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Research Information Standardization as a Wicked Problem: Possible Consequences for the Standardization Process

Case Study of the Specification Project of the German Research Core Dataset

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Abstract

In this paper, we analyze the degree to which the standardization project “Research core dataset” (CDS) qualifies as a wicked problem. The project was initiated in 2013 by the German Science Council. We suggest three solution approaches and discuss their application to standardization processes.

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1. Introduction

As the ongoing discussion about adequate research indicators reflects, universities, and non-university research institutes in most Western countries are faced with increasing reporting obligations^{1,2}. In order to meet growing demand for transparency and documentation of results in the research system, information about the input and output of the research processes are required. Both on the national and international level, we observe attempts to harmonize underlying definitions and exchange formats from historically grown Research Information Systems (RIS) in order to achieve comparability. The development of commonly agreed standards is crucial for reaching this

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goal. Understanding and standardizing research information is a complex task, involving a wide range of stakeholders in the science system. We assume that for involved actors to agree on a common standard for ambiguous definitions, they need to identify the nature of the problem in a first step.

The following article conceives of standardization processes for research information as wicked problems. This means that actors have already reached a consensus on the actual need to standardize this information. However, there might be disagreement with respect to the design, components and eventual decisions of this process.

2. Research information standardization as a wicked problem

Rittel and Webber³ define wicked problems as complex design problems “for which no single computational formulation of the problem is sufficient, for which different stakeholders do not even agree on what the problem really is, and for which there are no right or wrong answers, only answers that are better or worse from different points of view”⁴. Wicked problems are to be distinguished from “tame” problems. “Tame” problems have a well-defined statement. It is clear what they are and what they are caused by. Therefore, they require a systematic methodology typical of engineering or scientific inquiry, because they belong to a class of problems that can be solved in a similar way each time. Furthermore, they have a definite stopping point and problem solving has no bearing on future options^{3,5}. In contrast to these problems, Rittel and Webber³ identify characteristics of a wicked problem, which may be classified into Robert’s⁶ two problem dimensions:

The **problem’s definition**: (1) There is no unique formulation of a wicked problem; (2) Wicked problems do not have a stopping rule; (7) Every wicked problem is unique; (8) Every wicked problem can be considered to be a symptom of another problem; (9) The choice of explanation determines the nature of the problem’s resolution; (11) The multiple stakeholders cause social complexity;

The **problem’s solution**: (3) Solutions to wicked problems are not true-or-false, but good-or-bad; (4) There is no test of a solution to a wicked problem; (5) Since it is impossible to learn by trial-and-error, every solution attempt has irreversible consequences; (6) Wicked problems do not have an enumerable set of potential solutions, nor is there a well-described set of permissible operations; (10) The planner has no right to be wrong.

The concept originated in design science and found subsequent use in a wide range of fields. In software engineering the idea’s influence was twofold: Firstly, the Design Science methodology was shaped substantially by Rittel’s critique on Simon’s “the Sciences of the Artificial”⁷, which led to Simon’s revision of “ill-structured problems”⁸. Design Science concepts therefore often aim to solve wicked problems without further problem characterization^{9,10}. Secondly, the concept of wicked problems and solving strategies largely influenced incremental and agile software development models^{11,12,13,14}. We state that the substantial influence of the idea on software development enables modern system development methods like extreme programming or SCRUM to solve wicked problems. Over the 40 year lasting adoption process it can be observed that only some parts of Rittel’s definition remained popular¹⁴. Therefore their application to research information standardization requires a more detailed analysis of which characteristics of the original definition of wicked problems are invoked by stakeholders to describe the current situation.

3. Data and methods

Formal content analysis^{15,16} is used in order to examine whether the CDS project addresses a wicked problem. The sampling of thirteen interviewees covers experts participating in the working group of the German Science Council and includes all major stakeholders of the German science system. Both positions for and against RI standardization were represented in the sample. The objective of the interviews was to detect general conflicts, problems and potentials of the standardization process. Because the characteristics of wicked problems were not asked, the questions should not have affected the responses in a certain direction. The coding procedure included two coders and comprises two steps: Initially, statements of experts for the standardization project are assigned to the characteristics of a wicked problem (according to the definition of the problem and possible solutions). The assigned statements are then categorized using the formal method of inductive category building following Mayring¹⁶. After 30% of the statements were categorized, a revision of the categories was conducted. Out of 144 codings, 47 were coded differently. Out of these, five codings were dropped and 42 reassigned.

