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# Standardising Through Software

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**Abstract.** Since its inception in 1948, the World Health Organization (WHO) has been instrumental in setting standards for monitoring and evaluation of public health interventions and health service delivery. This paper focuses on the way in which these standards are operationalized through health indicators and analytical tools. We describe and discuss a concrete attempt by WHO to achieve this by embedding indicators and analytical outputs in a health information software that is used in a majority of the world's least developed nations. We analyse this phenomenon by using a concept of fluid standards, and challenge the 'conventional' perspective on standards as fully specified and unequivocal outputs of formal standardisation processes.

**Keywords:** standardisation, fluid standards, health information systems

## 1 Introduction

To build a healthier future for people, the World Health Organization (WHO) pursues global leadership on matters critical to health. Since its inception in 1948, WHO has been instrumental in creating a shared body of knowledge on epidemiology and health service effectiveness. Health programmes and interventions (such as HIV, tuberculosis and immunization) are organized, monitored, and evaluated similarly in different countries across the globe. However, little standardisation has so far been achieved around the information systems supporting the monitoring and the evaluation (M&E) of health programmes or interventions. M&E in this context is the ongoing *monitoring* of health indicators (such as immunization coverages or disease incidence rates in particular populations) and regular *evaluation* of health programmes and interventions. This lack of standardisation can be attributed to the existence of a variety of legacy systems; emergence of new diseases; weak national capacity around monitoring and evaluation; and variations in the disease burden globally.

There are many good reasons for standardisation of monitoring and evaluation across countries. Both the monitoring and evaluation activities are dependent on an information system that can provide information in a meaningful way. Much of the existing standards and guidance materials on M&E represent 'best practices', and as such it can be argued to have value for countries and their local monitoring and evaluation practices. M&E activities enable Ministries of Health to manage health interventions and allocate scarce resources where they have the biggest potential impact. For WHO and other global agencies, standardisation of monitoring and

evaluation facilitates analysis and also comparison of data being produced across different countries. Further, standardisation can bring benefits for WHO and other organisations supporting M&E-related activities in terms of leveraging economies of scale when producing curricula and capacity building initiatives on monitoring and evaluation topics, such as data quality assessment, visualization and presentation, as well as data use. From the perspective of those supporting the implementation and maintenance of information systems supporting M&E processes, standardisation means that both software components and other materials can more easily be re-used.

WHO as a global agency is engaged in setting norms and standards for monitoring and evaluation, and how it is operationalized through standard health indicators and analytical outputs and analysis. This paper focuses on a concrete attempt to improve the use of these standards by embedding indicators and tools in a certain health analytic software (DHIS2) used in a majority of the world's least developed nations. By using this *de facto* standard software, WHO aims to make it easier for countries to adopt 'global' standards and norms, and thereby achieving similar monitoring and evaluation practices across countries. DHIS2 is a software with a flexible metadata model, it is configurable and has a platform architecture that supports the development of add-ons like apps by third parties. This flexibility and generativity is a key enabler for its wide adoption. In this paper, we focus on the relationship between the DHIS2 software and WHO standards. And we argue that the complexities related to the global nature of DHIS2 and WHO standards, the variety of contexts where attempts are made to implement both of the them, and the intricacies of the interplay between DHIS2 and the WHO standards warrants an 'unconventional' perspective on standards. Based on an empirical focus, we analyse this phenomenon by using a concept of *fluid standards* (Hanseth and Nielsen 2017), where we challenge 'conventional' perspectives on standards as fully specified and unequivocal outputs of formal standardisation processes.

The paper is organised as follows: in the next section, we introduce the fluid standards concept and related literature. The third section gives an overview of the methodology, before the case is presented in section four. In the fifth and sixth sections, we discuss our findings and conclude.

## 2 Theory

There is vast amount of literature on standards in the field information systems, and we focus here on a small subset of this literature which is of particular relevance to our case. Braa *et al (2007)* discuss strategies for developing standards for information infrastructures, with a particular focus on the healthcare sector of low- and middle-income countries. They argue that standards within complex systems such as health information systems need to be adaptable and flexible, and point to the two forms of flexibility defined by Hanseth *et al* (1996): *use flexibility*, which is the flexibility of the standard to be used for different purposes and/or in different environments; and *change flexibility*, referring to how easily the standard can be changed. Braa *et al (2007)* argue for a strategy of standardisation where a new standard is created as an

*attractor,* evolving into a system of standards, and second, that this system of standards is made in a way that makes it *adaptive* to the local context.

