] the introduction of ISO 14025 claims that “such declarations are based on independently verified LCA data”, and later in the text an “independent

verification of the LCA" is required (ISO 14025, clause 5.7). ISO 14040 and ISO 14044 [4] do not use the term "verification". The need for harmonisation of terms in the ISO 14000 series of standards was already pointed out by Pålsson and Flemström [5], but has not been resolved to this day.
The term "verification" slips in as a kind of synonym for a "critical review" of an LCA study. For instance the ILCD Handbook uses the term "LCA verification" in the clause „Review schemes for Life Cycle Assessment", which is defined by referring to the definition of „LCA Review". Thus the synonymous use of the terms is prejudiced.
Also in the development of the ISO 14067 [6] standard for Product Carbon Footprint the term "verification" with reference to ISO 14025 is of importance.
Since the terms "Critical Review" and "Verification" have evolved from different application contexts, misunderstandings are arising about what exactly the terms should stand for.

2 Verification - philosophy of the term

In QMS or EMS the specification of requirements for which objective evidence shall be provided is not a problem on a technical level. Operationalisable requirements as well as the objective evidence to show compliance are defined. Operationalisable requirements in this sense may address the management system qualitatively but may also use quantitative indicators, e.g. by accounting for the annual reduction of energy input or CO2e-emissions of x % compared to the previous year or reduction of rejected products down to y %.
When establishing a management system the objective evidence shall be selected in such a way that compliance with the defined requirement can be attested beyond doubt. For instance compliance with the required transparency and continuity of a quality control system may be accepted when the control of defined documents relevant to product quality is established and demonstrated. A specific requirement for the product quality may be accounted for through the documentation of measured relevant functional characteristics and correlation of results to a "window of compliance". From this the % of rejected products could be derived.
In analogy to the QMS the compliance with requirements for the EMS, e.g. the required percentage of increase in energy efficiency, can be accounted for through the documentation of the energy bills related to the particular economic turnover and the correlation with the required percentaged target. The requirement to reduce the contribution to climate change by a defined percentage may also be

demonstrated by documented calculations of emitted greenhouse gases, e.g. based on the energy bills, if applicable complemented by measurements, and the correlation with the required targets.
If requirements and objective evidence have been developed consistently, it is then possible to simply go through a checklist in order to check whether all defined elements inherent to the system were handled correctly. Objective evidence in this sense is the documentation of executed activities or reached targets. If such activities to be executed or the targets to be reached are clearly defined as requirements with a related required objective evidence, then a verification as defined in ISO 9000 which is restricted to exactly this compliance pattern is possible and meaningful.
Since in the addressed management systems the procedures are standardised, but not the functional content, companies are free to design their requirements and consequently in the selection of the objective evidence. A compelling management system depends on the credibility of its verification, which in turn can be influenced by meaningful requirements and selection of relevant and stringent objective evidence.
The check if requirements and selected objective evidence are matched has to be one objective of certification (ISO 9001, ISO 14001) or validation (EMAS) of a management system..

3 Critical review - philosophy of the term

The critical review of an LCA originates from a completely different context of reasoning, that is from the idea of peer reviews normally applied to scientific publications [7, 8]. The well known 5 criteria for a critical review according to ISO 14044 clause 6.1 (see box) are not operationalisable in the same way as verifiable requirements as sketched out above. Thus objective evidence cannot be attributed to the criteria of a critical review and results simply be checked off in a checklist.

"The critical review process shall ensure that
- the methods used to carry out the LCA are consistent with this International Standard,
- the methods used to carry out the LCA are scientifically and technically valid,
- the data used are appropriate and reasonable in relation to the goal of the study,
- the interpretations reflect the limitations identified and the goal of the study, and
- the study report is transparent and consistent."

While in ISO 14040 and 14044 the elaboration of the elements of an LCA study is a requirement, the scientific capacity of the study cannot be checked by objective evidence.

Indeed it is possible to check whether e.g. the functional unit, system boundaries, cut-off criteria or allocation rules were defined. However the judgement whether the defined scope and framework were carried out consistently and in a scientifically adequate manner throughout the study are not adequate operationalisable through supplied objective evidence.

For example it is not possible to provide objective evidence for the plausibility of a selected functional unit, the defined system boundaries or the included data. The requirements cannot formally be operationalised and confirmed beyond doubt. This kind of evaluation is task of the peer review.

The logic of the peer review can be better described as a falsification process. On the basis of their professional experience the reviewers test the LCA results as well as the methodological implementation of the given rules to the best of their ability. If they detect no faults the peer review, in the logic of the peer review system, is then deemed to have secured sufficient quality.

As the philosophy of quality control of scientific work differs completely from the quality control of QMS, the concept of verification borrowed from these systems is not applicable at all for the quality control of an LCA study.

4 Conclusions and Recommendations

There are clear and relevant differences between the goals and procedures of verification and of critical reviews (peer reviews) of scientific studies. The differences are blurred by an inaccurate use of the terms and the result may be inadequate implementation of procedures, which fail their goals.

Therefore we recommend the following:

1. **A critical review cannot be carried out without proper scientific knowledge of the field of LCA. The critical review is a peer review, which cannot be carried out as a target performance comparison as in the case of verification.**
The critical review is the quality control of scientific work based on success or failure of falsification of the reviewed study. It includes a judgement on the usefulness of the presented study concept with respect to goal and scope and degree of detail. A critical review can only be carried out based on expert knowledge of the LCA methodology.

2. **Because the logical content of the terms being different, they shall not be used synonymously. For a given task, the right procedure shall be selected.**
When the compliance with defined procedures or the integration of certain measured values into a quantitative correlation system according to specified rules is asked for, a critical review is the wrong answer. In these cases the compliance of requirement and objective evidence is needed, not the falsification of results.

3. **In the upcoming revision process of ISO 14025 a clear differentiation into verifiable aspects and aspects that need a critical review shall be included. This should also provide clarity for the further development of ISO 14067.**
In ISO 14025 there is no clear differentiation between verifiable aspects and those aspects that should be subject to a critical review: The Product Category Rules (PCR), which are required in the Type III declaration scheme according to ISO 14025, define goal and scope for the product category in the methodological context of ISO 14040 which is a normative reference in the standard. These PCR are documented and, according to ISO 14025, shall be reviewed by a third party review panel.
In practice the PCR document is the basis for providing the LCA of a specific product of this product category underlying its environmental product declaration (EPD). The implementation of the PCR and the results of this LCA study are documented in a confidential project report. This report is substantial to the verification process of the EPD. Since the critical review of goal and scope for a product category, covered by the PCR, is not sufficient for the complete LCA study for a specific product, the critical review step of the project report will have to be integrated into the quality control procedure. This new procedural element must become part of ISO 14025 and there is a need for clarification that the project report is not verifiable in the sense of ISO 9000. However an EPD, developed in compliance with the LCA-results documented in the project report is verifiable. In the verification process of the EPD it has to be checked whether the verifiable requirements of the PCR and the results of the LCA are correctly transferred to the required format of the EPD.

5 References

[1] ISO 9000:2005. Quality management systems – Fundamentals and vocabulary.
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