4. Results

Table 1 and 2 provide the statement categories for each wicked problem characteristic. The third column holds information about how often this category was stated in relation to the total number of codes per characteristic.

Table 1: Statement categories supporting and contradicting the characterization of a wicked problem for the problem definition

WP	Categories supporting (+) and contradicting (-) the characterization	#
1. No definitive formulation	+ Rules for person allocation should be part of the standardization but are context-dependent	(9/18)
	+ Unclear standardization requirements and unclear standardization goals	(4/18)
	+ Research information is used in many contexts and therefore a single straightforward definition is not to be expected	(3/18)
	+ Different definitions cause different adjustment mechanisms	(1/18)
	+ Broader scope (national / international level) increases standardization requirements	(1/18)
2. No stopping rule	+ Required level of definition detail is not predefined and context-dependent	(6/17)
	+ Rules for person allocation should be part of the standardization but are context-dependent	(5/17)
	+ Definition differentiation leads to inflexible definitions, lack of differentiation leads to adjustment mechanisms	(2/17)
	+ Widespread existing definitions are not detailed enough or too detailed	(1/17)
	+ Standardization requirements will change over time, flexibility required	(1/17)
	+ Broader scope (national / international level) increases standardization requirements	(1/17)
	+ Standardizing research information does not solve the problem of their interpretation	(1/17)
7. Unique	- Widespread existing definitions	(3/4)
	- International initiatives have already started standardization	(1/4)
	+ Widespread existing definitions are not detailed enough or too detailed	(1/2)
	+ Research standardization has not been addressed before on national level	(1/2)
8. Symptom of another problem	+ Standardizing research information raises the question if research should be documented transparently	(7/28)
	+ Standardizing research information means standardizing reporting processes	(4/28)
	+ Standardizing research information does not solve the problem of their interpretation	(4/28)
	+ Research information standardization requires acceptance and contribution among all stakeholders	(3/28)
	+ Broader scope (national / international level) increases standardization requirements	(2/28)
	+ Standardization of research information aims at making research comparable	(2/28)
	+ Research information standardization requires a consistent subject classification	(2/28)
	+ Benefits of standardization will only be visible if a critical mass is reached	(1/28)
	+ Different definitions cause different adjustment mechanisms	(1/28)
	+ Research information standardization raises data protection issues	(1/28)
	+ Research information needs to standardize any research output	(1/28)
9. Explanation determines nature of resolution	+ Benefits of standardization will only be visible if a critical mass is reached	(1/7)
	+ By defining research information the interpretation and goal changes	(1/7)
	+ Reporting requirements depend on information availability, which is influenced by definition	(1/7)
	+ Widespread existing definitions are not detailed enough or too detailed	(1/7)
	+ Standardizing research information means standardizing reporting processes	(1/7)
	+ Research information standardization requires a consistent subject classification	(1/7)
	+ Multiple potential solutions are possible for research information standardization	(1/7)
11. Multiple stakeholders cause social complexity	- Stakeholder's different background did not cause more complexity	(2/5)
	- Common understanding about the necessity was clear to all stakeholders	(2/5)
	- Central organization unit where all reporting information runs together	(1/5)
	+ Multiple stakeholder on science system, federal, state and research institution level	(9/26)
	+ Research information standardization requires acceptance and contribution among all stakeholders	(6/26)
	+ Organizational reporting units are rigidly separated	(4/26)
	+ Research information needs to standardize any research output	(2/26)
	+ RIS have to be standardized	(1/26)
	+ Not all stakeholders want to make research information centrally available	(1/26)
	+ Which fields of research information should be standardized, which left on university level?	(1/26)
	+ Research information standardization requires a consistent subject classification	(1/26)
	+ Benefits of standardization will only be visible if a critical mass is reached	(1/26)

Table 2: Statement categories supporting and contradicting the characterization of a wicked problem for the problem solution