Another key concept introduced in a paper based in part on the same empirical case is the *hierarchy of standards* (Braa 2002). Here, Timmerman and Berg's concept of local universalities (1997) is used as a framework "within which the tensions between standardization and localization may be understood and handled" (Braa 2002, p. 123). Braa *et al* argue that a hierarchy of standards, where each level of an organisational hierarchy (e.g. health facilities, districts, regions, national, international level) are free to define their own local standards as long as they adhere to the standard of the level, is a strategy that can help resolve the tension between standardization and localization.

Hanseth and Nielsen (2017) introduce the concept of *fluid standards*, building on the Actor-Network Theory (ANT) concept of *fluids* and existing literature on flexibility and standardisation. While *fluids* share their basic characteristics with actor-networks, entities in a fluid are so closely related that they are no longer discrete, unlike the different nodes of a network (Mol and Law 1994). Standards are traditionally seen as "immutable mobiles", and the very notion of standards is built on that when they move from one context to the next they remain the same. Hanseth and Nielsen argue that standards in certain domains must rather have the nature of being "mutable mobiles" and transform as they move, i.e. they are *fluid* (2017). Borrowing from Mol and Law (1994), Hanseth and Nielsen describe the characteristics of fluid standards as: without clear boundaries; with multiple identities; based on mixtures of different things; robust through multiple purposes; continuity; and dissolving ownership. These characteristics are summarised in table 1 below. Fluid standards are particularly relevant in domains where a large number of different types actors are involved, where changes are rapid, or technology is closely link to user practices, for example information infrastructures and related standards for healthcare.

**Table 1.** Characteristics of fluid standards

| | |
|---|---|
| No clear boundaries | Boundaries defined by all that is needed to make the technology work |
| Multiple identities | Attributed by different people based on constituting or external elements, different boundaries, emergent and changing over time |
| Mixtures | Of different elements, elements that can be fluid themselves |
| Robustness | It is not clear when it stops acting, achieves its aims and when it fails and falters: from its multiple purposes and there being no single weak link that can make all the identities come apart. The strongest link may also dissolve and not be obvious. |
| Continuity | Share characteristics with other technologies, a family resemblance, which form continuity |
| Dissolving ownership | Fluid in itself allowing the technology the flexibility to have unclear boundaries and multiple identities |

The *standards* we focus on in this paper are broadly defined standards from the field of public health. In particular, we speak of *indicators*, *data elements* and *dashboards*. Indicators are measures of health status or performance, often linked to a target. A common type of indicators are service coverage indicators, such as "BCG vaccine coverage among children < 1 year". *Data elements* denote raw data, which is commonly counts of events, whether they are occurrences of a particular disease or a service being provided. To follow our example from the area of immunisation, "number of children given BCG vaccine" would be a data element that together with a population estimates makes up the BCG coverage indicator. A *Dashboard* is a set of visualisations of data, in most cases visualisations of indicators as charts, maps or tables. The dashboard metaphor also implies that the visualisation gives the user a quick overview of relevant information. Dashboards are thus typically aimed at a particular set of users, e.g. a manager within a specific area or health programme such as HIV/Aids or immunization, or for a certain level or position such as a district health manager.

## 3 Method

The authors are all part of the Health Information Systems Programme (HISP), a large-scale action research project dating back to the 1990s. The research methodology of the HISP project is discussed in Braa *et al* (2004). All of the authors are based at the University of Oslo, from where the development of the software platform discussed here is coordinated, and three of the authors have been directly involved in processes with WHO which we present. One of the authors was seconded to WHO for over two years, with work on building WHO content standards into the DHIS2 platform as one of the main areas of work.

