RESPONSIBLE STANDARDISATION OF 'SMART' APPLICATIONS

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ABSTRACT

The development of smart applications will pose a number of new requirements on the underlying standardisation process. Perhaps most notably, these include co-operation between hitherto distinct entities, the involvement of a variety of 'exotic' (by ICT standards) stakeholders and the adoption of a responsible standards setting process. The paper discusses these issues.

KEYWORDS

Multi-disciplinary standardisation, Smart applications, Internet of Thing

1. INTRODUCTION, BACKGROUND & MOTIVATION

Smart systems are a fairly recent trend that is increasingly gathering momentum. Their 'smartness' is the result of the integration of Information and Communication Technology (ICT) into 'traditional' technologies, thus providing them with advanced control and amenability functions previously available only in the virtual world. Prominent examples include the Smart Grid, Smart Manufacturing, Intelligent Transport Systems, Smart Homes and Smart Cities. To offer the user 'smart' applications, these systems require a communication infrastructure which, in turn, will typically be based on the Internet of Things (IoT), sensors and Cyber Physical Systems (CPSs). Forecasts indicate anything between 20 and 50 billion IoT devices for the year 2020.

Interoperability is the key requirement for all smart systems. To achieve interoperability between an extremely broad spectrum of devices and applications, internationally agreed standards are a *sine qua non*. Their true¹ ubiquity smart systems will affect human lives much more than the Internet and mobile communication have done so far. They will thus represent a major challenge for policy makers and for society as a whole. And not least, they will have an enormous economic impact. To make 'smartness' a reality, globally accepted standards are a *sine qua non*. These standards will shape the technical development and thus, to a certain extent, the future. The world of standards setting itself will also be affected by these developments. For one, the multi-disciplinary nature of smart systems will pose extra problems for the traditionally rather more 'mono-disciplinary' standardisation process. It will require co-operation between standardisation entities (and individuals) with very different cultures and from equally different backgrounds.

Today, the 'ubiquity' (anywhere, anytime, any device) of the Internet refers only to its accessibility. In contrast, the IoT's billions of sensors of different smart systems will collect data and make them available for users of smart applications. The results of the analyses of this massive amount of data may have major economic, ecological and other ramifications and directly impact citizens and businesses alike. Moreover, a considerable part of this data will be personal or private. Accordingly, potentially severe policy and ethical issues need to be addressed in the context of smart systems. Perhaps most prominently, these must include security and privacy aspects of data and communication.

That is, specifically for ethical issues to play a role already during smart systems standards development initiatives, overarching 'Responsible Standardisation' (RS) guidelines are needed. They would ensure that standardisation initiatives take into account internationally agreed non-technical (specifically ethical) aspects to be associated with a certain technology.

¹ As opposed to the frequently claimed ubiquity of the Internet, which refers only to its accessibility, really.

Standardisation of smart systems has started only comparably recently, with its focus still largely on the communication infrastructure. Giving the complexity of smart systems, their broad variety of stakeholders and the resulting multi-disciplinarity of both the systems design and the underlying standardisation process it should still be possible to introduce RS in the field. However, the sooner action will be taken the better.

2. MULTI-DISCIPLINARY STANDARDISATION OF SMART TECHNOLOGIES

Until not so long ago standardisation was mostly a rather ‘mono-disciplinary’ activity. More recently, convergence of formerly separate technologies has been an emerging development. For instance, the integration of (tele)communication and information technology led to ICT. The integration of ICT, in turn, instils smartness into more ‘traditional’ applications. Examples of resulting smart application areas include, among others, Intelligent Transport, Smart Manufacturing, the Smart Grid and, ultimately, Smart Cities. Table 1 shows some of the major disciplines involved in five major smart application areas.

Table 1. Disciplines involved in different application areas (no claim for completeness)

Industry 4.0	Intelligent Transport	Smart Grid	Smart Buildings	Smart Cities
Production	Transport Telematics	Power Engineering	Architecture	The grand total of the
Engineering	Traffic Engineering	Computer Science	Civil Engineering	others plus
Telecommunication	Power Engineering	Telecommunication	Computer Science	City planning
Computer Science	Automotive	Economics	Telecommunication	Environmental studies
Robotics	Computer Science,		Sociology	Politics
Control Engineering	Telecommunication		Psychology	
.....	Economics			
				

In a way, Smart Cities represent the ultimate smart application, being more or less a superset of the others. Here in particular, the development meaningful standards, i.e. standards that are not just technically sound, but also economically viable, sustainable and of societal value (see also sect. 3) will necessitate the participation of an extremely wide range of stakeholders. In addition to representatives of the numerous technical disciplines listed in Table 1 these also include other groups that are not normally represented in standards setting like citizens, NGOs, unions and perhaps also politicians, sociologists and philosophers.

This involvement may materialise in different forms. Joint participation in one WG would be one option. In this case, major problems likely to be encountered may be expected to relate to the actual active involvement of the more ‘exotic’ (non-technical) stakeholders. If a realistic way to achieve this can be found, the lack of a common ground and of mutual understanding will have to be overcome before meaningful standardisation work may commence. This is a problem generally encountered in multi-disciplinary co-operation (see e.g. [Bruce et al., 2004]) and standardisation is no exception.

