Using a Domain-specific Modeling Language for Analyzing Harmonizing and Interfering Public and Private Sector Goals

A Scenario in the Context of Open Data for Weather Forecasting

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Keywords: DSML, e-Government, GoalML, Goal Modeling, Open Data.

Abstract: The opening of data by public organizations can result in innovations and new business models in the private sector. Yet, the public and private sectors may have different and sometimes interfering objectives. In this paper, we analyze the goals of an open data business model for weather forecasting using the multi-perspective goal modelling language GoalML. The public and private sectors partly share similar goals, but creating public value was found to be interfering (to some extent) with the private sector objective of making profit. One of the values of GoalML is that it clearly shows harmonizing and interfering goals. The interfering goals are one of the explanations for a slow adoption of open data. Mechanisms need to be developed to deal with them.

1 INTRODUCTION

In the past ten years, the opening of public sector data, or 'open data' for short, has gained increasing attention. Open data can be defined as: "non-privacy-restricted and non-confidential data which is produced with public money and is made available without any restrictions on its usage or distribution" (Janssen et al., 2012, p. 258). Data excluded from this definition concern private, confidential, and classified data. Open data can be provided by both public or private organizations, as such, in contrast to the previous definition it is not necessary to be collected or produced with public money (O'Riain et al., 2012). There are at least four motivating statements to make use of open data. First, it provides greater return on public investments. Second, policy-makers are provided with data needed to address complex problems (Arzberger et al., 2004). Third, it is possible to tap into the intelligence of the crowd by enabling citizens to participate in analyzing large quantities of data sets (Surowiecki, 2004). Fourth, organizations can improve their accountability and transparency (Janssen et al., 2012; Zhang et al., 2005). The growth of open data does not merely come with benefits, as it is also known that organizations have to deal with adoption barriers in order to make data openly available and to let it be used successfully (Janssen et al., 2012). Governments release their data to propagate their public values, that form the basis of the democratic system (Moore, 1995). There seems to be no common definition of public values (Cordella and Bonina, 2012). However, they cannot be merely embraced by special interest groups, as public values should be part of society as a whole (Jørgensen and Bozeman, 2007). In other words: "the public sector is there for everybody, it is not the extended arm of a particular class or group" (Jørgensen and Bozeman, 2007, p. 361). The propagation of public values by public organizations can be directly associated with the achievement of goals that these organizations need to fulfill in order to pursue public values.

One of the problems concerns the situation where goals of private organizations that make use of public sector data might differ in part from goals that public organizations have in relation to that identical public sector dataset. More precisely, one of the complexities in open data is the involvement of organizations having different goals than the organization that is the provider of the data. In this paper, both public and private sector goals related to the opening and usage of data are analyzed to understand to what extent they are similar, harmonizing, different, or even interfering with each other. It

Overbeek S. and Janssen M..
Using a Domain-specific Modeling Language for Analyzing Harmonizing and Interfering Public and Private Sector Goals - A Scenario in the Context of Open Data for Weather Forecasting.
DOI: 10.5220/0005237505310538
In *Proceedings of the 3rd International Conference on Model-Driven Engineering and Software Development* (MODELSWARD-2015), pages 531-538
ISBN: 978-989-758-083-3

can be seen that whereas the public sector is focused on creating public values, the private sector is profit-oriented. They will be less concerned with, for example, ensuring social security or increasing citizen empowerment, although they need to comply with governmental regulations. The goal analysis will be conducted in the context of a 'Weather Radar' scenario, which is inspired by a weather forecasting service operated by a Dutch private organization called 'Buienradar' (www.buienradar.nl), which makes use of open data to provide real-time weather information for their clients. Competitors of 'Buienradar' include Druppel (www.druppel.nu), Shower Alarm ('Buienalarm' in Dutch, see: www.buienalarm.nl), and Drash (dra.sh). The weather data is collected by a semi-public meteorological organization funded by public money. In case of Buienradar, data is collected from the Royal Netherlands Meteorological Institute, of which the abbreviation of the Dutch translation is 'KNMI' (www.knmi.nl). These (semi-)public and private organizations have goals related to the opening and use of open data and, therefore, provide a proper context on which our scenario is inspired.

