A SERVICE-BASED FRAMEWORK FOR PERSONAL TIME MANAGEMENT IN SMART CITIES

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Abstract

Purpose- Within the Enterprise contexts, one of the most important aspects is the realization of intelligent services (inspired by the paradigm Service-Dominant Logic, SDL), which obey the wishes and constraints of final users. To achieve this aim in an efficient way, various efforts are considered, from technological, economical and modeling points of view. The aim of the paper is combining the SDL theory, the Personal Time Management (PTM) technique "Getting Things Done" (GTD) and the IBM Smarter Cities model to create a valuable co-operation among all the entities involved by using Information Technology (IT) tools, such as DSS.

Design/Methodology/Approach- In order to obtain high synergies in social, industrial and personal aspects, the authors propose a service-based framework for Personal/Business Time Management (PBTM), designed according to SDL. The framework foresees the activation, coordination and integration of more isolated services, involving either the Enterprise or its employees, hence creating a mechanism of co-creation of value in order to fulfil its goal. In particular, a such approach, beside services based on classical clustering/scheduling/optimization algorithms (e.g. CPM) and coming from business systems, integrates profiling services (hobbies, age, points of interest) due to personal or business devices, and services offered by Smart City (information on traffic, viability).

Findings- The artifacts of this work concern, from one side, the realization of a Smart Personal Agenda, based on the integration of existing clustering, scheduling and optimization algorithms and improved by collected information on user profiles. On the other, the definition of a scalable and reusable service-based framework, which integrate the proposed Personal Model-driven DSS in the IBM Smarter City technological model via Group DSS consisting of shared Personal DSS of individuals who belong to the same organization.

Research limitations/implications (if applicable)- This paper implies several limitations, which can be mainly synthetized in: analyzing massive volume of data (known as big data analysis) and privacy.

Practical implications (if applicable)- The paper implements a service-based virtuous circle that leads to more than a few practical implications for personal, organizational and city purposes. Some examples of the main achieved benefits are personal and organizational time optimization via Model-driven DSS or individual aggregated agendas data feeding Smarter City System or customized services provided by the City to entities that are part of it.

Originality/value- The DSS represents a starting point to realize intelligent prototypes, able to manage the personal agenda applying principles of GTD and optimizing transfers and free time, readapting conveniently some tasks if necessary. Moreover, it also represents a new extremely valuable source capable of feeding Smarter City System with anticipated data, in order to set a win-win cooperation among all the entities involved.

Keywords- SDL, clustering, Scheduling, Smart City, DSS.
Paper type- Research paper.

1. Introduction

The paper proposes a service-based framework for Personal Time Management (PTM) in Smart Cities, designed according to the principles of Service Dominant Logic (SDL) and its concept of service, see Cinquini et al. (2001), Spohrer et al. (2008a, 2008b, 2009, 2012), Vargo et al. (2004, 2006, 2008). Thus, it involves different interesting research areas. Among the most important ones, it deals with Decision Support Systems (DSS). For example, see Abbate et al. (2014) and De Maio et al. (2011), with emphasis on organizations in Gaeta A. et al. (2012) and Gaeta M. et al (2012). Power defines them (see DSSResources.com) as "interactive computer-based systems or sub-systems intended to help decision makers use communications technologies, data, documents, and/or models to identify and solve problems, complete decision process tasks, and make decisions…".

However, the aim is to contextualize them in a Smarter City, which is defined as a high-tech intensive and advanced city that connects people, information and city elements

using new technologies in order to create a sustainable, greener city, competitive and innovative commerce, and an increased life quality, as described in Bakıcı et al. (2012). Other examples are in Albino et al. (2014) and Barile et al. (2010). In particular, we refer to the IBM Smarter City approach, see Kehoe et al. (2011), since, unlike others, it is a DSS-based model and provides a formalized technological infrastructure suitable to make a city smarter, with consequent advantages for citizens, see also Garhammer (2002) for details. Indeed, IBM uses DSS to serve its Governance in long-term planning activities.

Nevertheless, in our framework we want to extend DSS to every city level, in order to obtain optimized agendas data coming from entities who belong to the city itself, like individuals and organizations. This is a key point, because so far, to the best of our knowledge, no one has thought of using personal and organizational agendas data as new Smarter Cities source of value. Instead, they are an extremely valuable source, since they provide homogeneous, already aggregated and easily treatable anticipated information, which let smarter cities organise themselves in advance. Moreover, sharing this information sets a virtuous circle of services exchanged among entities that are involved into the city itself.