While the research is part of a larger action research project, it has not followed an overall, pre-defined research design as prescribed by canonical action research (Davison 2004). However, the practical work has followed the key principles of action-oriented research, with cycles of planning, implementation, evaluation and dissemination (Susman and Evered 1978; Baskerville 1997; Checkland 1998).

Data was collected primarily in the form of notes, minutes from meetings, and field notes from visits to countries for field testing. With each of the health programmes involved in the process, work was done iteratively with cycles of meetings to discuss the content standards and requirements, work on developing prototypes of the standard configurations in the software, and meetings to review and identify further changes to be made. Notes from these activities make up a substantial part of the empirical material.

Data has been analysed through presentations of and discussions on the empirical material among the authors. A strength here has been the varied level and type of involvement of the different authors. One author has been involved *hands-on* in the work on a day-to-day basis for about three years; two of the authors has been involved in several activities throughout the period, such as review meetings and testing at the country level; whilst one author has had an outsider perspective which has enabled

him to ask questions and see connections that are not immediately obvious to those with the in-depth knowledge of the processes studied.

## 4 Case

In this section, we will go into detail on the empirical material from the case. We will first give a brief introduction to the software platform in question, and then an account of the process of building health data standards into the software platform.

The software discussed here is an open source software platform for collection, management and analysis of data called the DHIS2. DHIS2 has roots going back to post-apartheid South Africa in the mid-1990s, and is currently used in more than 50 countries - predominantly low- and middle-income countries in Sub-Saharan Africa and South Asia. DHIS2 does not include any content (such as indicators or data elements), and is thus configured from scratch in each country according to local needs. Configuration of the platform is done through the user interface without the need for software development, and the barrier to add and change content is thus low. Content such as indicators, data elements and dashboards are commonly referred to as *metadata* in the context of DHIS2, and this metadata can be moved (imported and exported) between systems through configuration files.

The overall standardisation process we discuss in this paper can be seen as having three stages. The first stage is the development of the content standard itself, i.e. the definition and selection of health indicators and data elements and documentation of best practices around analysis of these indicators that form the basis for the dashboards. These content standards are typically published by WHO as standards or guidance documents. For example, the WHO Tuberculosis (TB) programme has published a "Compendium of indicators for monitoring and evaluating national tuberculosis programs" that defines recommended TB indicators; "Definitions and reporting framework for tuberculosis" with recommendations for data collection including data elements; and "Understanding and using tuberculosis data" with recommendations on how to analyse these data elements and indicators.

The second stage of the process is the translation of these content standards into the DHIS2 software platform. We use the term *translate* here to denote the process of taking the content standards described above and developing standard configuration packages for DHIS2 based on and in accordance with the standards. The *configuration packages* consist of XML or JSON documents with definitions of indicators, data elements, dashboards etc. which can be imported into DHIS2 systems, documentation and guidance on the technical implementation of the packages, and in many cases training material on data analysis and use based on the standard content.

The third and final stage is the implementation and use of these standards in countries, through national DHIS2 systems. The focus of this paper is on the second stage of the process.

WHO has since its inception had publication of guidance and standards within the area of health as one of its key functions. The process we focus on in this paper, of translating these standards into the DHIS2 software platform, is far more recent, starting in earnest in 2015. The initiative stems from the Information, Evidence and

Research department of WHO, as part of an effort to improve the availability of guidance and standards on routine facility-based information in a holistic way, i.e. across specific topics and health programmes. Translating the standards into DHIS2 in metadata packages that can be provided to countries is thus only one component of this work.

The practical work of creating these standard configuration packages has been done in parallel for different health programmes. Work in the different areas started at different points of time, and has reached different levels of maturity as of this writing. While there are quite substantial differences in both comprehensiveness and maturity of the standard configuration packages, the development has followed a similar iterative process: discussions with domain experts on how standard content can be translated into the software; development of prototype configurations; and reviews of these prototypes.

## 5 Discussion

The case reported on in this paper is a process of translating content standards that exists primarily in the form of published, normative documents into standard configuration packages for a software platform. In this section, we will first discuss how during this process an effort was made to ensure the content was 'adapted' to become an *attractor* for countries, and that use and change flexibility was maximised to facilitate adoption. Secondly, we discuss how the process led to changes or adaptions in both the content standard and the software platform. Finally, we discuss how the standard configuration packages for DHIS2 can be conceptualised as *fluid standards*.