WP	Categories supporting (+) and contradicting (-) the characterization	#
3. Solutions not true-or-false, but good-or-bad	+ Definitions have to fit multiple contexts, whether a definition is true depends on the multiple valuation measures	(8/19)
	+ Applicability of definitions is more important than formal correctness	(4/19)
	+ Widely used definitions are accepted, even if better definitions would be possible	(2/19)
	+ Data quality rises if research information is used internally (e.g. performance-based funding allocation or funding)	(1/19)
	+ Different definitions cause different adjustment mechanisms	(1/19)
	+ Research information standardization requires a consistent subject classification	(1/19)
	+ Incompatibility of existing definitions	(1/19)
	+ Organizations might not need the full set of standardized RI definitions	(1/19)
5. Irreversible	- Standardization requirements will change over time, flexibility required	(1/1)
	+ RI standardization changes awareness and perception of evaluation, this may cause rejection	(1/3)
	+ Standardized RI definitions cannot be easily changed back	(1/3)
	+ Normative power of RI standardization may change behavior of organizations	(1/3)
6. Solutions not countable	- For a subset of definitions the alternatives are countable	(1/1)
	+ Infinite number of definition alternatives	(4/8)
	+ Definition alternatives are not comparable because they are on different semantic levels	(2/8)
	+ RIS vendor coverage changes	(1/8)
	+ Research information standardization requires a consistent subject classification	(1/8)

The numbers of codes per document are depicted in Fig. 1 for the characteristics of a wicked problem. The vertical axis plots the characteristics provided by Rittel & Webber in accordance with the enumeration provided above. The number of statements providing evidence for (black) or against (gray) each characteristic divided by the number of documents (13) is plotted horizontally. In general, considerably more supporting than contradicting statements for the characterization of RI standardization as a wicked problem were found.

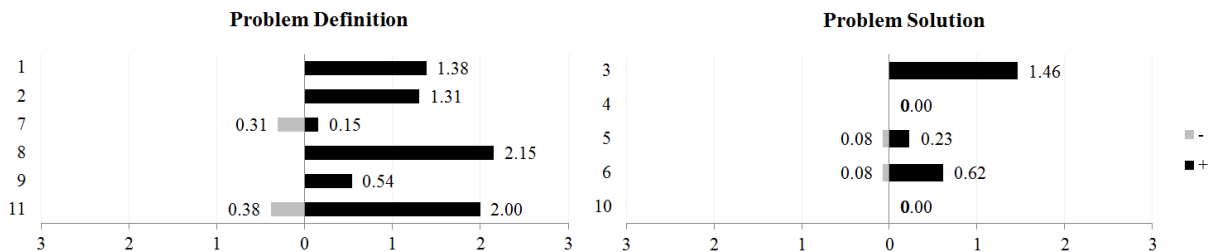


Fig. 1: Number of Codes per Document for the Characteristics of a wicked problem

5. Discussion

With respect to the definition phase, the experts' answers point to a wicked problem according to the characteristics provided by Rittel & Webber in four out of six cases (1, 2, 8, 9). Two characteristics were found to be controversial in our case:

- 7 - Every wicked problem is essentially unique: As Table 1 shows, the vast number of existing definitions speaks against the problem being unique. Other experts argued that this multiplicity of existing definitions causes the definition process to be a more complex new problem. Another position against Rittel's characteristics of a wicked problem is that there are already international initiatives addressing RI standardization. Notwithstanding, there has not been any standardization effort in Germany so far for RI on the national level taking international regulations and developments into account.
- 11 - Multiple stakeholders cause social complexity: Interviewees have partially reverted this claim e.g. by means of the following statements: different backgrounds and affiliations of stakeholders do not render the process more complex; the common understanding about the necessity of the project was clear to all stakeholders; or there is a

central organizational unit where all reporting information runs together. Still, the vast majority of statements support the position that multiple stakeholders cause more social complexity. The main corresponding statements were that research information standardization requires acceptance and contribution among all stakeholders, that the stakeholders and reporting units as well as their reporting processes are rigidly separated and that this holds for the science system on national, federal and research institution level.

