Decision support system for science communication: Reflective practitioners through a science communication laboratory

Maarten C.A. van der Sanden
Dept. Science Education & Communication
Delft University of Technology
The Netherlands
m.c.a.vandersanden@tudelft.nl

Steven M. Flipse
Dept. Science Education & Communication
Delft University of Technology
The Netherlands
S.M.Flipse@tudelft.nl

Abstract

Science communication professionals deal with non-linear ill-defined wicked problems on a daily basis. In order to cope with these problems professional decision support for science communication professionals needs to be developed. Support systems that lead to overview on the one hand and focus at the other. In an ideal world these support systems perfectly resemble to realty. However, difficulties in parameterization of all kind of aspects, such as societal and ethical values, lead to support systems that must rely on the reflective interaction between the science communication professional and a supportive tool. In this paper we focus on two examples of professional support development in which taken decisions on responsible innovation and on consumer acceptance of smart technology plays a role. The first supports interactive business-to-business decision making and the second interactive business-to-consumer decision making. From these examples it becomes clear that even the development of support tools (social tooling) as a technological platform leads to a more reflective science communication professional and

community of science communication professionals. We conclude this paper saying that a 'Science Communication Laboratory' could be a future development in social learning amongst science communication professionals.

Introduction

Science communication is a developing discipline in which next to straight forwarded science education also dialogue and citizen science plays an important role. The latter often channelled by dialogue or other two-way communication channels. As a result the science communication (SC) professional has to deal with all kinds of professional roles, such as knowledge broker, intermediate, spokesman (Wehrmann & Henze, 2014; Mulder et al, 2008; Meyer, 2010) on a daily basis. And also corporate science communication of researchers and their institutions gets more and more important in the light of university's positioning in an international cooperation for research and higher education (Van der Sanden & Osseweijer, 2012;Verouden et al, 2013). These development lead to complex science communication practices that entail many decisions on various communication processes, channels and means, at various moments with all kinds of target audiences. But how to make decisions in the first place? Decision making contains next to rational components irrational reasoning (Cook et al, 2007; Ariely, 2010). Therefore, SC-professionals deal with an inevitable feeling of uncertainty.

The aim of this paper is to explain how at the one hand parameterization of support tools for SC-professional is rather difficult, but at the other hand leads to a more professional and reflective SC-practice. Even the development of such support systems entail accountable SC-professionals.

Uncertainty & scenarios

There are various kinds of uncertainty a SC-professional has to deal with. A distinction is made between uncertainty due to a lack of knowledge and uncertainty due to variability inherent to the system under consideration (Walker et al, 2003). A decision support instrument needs to elaborate on these aspects of uncertainty. The big question then is how to make such uncertainty explicit. How to support bounded rationality

(Kahneman, 2003), which all professionals have to deal with? As Jones (1999) writes, bounded rationality asserts that decision makers intended to be rational; that is, they are goal oriented and adaptive, yet because of human cognitive and emotional architecture, they occasionally perform worse on being goal oriented and adaptive in important decisions. Limits on rational adaptation are of two types. First procedural limits, which limit how we go about making decisions. And second, substantive limits, which affect particular choices directly. Hollnagel (2007, p.4) state that: *"decision making is an activity or a phenomenon rather than a process, thereby replacing the idealistic assumptions about a rational decision maker with a more realistic set of assumptions about decision making as a facet of work.*" Such assumptions like: 1) decision making is not a discrete and identifiable event; 2) decision making is not primarily a choice amongst alternatives; 3) decision making is not usually a distinct event that take place at a specific point in time that be isolated from what goes on in the environment.

Daily scenario thinking by SC-professionals, *"if….then…but…"* is based on these assumptions and feelings of uncertainty. Scenarios, as Schoemaker (1995) writes, are amongst the many tools a manager can use for strategic planning. Scenarios stand out for their ability to capture a whole range of possibilities in rich detail. By identifying basic trends and uncertainties a manager can construct a series of scenarios that will help to compensate for the usual errors in decision making: overconfidence and tunnel vision. Decision support for SC-professionals is meant to support scenario thinking and therefore professional reflections on complex dynamic science communication opportunities.

Decision-support system & modelling

As a means to cope with this uncertainty and play with various SC-scenarios, decision support systems can be used. Such systems could help make assumptions explicit can provide an environment to test different scenarios and their expected outcomes. An ideal support system describes the decision process of SC-management in which theory and data (e.g. concerning consumers), SC-management information, SC-management goals, professional's experience, creativity, intuition and feedback are combined. SC-management is defined in this paper as strategic questions a SC-manager might have concerning the design of a SC-processes towards various target audiences resulting in a SC-strategy that might change the behavioural intent of target audiences, their view or behavior concerning science and technology development, and/or possibly their willingness for collaboration and cooperation in science and technology development.