The multi-perspective Goal Modelling Language (GoalML) (Overbeek et al., 2015) is used to design goal models for the Weather Radar case from the point of view of the involved organizations. It is shown that these goal models enable to perform different kinds of analyses, which includes but is not limited to: determination of how goals are ordered in a goal hierarchy, which goals are similar and harmonizing, or which goals are different and even interfering. There are three main reasons why GoalML has been selected for the design of the goal models. First, GoalML models are an integral part of enterprise models, which provide relevant contexts, such as: Descriptions of resources, business process models or models of the IT infrastructure (Overbeek et al., 2015; Frank, 2014). Second, while it is possible to model goals with a general purpose modelling language (GPML) like the Unified Modelling Language (UML) or the Entity-Relationship Modelling (ERM) language, the GoalML is actually a domain-specific modelling language (DSML). This is for three reasons: Using a GPML requires a modeler to reconstruct relevant concepts such as various kinds of goals from scratch, which compromises modelling productivity. Furthermore, a DSML includes specific constraints that prevent modelers to a certain degree from creating erroneous models. Finally, a DSML enables the use of a specific visual notation or, in other words, a concrete syntax, which fosters comprehensibility.

The structure of this paper is as follows. Section 2 describes the background of the scenario that is used as a basis for the creation of goal models related to the opening and using of weather data. The goal models are presented in section 3 and, subsequently, discussed in section 4. The paper ends with conclusions and future research in section 5.

2 A SCENARIO FOR OPENING AND USING WEATHER DATA

The motivation to stimulate organizations in opening their data is embodied in the European Union (EU) Public Sector Information (PSI) directive, which was released in 2003 (EU, 2003). This directive is based on two ideas. First, public sector data should be made available for third parties at low prices and unrestrictive conditions, and, second, this would ensure a 'level playing field' among organizations, which means that equal opportunities are provided for organizations. One of the objectives of the publication of open data is to facilitate the innovative use of these data by companies (Dawes, 2010; O'Riain et al., 2012; Neuroni et al., 2013). The European Commissioner believes that open data boosts the European economy by €40 billion per year (EC, 2010). These prospects of the publication of open data leading to possible usage by third parties directly relate to the development that organizations increasingly use social media to facilitate interactions between themselves and their clients (Chun et al., 2012). Social media are considered to be "a group of Internet-based applications [...] that allow [for] the creation and exchange of user-generated content" (Kaplan and Haenlein, 2010, p. 61). The Weather Radar weather forecasting service uses open data collected with public money and after enriching the data it is provided to the users. They employ two channels to interact with their users, which includes a Web site and an application, or *app* for short, which can be downloaded and installed on mobile devices.

The combination of open data and social media has led to the introduction of so-called *infomediary business models*, which "can be initiated by [...] public or private [organizations] and are aimed at supporting the coordination between open data providers and users" (Janssen and Zuiderwijk, 2014, p. 2). A business model in general contains the rationale and the elements required to accomplish certain organizational objectives (Keen and Qureshi, 2006). The revenue models of the Web site and the app are slightly different, as the Web site primarily depends on advertisements, whereas the app provides advertisements and options to buy additional content within the app itself. For example, this includes the options to buy 3

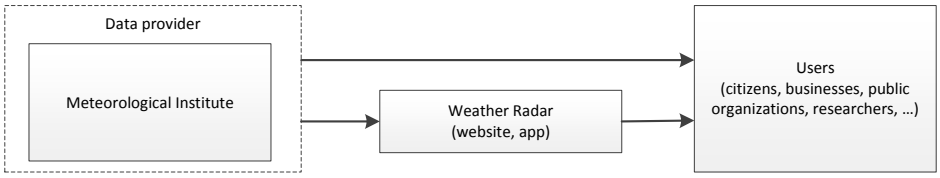

Figure 1: Open data network for the Weather Radar scenario.