Close co-operation between different more or less ‘mono-disciplinary’ WGs would be another option. In this case, the issue of broad stakeholder involvement would still persist. In addition, the problem of different boundary conditions of the different WGs would play a role. The boundary conditions in ICT standardisation are different from those in most other areas. These reasons include, for example, ICT’s typically short technology life cycle, the importance of Intellectual Property Rights (IPR) and generally the amount of money that may be at stake. Different standardisation ‘cultures’ represent a related problem. In practice, these differences result, on the one hand in the particularly formal processes and procedures of, for example, the ITU and on the other hand in the rather more ‘chaotic’² approach of e.g. the IETF.

The standardisation environment in the ICT sector is rather unique, not least due to the importance of private standards consortia whose time-frames, rules, processes and by-laws may differ considerably from those of the formal Standards Developing Organisations (SDOs). These differences will not exactly help to simplify co-operation either.

Virtually all smart applications have strong security and privacy requirements. These requirements also need to be addressed by standardisation. Ideally, approaches like ‘privacy by design’ (see e.g. [Langheinrich, 2001]) should be adapted to – and adopted by – standards setting.

² No meant in any derogatory way.

3. RESPONSIBILITY

Research and innovation (R&I) need to be guided to address the various challenges society faces. This holds all the more for R&I in smart applications. Responsible Research and Innovation (RRI) provides guidelines to address these challenges. V. Schomberg [2013] defines RRI as “*a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)*”.

Stilgoe et al. [2013] propose four dimensions of RRI. These dimensions also emerged as the result of an in-depth literature review [Burget et al., 2017]. They include

- Anticipation – to adopt a forward view that takes into account opportunities, risks, environmental concerns, etc.
- Inclusion – to enlist ‘new voices’ that may challenge long-standing approaches.
- Reflexivity – to put research into context through regular questions regarding norms and values.
- Responsiveness – to adapt as experience is gained and knowledge is built.

That is, not just technical and economic, but also e.g. societal, ethical and environmental aspects shall be taken into account during the innovation process. This, in turn, means that a broad range of stakeholders has to be involved in the process, notably those that are not normally involved in R&I (e.g. consumers, NGOs, etc.). To this end, and using ICT as an example, Jirotko et al. [2016] first note that applicable professional guidelines and codes of conduct have been in place for a while, but question their relevance and suitability for future developments. They also develop an adaptable framework (the AREA Plus Framework) that shall enable and support expert discourses on RRI.

All this may also be said about standards setting (see also above). Therefore, responsible standardisation is something that needs to be introduced. After all, standardisation represents (one of) the earliest design stage(s), during which a future technology is shaped [Williams & Edge, 1996].

Wickson & Forsberg [2015] refer to standardisation as a “...*kind of interstitial space because it effectively occupies a location somewhere between what are currently recognized as key domains, e.g. those of science, policy, civil society and industry*”. This space, or rather its output, has a tremendous albeit usually overlooked impact in almost all sectors. The at one time popular perception that standards largely hamper innovation has recently been disbanded. [Swan & Lambert, 2010] and [Swann, 2010], for example, show that standards can do both, hamper and enable innovation and that the latter effect is much more pronounced. Blind [2013] highlights the fact that both standardisation and standards can be used to promote innovation, especially in relation to research, IPR and public procurement.

Three orthogonal types of approaches to link RRI to standardisation may be identified:

- To deploy standardisation to strengthen RRI.
[Jacob et al., 2013] observe that one option would be “... *linking research projects with standardisation activities, because national and European standardisation bodies provide the platform for the involvement of all interested stakeholders to participate in the development of standards, which reflect not only the interests of industry and research, but also representatives of societal interests, ...*”.
- To develop Standards for RRI.
A number of standards have been developed that could be of relevance for RRI. At the more general level, these include e.g. the ISO 26000 series on Corporate Social Responsibility and the ISO 31000 series on Risk Management. Closer to the field of smart systems, [ITU-T, 2015], for instance, offers an in-depth discussion of the roles of the different groups of stakeholders in the standardisation of smart cities. Moreover, a number of ITU-T Technical Reports discuss aspects relating to sustainable cities.
- To apply RRI principles in standards setting.
Applying RRI principles not just in innovation but also in standards setting (which may well be a very early stage in an innovation process) is perhaps the most important aspect and should help make standards more credible and legitimate.

This holds particularly with respect to the involvement of the widest possible variety of stakeholders, both technical and societal. Sadly, this is not normally the case in the ICT sector (see above and e.g. [Werle & Iversen, 2006]). Here, SMEs (Small and Medium-sized Enterprises), users, consumers, NGOs and other societal stakeholders are dramatically under-represented (forming the ‘Third Estate’ in standards setting; [Jakobs, 2005]).

4. IN SUMMARY

The need to standardise ‘smart’ applications may (will?) bring about changes in standardisation. This is mostly due to the likely future true ubiquity and inescapability of these applications. To actually reach the necessary levels of credibility and legitimacy for these technologies RRI principles will need to be applied to the standardisation of smart applications. Along similar lines, these technologies not just need to be technically sophisticated and economically viable but first and foremost be sustainable and of societal value. To this end, both individuals and the various Standards Setting Organisations (SSOs), from very different backgrounds and sectors, respectively, will need to co-operate very closely. This process will have to involve *all* stakeholders in the process. This need is highly likely to affect individual SSOs, the links that exist between them and thus the standardisation landscape as such.

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