Modelling and simulation are key words in our approaches towards a decision support system, eventually leading to a possible visual SC-management ‘dashboard’ for SC-professionals. Simulated representations of target audiences have been developed by various researchers on e.g. target audience’s need (Jager and Janssen, 2012; Van der Sanden et al, 2013). The insights obtained from these studies show the dynamic psychological and sociological aspects of target audiences and the many choices/scenarios a SC-professional can make or choose from. Therefore, the two examples of SC-support described in this paper on consumer behaviour concerning the introduction of smart energy meters and the SC-support for research & development management, bridge between theory and an uncertain practice and make possible decisions more insightful and tangible.

The main challenge in developing decision support systems is to keep outcomes understandable, manageable and meaningful for the SC-professional and to provide a useful interactive tool with which to test possible effects of science communication efforts. The user of the tool, guided by the results from simulations and visualisations of available data and theories, can then make a better-informed decision. The decision support systems should not be considered as a decision-*making* entity, but the intelligence and creativity is in the use of the tool by professionals (Pommeranz, 2012). This makes their practice more reflective and more accountable since they are deeper involved in the possibilities at stake.

Methodology & results

In the two cases described in this paper an agent-based model was developed based on survey data. We made use of structural equation model using Amos 16.0 software, in which the various measured variables and latent variables are put together in an assessed model based on confirmatory factor analysis. This results in assessed theoretical models which describe: a) consumer behaviour regarding acceptance of smart energy meters (Van der Sanden et al, 2013) (see fig. 1) b) the assessed interrelations between key performance indicators (KPI) of innovation management (Flipse et al, 2013) (see fig. 2).

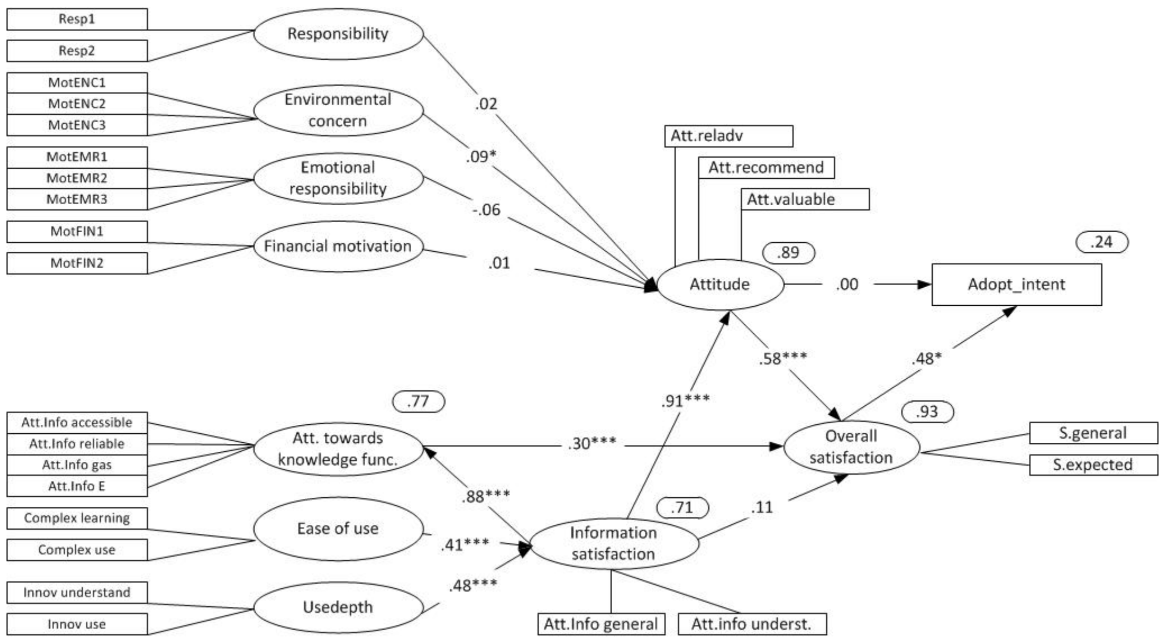

Figure 1

Moreover, the first is implemented in an agent-based model, which allows running experiments with various scenarios for a synthetic population. In this model, each household is modelled as an agent with their own characteristics (e.g. age, type of house) and personal opinion on the environment (e.g. concerns about climate change) as well as the use of smart energy technologies (e.g. ease of use or financial motivation). Each agent in the model forms an opinion on the satisfaction with a smart energy meter and decides whether or not they would like to purchase one. The decision making process is modelled according to the structural equation model calibrated with the survey data, using the set of coefficients for the various factors as weights in the decision tree (see fig.1). This means the simulation model takes the data from the survey as input and uses the behavioural model to predict the response of each individual. From that starting point it is possible to make changes to any variables and to observe how this impacts the individual's decisions or that of a group or the entire population.