With regard to the problem solution phase, the answers given by the experts tend towards the characterization of the process as a wicked problem in two out of five cases (3, 6). There were no answers found for two characteristics (4 – There is no immediate test for a wicked problem, 10 – The planner has no right to be wrong). One possible explanation could be the time of the investigation (the interview was conducted at the very beginning of the process). One characteristic was stated controversially:

- 5 - Since it is impossible to learn by trial-and-error, every solution attempt has irreversible consequences: One answer indicated that the results of the standardization process are flexible. Therefore learning by trial-and-error would be possible. This is contrasted by another expert who states that standardized RI definitions cannot be easily changed back. Furthermore it was stated that RI standardization changes the awareness and perception of evaluation, which may cause rejection of future standardization efforts. Therefore, we argue that even if the standardization results in flexible standards, the process at such influences involved stakeholders, changing the requirements for further standardization endeavors.

Since the interviewed experts were participants of the initial definition phase of the CDS project representing all major stakeholders of the German science system, they have good knowledge of the nature of the analyzed problem. Yet, their degree of involvement in the process may also lead them to overrate the complexity of the process to standardize research information. An additional survey of outside observers of the process could corroborate the conclusions drawn in this paper. Another limitation results from the fact that the literature applying the concept of wicked problems typically just states that the analyzed problem meets the necessary criteria. Consequently, there is hardly any comparable empirical work systematically studying the intricacy of problems. Thus, our study can be considered a first, explorative attempt to deal with this issue. In the future it might also be addressed with different methods like standardized questionnaires.

6. Consequences and outlook

The results of the content analysis underline our interpretation of the standardization process as a wicked problem according to the stated criteria in both the problem definition and problem solution phase. However, our data lend evidence against one of the characteristics. Regarding two other characteristics, evidence is mixed. The remaining eight characteristics are supported by the answers of the experts with respect to the standardization process of the core research data set.

As there have been thorough discussions for solving wicked problems, three exemplary approaches are discussed and the consequences for standardization projects are proposed:

Jentoft and Chuenpagdee⁵ enforce the argument by Kunz and Rittel¹⁷ that problem definition cannot be assumed a priori when it comes to wicked problems. It can rather be considered as part of the empirical research issue. The findings of the formal content analysis showed that in line with Rittel's characterization of wicked problems there is a high complexity in problem definition for RI standardization in this project. In order to take the higher relevance of the problem definition into account and to enable a more empirically driven discussion and development we therefore propose the formal analysis of this complexity by implementing methods like Prototyping, scenario development or the Delphi method.

According to Conklin and Weil¹⁸, addressing wicked problems shifts the focus from the final solution to the quality of the problem-solving process. Processes to solve wicked problems integrate various stakeholders and are argumentative in nature. For this reason, the use of *computer supported argument visualization* (CSAV) has been suggested to support the rigorous documentation of the argumentation process^{19,20,21}. Formal languages like *Issue Based Information System* (IBIS) were developed by Kunz and Rittel¹⁷ to enable visual representation of argumentation. In the CDS project IBIS is applied to achieve a common definition representation shared by the

involved stakeholders. We propose to not only use models and formal visual tools like mind mapping, mental models or CSAV in the development of the solution but to also initiate an early discussion on the problem itself for both the *problem definition* and the *problem solution phase*.

To solve a wicked problem, Weber and Khademian²² emphasize the need for integrating and distributing relevant information among all players in the solution process. Furthermore, Conklin and Weil stress that the acceptance of the solution is more important than the solution itself¹⁸. In our view this principle also applies to standardization efforts, which are for the most part not mandatory. Based on the experiences from the CDS project, we expect acceptance in solving a wicked problem among stakeholders to depend on the extent and quality of the information shared. Although higher transparency is one of the main aspirations of CSAV, the literature still lacks studies on the relationship between information distribution and acceptance in wicked-problem solving. This research gap might be addressed in future empirical analyses.

The formal content analysis presented in this paper provides first exploratory insights into the wicked nature of standardization projects. For RI standardization widely used methods for software development, although strongly influenced by the concept of wicked problems, do not entirely deal with all resulting problem dimensions. As RI standardization is more than just software development, its complexity should also be analyzed empirically and addressed by using argumentation visualization.

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