Braa *et al* argue that one strategy for standardisation is firstly, to create a standard that becomes an *attractor* for use of the system of standards, and secondly, to ensure that the standards are *adaptive* (2007). While this has not been a conscious strategy in this particular case, in practice this work has strived to achieve both. During the process, there were many discussions on what data would be available in national systems, which would influence what indicators it would be realistic to promote. While the standard packages in DHIS2 are meant to be adaptable, pre-defined dashboards in particular will not be meaningful in cases where few of the indicators are available. An effort was made to identify what would be seen as useful at the country level, i.e. what would have been seen as having an added value, and also what would be useable, i.e. that there would be the capacity at various levels to analyse and interpret the content. Some of these standard dashboards in particular would thus be *attractors* that could generate interest in the wider set of standard configuration packages, some of which were more comprehensive and would require a larger effort to implement.

During the process, an effort was made to ensure that the standards could realistically be implemented in an as many different countries as possible. A key to this was to keep the standard as simple as possible, and reducing, for example, disaggregations into age groups to a minimum. This can be seen as increasing the *use flexibility* which Braa *et al* argue is the ability to use a standard in different

environments - in this case countries (2007). Similarly, efforts were made to maximise *change flexibility*. For example, within several of the programme areas different modules were made to cater for countries that needed only analytical outputs, and those who needed a complete metadata package that included data elements, indicators and analytical outputs.

The nature of the content standards was of great importance to the process of translating them into standard configuration packages. Across different health programmes and areas, the type and detail of the content standards available varied greatly. For example, the TB programme, as mentioned above, had published guidance and reference documents which defined indicators, reporting forms with data elements, and analytical outputs respectively. In other areas, standards existed only for certain things (e.g. indicators), and/or what existed in terms of guidance was spread across several publications that were not always fully harmonized. In cases where there was no existing content standard, a decision had to be taken either to leave those components out of the configuration package in the software, for example providing only indicators and dashboards and no data elements, or to define the content standard as part of the process of translating it into the software.

It became apparent how the translation from a written content standard into a software configuration package can change both the standard itself and the software it is translated into. For example, there were several instances where the visualisation of data proposed in the content standard could not be implemented with the existing analytical support in the software. In some cases, this was handled by making an alternative but similar type of visualisation, so that the resulting standard in the software was slightly different from its written reference. In other instances, this was not seen as acceptable and the software had to be modified, through the creation of a new application for the software platform which could be included in the standard configuration package.

The flexibility of the software has been a key factor that has allowed this standardisation process to take place. As discussed above, while the software was not always able to produce the exact outputs required by the standard, in the cases where it failed to do so it was possible to extend the software through custom-made applications. There is at the same time a paradox here: the software has become a *de facto* standard in large part due to its flexibility and how easy it is to add and change data elements and indicators. This in turn has enabled the in many cases quite "messy" and non-standard national implementations, and thus the need for WHO and others to promote standardisation. And this standardisation, as discussed here, is again enabled by the flexibility of the software.

The process of translating these content standards into a software platform was not a formal standardisation process. We argue that rather than understanding these configuration packages for DHIS2 as conventional, fully specified and unequivocal standards, it makes more sense to discuss them as *fluid standards*. Returning to the description of the different dimensions of fluid standards in section 2, in table 2 below we describe the standard configuration packages as a fluid standards.