hours or 24 hours rain forecasts, information about thunder, hail and sun power. The app is based on a so-called 'single-purpose app' infomediary business model (Janssen and Zuiderwijk, 2014). "Single-purpose apps provide real-time services such as information about weather, quality of restrooms, vehicles, houses, and pollution. These apps often provide a single function, based on one type of provided open data. The app processes the data and presents it visually for the ease of the users" (Janssen and Zuiderwijk, 2014, p. 11). The 'open data network' for this scenario is shown in figure 1. The data is primarily based on information collected by a meteorological institute, which is the semi-public open data provider. The private organization offering the weather forecasting service extrapolates the data to make predictions and visualizes the data on a geographical map. For users, this is complicated to realize by themselves and as such there are hardly any users who use this raw open data correctly (Janssen and Zuiderwijk, 2014). The line at the top of figure 1 indicates that it is, however, possible to use raw open data directly without relying on an infomediary as a liaison party.

3 GOALS FOR OPENING AND USING DATA IN THE SCENARIO

Figure 2 presents the goal model of a meteorological institute being the semi-public sector data provider. This goal model includes the goals that this institute wants to achieve by opening up their weather data to be used by third party organizations such as infomediary organizations providing a weather forecasting service. Figure 3 shows the goal model of an infomediary that uses open weather data to deliver a weather forecasting service to possible users. The goal models have been designed by using GoalML. The diagrams include both so-called engagement goals and symbolic goals (Overbeek et al., 2015). An *engagement goal* is a goal of which the desired result is quantifiable, for example, the goal 'increase citizen services' shown in figure 2 is an engagement goal, as it is quantifiable whether the number of new services have indeed increased. Motivations and the performance of employees responsible for goal achievement can also be made more explicit by means of such engagement goals. An engagement goal is visualized as a target. A *symbolic goal* is a goal of which the desired result is not directly quantifiable and includes a qualitative aspect and is visualized as a lighthouse. An example of a symbolic goal found in figure 2 is 'increase citizen satisfaction', as the increase of citizen satisfaction is not directly quantifiable. A symbolic goal 'increase trust' is shown on top of figure 2. The star symbol with the number one inside the star shows that this specific goal has the highest priority.

The circles shown on the top right of each of the goals depict specific goal matter, further specifying the goal content. A yellow hexagon with a plus symbol in it is part of the goal matter of the mentioned symbolic goal. This shows that something needs to increase upon achievement of the goal, in this case the trust of the semi-public agency. In contrast to the hexagon with a plus symbol, a hexagon with a minus symbol indicates that something needs to decrease. The symbol of an eye looking at a diamond as part of the goal matter of the symbolic goal shows that the goal content is qualitative in nature. When further interpreting the diagrams shown in figures 2 and 3, it can be determined that two other symbols can be part of the goal matter, which are the indicator symbol and the 'object' symbol. For example, the goal matter of the 'increase added value' goal shown in figure 3 contains an indicator symbol, expressing that the goal content is quantitative in nature. The 'object' symbol is illustrated by means of a combination of a circle, a triangle, and a rectangle. This symbol is used to indicate that an explicit 'object' is part of the goal content. For example, the 'object' symbol in the goal matter of the 'keep existing users' goal as part of figure 3 indicates that a 'user' is a specific object to take into account as part of the goal content. Next to the two different kinds of goals and the goal content, there are three kinds of relationships that can be found in both diagrams: A causal relationship, a meansend relationship, and a mathematical relationship. The causal relationships are indicated by means of domino pieces, together with an arrow that points in the upward direction indicating a positive causal relationship. For example, the goal 'increase citizen satisfaction' found in figure 2 has a positive causal