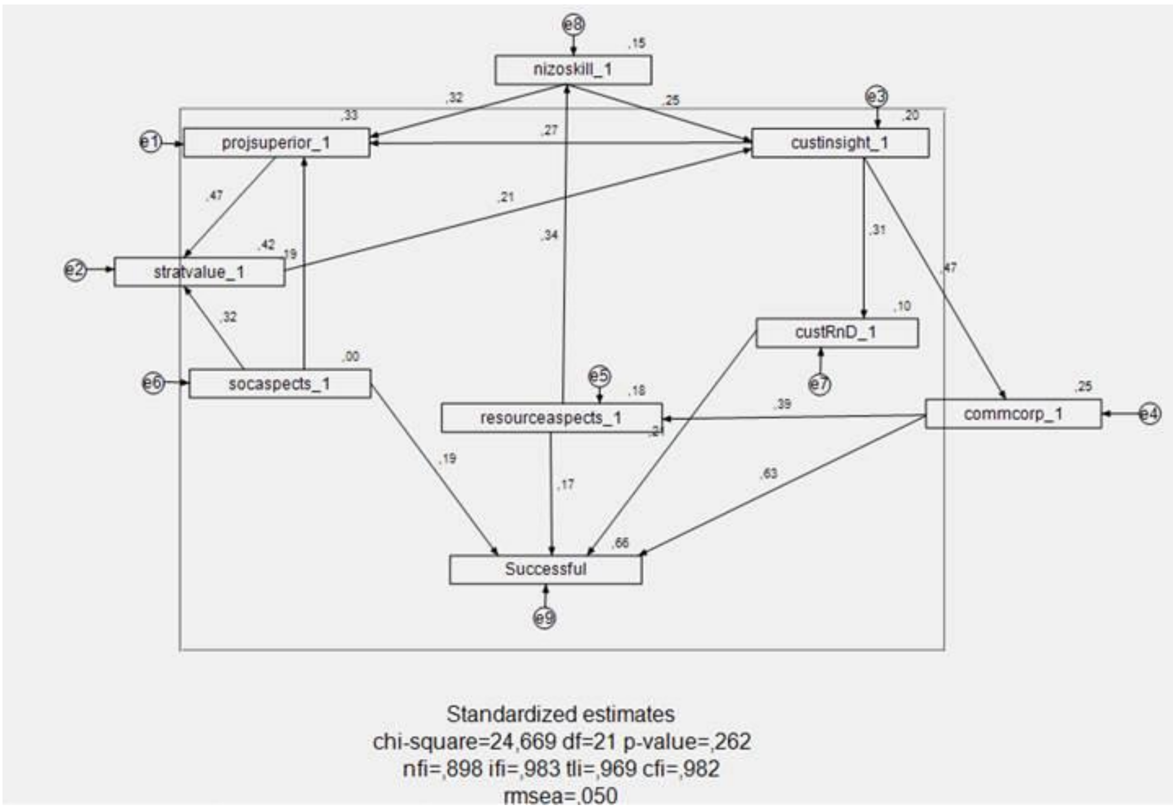

Figure 2

By setting up realistic scenarios together with the problem owner in this case an energy company, the model can assist in making decisions on, for example, a new advertisement campaign or the focus of a letter to the consumers. By trying out what might happen in a simulated environment the user can also evaluate his or her own experience and expectations. The results of the simulation can then help shape the decisions about smart meter introduction or lead to additional questions needing to be asked in order to gain a more profound idea the consumer population. This simulation module could be part of a support decision tool in which also communication policy and strategy are taken into account. The first results indicate (Van der Sanden et al, 2013) that marketers test and reflect on their marketing scenarios and possible interventions and develop various scenarios based on these simulated outcomes. Future research should be carried out on validating the simulations and on developing more complex, and therefore more realistic scenarios and according simulations.

Concerning the innovation management tool, the same route of reasoning has been followed. The difficulties in innovation management originate from the numerous KPIs that influence innovation processes quality. Upfront it cannot be assumed that improving performance on one KPI automatically increases quality of other KPIs or even the innovation process as a whole. As such, a model was developed that links the various KPIs together in a model that can be used by Research and Development (R&D) professionals in collaboration with an external consultant (such as a SC professional) to make better-informed R&D related decisions. This model was developed in particular for a contract research organization, i.e. not for all innovative organisations in general. E.g. the model shows that there are different levels on which innovation practice can possibly improved (customer, project content and project context) which all link together.

The model can be used to compare running projects against. Such comparison can help estimate the quality of currently running projects in relation to successful and less successful projects that were used to build the model. The comparison could e.g. indicate that in a certain project, most effort would be required in increasing the strategic value to the customer, while available resources are very satisfactory. Based on the outcomes, professionals can better determine how to e.g. best spend their time and effort; in this example possibly to focus on increasing customer contact rather than buying new equipment.