**Table 2.** Characteristics of fluid standards as applied to standard configuration packages.

| | |
|---|---|
| No clear boundaries | There are no clear boundaries between the standard configuration package, the global and generic DHIS2 and the implementation of DHIS2 in different health programmes in different countries. Through the standardisation process, both the WHO standard and the DHIS2 software were changed. There is also no clear distinction between the different actors involved in the standardisation process. |
| Multiple identities | For some, the standard configuration package is a tool for promoting normative guidance from WHO; for others, a method for facilitating configuration of DHIS2 for those supporting technical implementation; and yet for others the opportunity to add functionality to the health information system of Ministries of Health. |
| Mixtures | The standard configuration packages consist of many different things, including the generic DHIS2 platform itself, a machine-readable configuration (JSON-document), related training material, and a team offering opportunities of financial and technical assistance. |
| Robustness | The standard configuration packages have been conceived so that they can be used fully or partially, and modified according to the context in which they are used. Being based on Open Source and with extensive APIs, DHIS2 is flexible and open for modification and integration with other systems. To facilitate this, there is a growing network of DHIS2 experts located in developing countries. |
| Continuity | It connects with and builds on the global and generic DHIS2 platform, the implementation of DHIS2 in countries, the existing health information systems and established M&E and clinical practices as well as the 'best practices' defined by WHO |
| Dissolving ownership | The standard configuration packages are developed and published by WHO, but can be modified by consultants, organisations, Ministries of Health to fit the local context. This is also the case with the generic DHIS2 software. |

We have made an attempt to discuss the standard configuration packages as fluid standards in the table 2 above. We believe that this discussion has shown that fluid standards are a fruitful perspective to understand the nature and robustness of the standard configuration packages as well as the processes of their definition and continuous redefinitions.

## 6 Conclusion

*Flexibility* has played a key role in the processes discussed in this paper. First, the flexibility of the software platform is one of the factors that makes it a *de facto* standard in developing countries. Second, the same flexibility makes it possible to develop a range of different standard configuration packages based on WHO's normative guidance. And third, in the process of translation content standards into

standard configuration packages for the software, a conscious effort was made to ensure the *use* and *change* flexibility of the resulting products. However, we argue that while this flexibility of the standard was important, it was not enough. By discussing this case of *standardising through software* using the concept of fluid standards, we have also discussed that the robustness of these standards is related to their nature of being without clear boundaries; having multiple identities; being based on mixtures of different things; being robust through multiple purposes; achieving continuity; and with dissolving ownership. Whether the goal of developing standard configuration packages that can be used and be useful across countries will be achieved will only be clear after further implementations efforts. This will be a topic for future research.

## References


1. Baskerville, Richard L. 1997. "Distinguishing Action Research From Participative Case Studies." *Journal of Systems and Information Technology* 1 (1): 24–43.
2. Braa, Jørn, and Calle Hedberg. 2002. "The Struggle for District-Based Health Information Systems in South Africa." *The Information Society*, no. 18: 113–27.
3. Braa, Jørn, Eric Monteiro, and Sundeep Sahay. 2004. "Networks of Action: Sustainable Health Information Systems Across Developing Countries." *Management Information Systems Quarterly* 28 (3): 337–62.
4. Braa, Jørn, Ole Hanseth, Arthur Heywood, Woinshet Mohammed, and Vincent Shaw. 2007. "Developing Health Information Systems in Developing Countries: the Flexible Standards Strategy." *Management Information Systems Quarterly* 31 (Special Issue).
5. Checkland, P, and S Holwell. 2007. "Action Research: Its Nature and Validity." *Systemic Practice and Action Research* 11 (1): 9–21.
6. Davison, Robert, Maris G Martinsons, and Ned Kock. 2004. "Principles of Canonical Action Research" 14 (1): 65–86.
7. Hanseth, Ole, Eric Monteiro, and M Hatling. 1996. "Developing Information Infrastructure: The Tension Between Standardization and Flexibility." *Science Technology Human Values*, no. 21: 407–26.
8. Hanseth, Ole and Petter Nielsen. 2017, in review. *Fluid Standards: A Conceptualization of the Changing World of Standards Based on a Case Study of an m-Commerce platform.*
9. Mol, Annemarie and John Law. 1994. "Regions, Networks and Fluids: Anaemia and Social Topology". *Social Studies of Science* 24 (4): 641-671
10. Susman, Gerald I, and Roger D Evered. 1978. "An Assessment of the Scientific Merits of Action Research." *Administrative Science Quarterly 23* (4): 582–603.
11. Timmermans, S, and M Berg. 1997. "Standardization in Action: Achieving Local Universality Through Medical Protocols." *Social Studies of Science* 27 (2): 273–305.
12. WHO. 2017. *The role of WHO in public health.* Available at http://www.who.int/about/role/en/. Accessed May 1 2017.