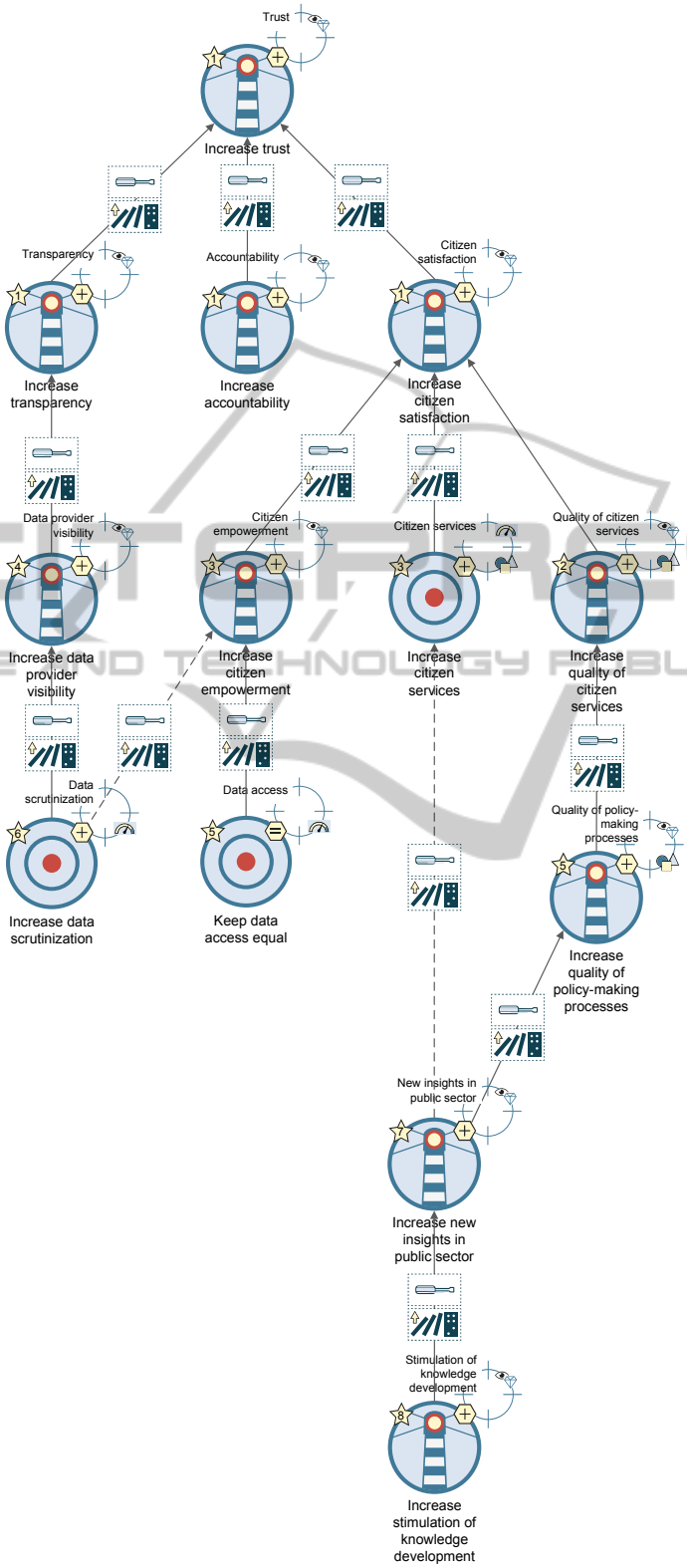

Figure 2: Goal model of a semi-public meteorological institute for opening weather data.