Conclusion & discussion

The reflective properties of these support systems aid the SC-professional in making decision on complex processes as the roll out of smart metering and innovation management in which communication and collaboration plays an important role. Both systems visualize possible choices and evoke reflection of the SC-practitioner of discussion amongst SC-practitioners despite the early stage of development of these support systems.

Therefore developments like these in the SC-domain might be seen as practices for professional development in which SC-research and daily SC-practice closely cooperate. A practice in which the various roles of SC-professionals, the various SC-processes and the according data gathering and complex evaluations are tooled in order to function as platform or 'SC-laboratory' in which the numerous wicked ill-defined challenges for science communication becomes tangible and therefore much more discussable.

This technological platform together with the processes of reflection, discussion and learning might be seen as process of social learning as Wenger (2000) describes. He writes that the success of organizations depends on their ability to design themselves as social learning systems and also to participate in broader learning systems such as industry, a region, or a consortium. To manage these system of social interaction as a social systems means: 1) giving primacy to the kinds of informal learning processes characteristics of communities of practice, and designing organizational structures and processes that are in the service of the informal; 2) placing a lot of emphasis on the meaningfulness of participation in the organization, on the possibility of building interesting identities, and on community membership as the primary relationship to the organization; 3) organizing for complexity, working to link the various communities that constitute the learning systems in which the organization operates; offering channels, shared discourses, processes, and technology platforms. From the latter, the technological platform, we described the early start.

References

Ariely, Dan (2010), Predictably irrational.The hidden force that shape our decisions, US, Harper Business & Economics.

Cook, M., Noyes, J. and Masakowski, Y. (2007), Decision making in complex environments, Burlington, Ashgate Publishing Company.

Hollnagel, E. (2007), "Decisions about "what" and decisions about "how", in Cook, M., Noyes, J. and Masakowski, Y. (2007), Decision making in complex environments, Burlington, Ashgate Publishing Company, pp. 4-12.

Flipse, S.M., Sanden, M.C.A. Van Der, Velden, T. Van Der, Fortuin, F.T.J.M., Omta, S.W.F. and Osseweijer, P. (2013), “Identifying key performance indicators in food technology contract R&D”, Journal of Engineering and Technology Management, 30, pp.72-94.

Jager, W., and Janssen (2012), “An updated conceptual framework for integrated modeling of human decision making: the consumant II”, Paper for workshop complexity in the real world, ECCS 2012, Brussels, 5-6 September 2012.

Jones, B.D. (1999), “Bounden rationality”, Annual Review of Political Science, 2, pp.297 321.

Kahneman, D. (2003), “Maps of bounded rationality: psychology for behavioral economics”, TheAmerican Economic Review, 93(5), pp. 1449-1475.

Meyer, M. (2010), “The rise of the knowledge broker”, Science Communication, 2010 (32), pp. 118-127.

Mulder, H.A.J., Longnecker, N. and Davis, L.S. (2008), “The state of science communication programs at universities around the world”, Science Communication, 3092), pp.277-287.

Pommeranz, A. (2012), Designing human-centered systems for reflective decision Making, PhD Thesis, Delft University of Technology.

Sanden, M.C.A. Van Der & Osseweijer, P. (2011), “Effectively embedding science communication in academia: a second paradigm shift?”, In Successful science communication: telling like it is, Bennett, D.J & Jennings, R.C. (Eds.). New York: Cambridge University Press, pp.423-442.

Sanden, M.C.A., Van Der, Koen H. Dam Van., Stragier, J. & Kobus, C.B.A.(2013), "Simulation based decision support for strategic communication and marketing management concerning the consumer introduction of smart energy systems", Journal for Communication Studies, 6, 1(11), pp.75-104

Schoemaker, P.J.H. (1995), "Scenario planning: a tool for strategic thinking", Sloan Management Review, Winter 1995, pp. 25-40.

Verouden, N., Sanden, M.C.A. Van Der and Aarts, N. (2013), "Silences as strategic communication in multi-disciplinary collaborations within the university and beyond", Proceedings 'Silence in the history and communication of science', Imperial College, London, December 2013.

Walker, .E., Harremoes, P., Rotmans, J., Sluijs, J.P. Van Der, Asselt, M.B.A. Van, Janssen, P., and Krayer Von Kraus, M.P. (2003), "Defining uncertainty. A conceptual basis for uncertainty management in model-based decision support", Integrated Assessment, 4(1), pp.5-17

Wehrmann, C. & Henze, I. (2014) "You cannot start too early, integrated professionalization activities of science education and science communication Novices", Journal of Research in Science Teaching (submitted)

Wenger, E. (2000), "Communities of practice and social learning systems", Organization, 7(2), pp.225-246.