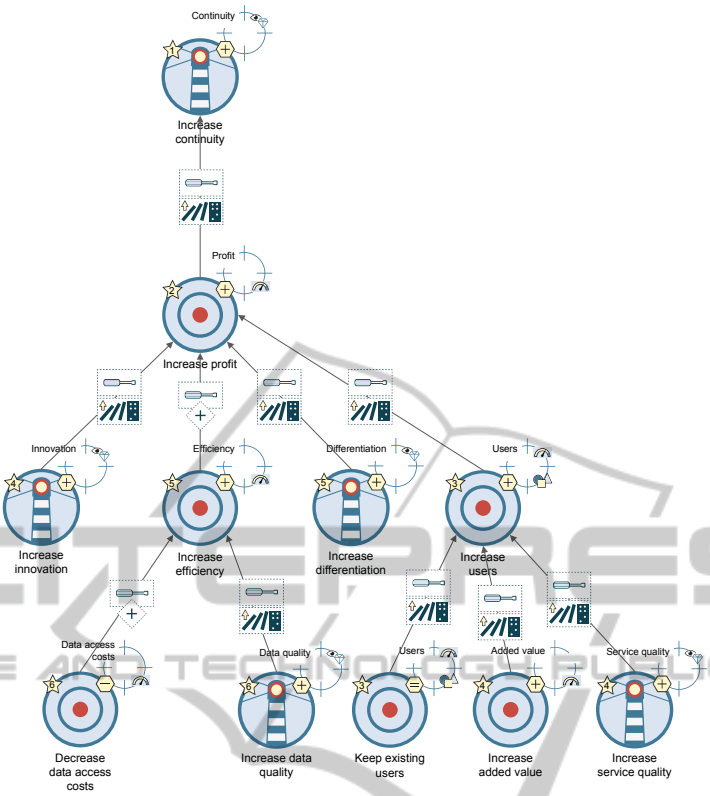

Figure 3: Goal model of an infomediary organization that uses open weather data.

effect on the 'increase trust goal'. The meansend relationships are combined with the causal (and other) relationships shown in the diagrams. For example, the goals 'keep existing users', 'increase added value', and 'increase service quality' shown in figure 3 are a means to support in reaching another final goal, which is the 'increase users' goal in this case. Finally, the positive mathematical relationship between, for example, the goals 'increase efficiency' and 'increase profit' indicates that increasing the efficiency has a positive mathematical effect on the actual profit that is made by the infomediary.

4 DISCUSSION

When comparing both diagrams, there are differences and interferences that can be identified. Fortunately, there are also similarities and harmonious circumstances that can be identified. First, identified differences and interferences will be described. Second, the similarities and harmonious circumstances are discussed. Obviously, it can be seen that the goal model of the semi-public agency for opening weather data contains more goals and the goal hierarchy itself is deeper. Consequently, for a semi-public agency like a meteorological institute the structure of lower-level goals that need to be achieved as a result of opening up weather data is more complex and it seems more demanding to achieve the topmost goal in the hierarchy. This has to do with the fragmented government structure in which different organizations have different priorities (Kraaijenbrink, 2002). For example, the Dutch Ministry of Economics focuses on value creation and innovation by businesses. The Dutch Ministry of Interior has prioritized goals related to transparency, reputation, and improved democracy (Plasterk, 2014). For the meteorological institute as part of the scenario as discussed in section 2, trust, accountability, and citizen satisfaction are high on the agenda as well. This means that the opening of data requires prioritizing goals and making trade-offs. When interpreting the goals that have the highest priorities, there seem to be big differences between the open data provider and the infomediary. The top priorities for the data provider have to do with increasing trust, transparency, accountability, and citizen satisfaction by opening data, while the top priority for the infomediary is to increase its continuity by using open data. For the meteorological institute being the data provider, an increase in trust can be achieved after achieving an increase in transparency, accountability,

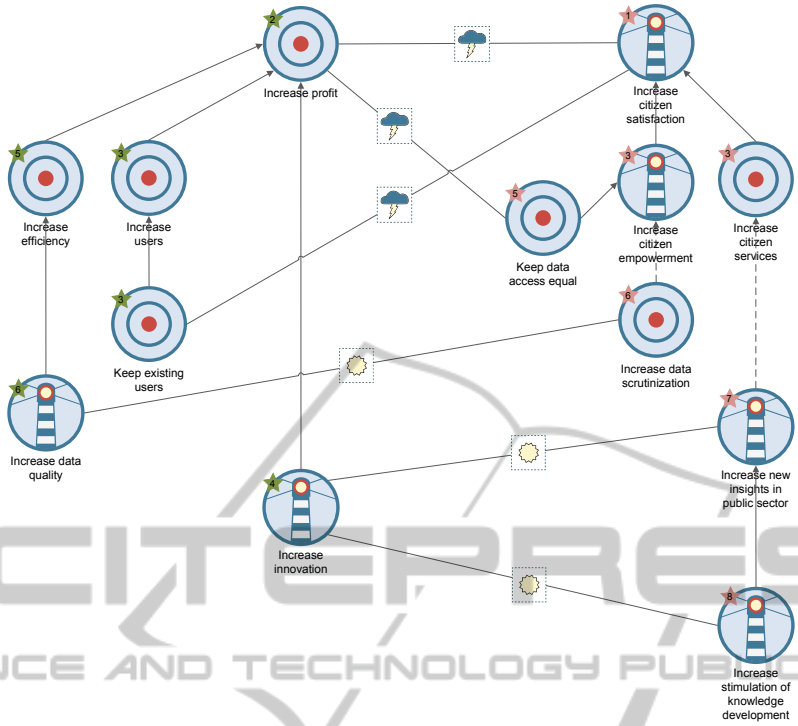

Figure 4: Harmonizing and interfering goals related to open weather data.

and citizen satisfaction. When interpreting this goal, however, it is assumed that an 'increase in trust' can be interpreted differently by those who are responsible to achieve this goal. People can come up with different interpretations in case they want to determine when a government agency can be 'trusted'. The term trust is somehow related to terms like hope, confidence, belief, and commitment and deals with actively anticipating and facing an unknown future (Sztompka, 1999, p. 25). When acting in uncertain and uncontrollable conditions, people take risks and make bets about the future. As such, this key goal of the open data provider might be understood in many different ways, which makes the achievement of this goal seemingly more complex than achieving the key goal(s) of the infomediary.

For the infomediary, the achievement of an increase in continuity directly relates to the achievement of an increase in profit. The goal of increasing their profit is reflected in their business model, as advertisements and options to buy content within the mobile app are provided. The goal to increase profit that is related to the private value to increase profit might interfere with the public value to increase citizen satisfaction. Analogous to how software is developed under the GNU General Public License (see: www.gnu.org/licenses/gpl-3.0.en.html), a government agency that offers open data wants end users to use, share, and extrapolate this data for free. Users can get bothered by advertisements while using the weather forecasting service and they might not want to be bothered with additional content that must be bought to get access to more advanced features or additional data. Especially when the mobile app allows users to pay for features that allow access to additional data, there is interference between the 'increase profit goal' of the infomediary and the goal 'keep data access equal' of the semi-public data provider. As can be seen in figure 2, when this goal cannot be achieved, the possibility to achieve the related goals that are higher in the hierarchy, such as 'increase citizen empowerment' and 'increase citizen satisfaction' is threatened as well. Another side-effect of providing the users the possibility to pay additional content within the app is that users might become disappointed after realizing they have to pay for additional features or content after having downloaded an app that was downloadable at zero costs. This also threatens the goal of the semi-public data provider to increase citizen satisfaction. Although there are differences and interferences to be found when comparing the key goals of both models, an increase in the trust level of the data provider presumably contributes to achievement of the 'increase continuity' goal of the infomediary. It is assumed that the continuity of an infomediary is easier to protect in case

the used open data originates from a trustworthy data provider. However, differentiating from other competitors in the market and asking citizens to pay commercial rates in order to reach some higher-order goal will never fit with public sector goals, as these kind of goals are not concerned with commercial interests. Another harmonizing aspect found in the two goal models is related to the users of the weather forecasting service. Achieving the goal 'increase citizen satisfaction' found in the goal model of the meteorological institute will probably have a positive effect on the goal 'keep existing users'. The assumption underlying this statement is that once the satisfaction of citizens that are also existing users of the weather forecasting service increases, the probability they will keep using this service increases as well.

The goals 'increase data scrutinization' as part of the goal model of the meteorological institute and 'increase data quality' as part of the infomediary goal model are also considered to be in harmony with each other. If the meteorological institute increases the possibilities to scrutinize its open data, this might lead to a further improvement of the data quality. The goal 'decrease data costs' is considered to be in harmony with the goal 'keep data access equal'. The goals 'increase stimulation of knowledge development' and 'increase new insights in public sector' are in harmony with the goal 'increase innovation'. The infomediary might benefit from an increase in new insights in the public sector which can lead to an increase in innovation for the infomediary and, vice versa, the open data provider might benefit from innovation in the private sector to gain new insights that are relevant for them. Figure 4 shows the resulting goal model in which it has been visualized which goals are in harmony with each other and which goals are interfering with each other. Goals that have relationships with a symbol of a sun attached to it show that these goals are in harmony with each other. The symbol with a dark cloud and a lightning flash indicates that goals are interfering. The priority symbols of those goals that belong to the open data provider have been colored green, while the priority symbols attached to the goals belonging to the infomediary have a red color. Note that although there are goals shown in figure 4 that are harmonizing or interfering, this does not imply that this situation should be identical for other open (weather) data scenarios. Whether goals are in harmony or interfering also depends on which measurements are taken to achieve goals. For example, there might be ways to increase profit without interfering with the goal 'increase citizen satisfaction', or, the other way around, there might also be new insights created in the public sector that might not boost innovation in the private sector.

5 CONCLUSIONS AND FUTURE RESEARCH

In the past decade, the opening of public sector data steadily but slowly grew in popularity. One of the complexities in open data concerned the difference in goals of those organizations involved in the opening and usage of the data. In this paper, a scenario has been presented that involved a semi-public meteorological institute, which released weather data for the public. The scenario also included an infomediary, a private organization that used and extrapolated this open weather data in order to offer an advanced weather forecasting service to its users. Both public and private sector goals related to the usage of open data have been analyzed to understand to what extent goals related to open data in the public and private sectors are similar, harmonizing, different, or even interfering with each other. GoalML is a DSML that is suitable for modelling goals in the public and private sectors and can be used to support organizations with developing, using, and maintaining goal models. The priorities that public organizations assign to their goals might be different per organization and is dependent of their overall role within the public administration. Already within the public administration goals are diverse and might be interfering. Furthermore, the analysis shows clearly the conflict of interest between the private and the public sector. In particular, it is shown that the private sector goal to increase profit might interfere with the public sector goal to increase citizen satisfaction and the goal 'keep data access equal'. The interfering goals might be one of the reasons why the realization of open data by public organizations can be problematic. Due to requirements on open data usage, private organizations might think that that sometimes interfering goals result in choices that might not favor their interest. However, it are not merely the public and private sector goals related to open data that result in interferences, but the implementation of measurements to achieve these goals influences relationships between public and private sector goals as well. It might be that mechanisms can be developed that are acceptable for both the public and private sectors. As such, we recommend public and private sectors to start discussing the release and use of open data and come up with mechanisms that can satisfy the requirements of both sectors. This recommendation is also inherent to future research. GoalML offers stakeholders of open data in the public and private sectors the pos-

sibility to act as an instrument in further analyzing and discussing models and scenarios to satisfy intra-sectorial requirements. An important task to perform in this context is to make GoalML even more suitable for use in different contexts such as goal analysis of 'open data networks', as GoalML is rich in detail which makes it suitable for advanced users but less suitable for more novice users at first. Another part of future research deals with the question how goal models can be integrated into software with the intention to provide different forms of computer-based support for, e.g., strategy formulation, goal achievement, and enterprise management in general. A possible form of computer-based support is to use the information presented in goal models for deductive purposes. For example, information from goal models provide a foundation for the generation of rules that need to be adhered to when conducting tasks or processes that are related to a goal. By adhering to these rules, it is possible to steer in a direction that would lead to goal achievement. This part of future research also relates to creating models at runtime and self-adaptive systems, which implies that a system adapts its structure, functions, or processes to a (manually) modified goal system. A self-adaptive system might also modify the goal system itself to better cope with a changing environment.

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