Hence, the aim of this paper is presenting a service-based framework, which combines PTM techniques and the IBM Smarter Cities model, see Kehoe et al. (2011), in order to create a valuable co-operation among the entities involved through Information Technology (IT) tools, such as DSS. For further explanations about PTM, see also Allen (2001), Babauta (2010), Cirillo (1980), Claessens (2007) and Covey (1989). Consider also Fondahl (1962) for a possible methodology for PTM activities.

Furthermore, the framework is realized setting a win-win cooperation based on SDL principles. Indeed, using the proposed framework, on one hand Smarter Cities can take several advantages of available anticipated information delivered by shared agendas of citizens, like redacting detailed city plan and reliable demand forecasts. On the other hand, single user can receive back customized services provided by the city thanks to the information previously sent, such as dedicated public transports or guaranteed safety levels.

The remainder of this paper is organised as follows. The next section provides the first representation of our framework and analyses it from a SDL point of view. The paper then explores four main PTM methods, compares them, and presents our Personal Model-driven DSS used as PTM tool. This is followed by an exploration of the IBM Smarter City approach. Then, an architectural solution of our framework is provided. Finally, the paper focuses on the main limitations and ends with a summary of the principal findings, implications and suggestions for future research activities.

2. The Service-Based Framework for Personal Time Management in Smart City

In this paper, we present a service-based framework, which combines the IBM Smarter City approach with a Personal Model-driven DSS and provides benefits for all the entities

involved. To explain it, we start from the IBM Smart City vision (Fig. 3, page 12) and analyse it from its lowest level, see Kehoe et al. (2011).

The first layer we found is the City itself, which consists of people who work and live together in enterprises and communities, respectively, labelled as organizations. Thus, the first step through our framework is to decompose the IBM city layer into three levels: people, organizations and city. Such division is represented as a half pyramid, which still needs to be integrated into the IBM model because people, as well as organizations, are part of a city. In order to fill this gap, we propose Fig. 1 as the first representation of our framework.
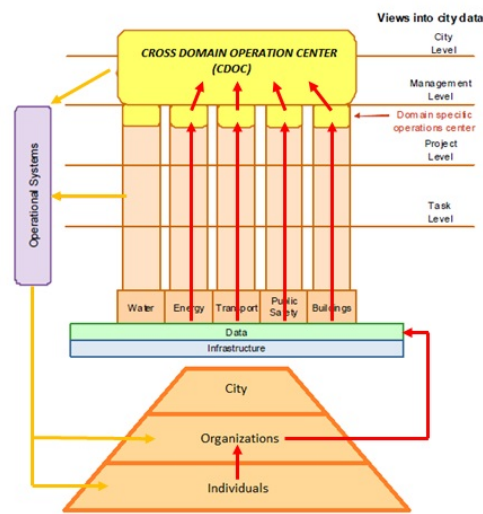

Fig. 1. The first view of our framework.

In contrast to what we see in the IBM model (Fig. 3, page 12), in Fig. 1 the pyramid below (which substitutes the IBM city layer) and city domains view above are not separated, but exchange services via data. Indeed, this scheme represents our idea in a good way, since it displays a virtuous circle of information that starts from individuals and, crossing the whole city, ends to services. Therefore, the circle starts from people that, using their Personal Model-driven DSS, optimize their own time (as explained in the paragraph below) and share their agenda with organizations to whom they belong. This is a usual habit of human-being, as remarked by the Greek philosopher Aristoteles through the sentence "Man is a social animal". Hence, each person takes part to the society (consisting of several organizations) and, on daily basis, has commitments and appointments, which also involve other people, who can belong to the same organization or to other ones. Thus, a Personal Time Management (PTM) tool cannot be seen as a stand-alone technology useful for only one person. In particular, as people are interconnected each other, their PTM tools have also to cooperate. Hence, our framework arises observing that the previously-cited Personal-DSS evolves in a Group-DSS, which serves a whole organization and is made up by sharing, within the organization, the

personal agendas of all the people who belong to the organization itself. This leads to several direct benefits for organizations, capable to schedule group meeting according to individual commitments. Moreover, people can immediately be aware of the scheduled meeting and so prepare themselves. Moreover, from Figure 1, we see that organizations send to city data layer all this collected information, which feeds each city domain in advance. In fact, agendas contain a great amount of data regarding next actions and calendar events that people are going to do in their next future. This is an important point because, by sharing this information, organizations provide a highly precious source of value that allows city to redact detailed plans, readapt itself, or make meticulous demand forecasts based on people calendars. Obviously, all these data involve more than one city domain. Indeed, from a holistic point of view, information generated by these shared data are transformed and then exchanged by city domains. Thus, the outcomes, like plans, obtained by each domain can be an added source of value for the others. Moreover, our framework is not based on a one way exchange. Indeed, information elaborated by city-wide operational processes comes back to the source (users) as services provided by the city.

By analysing the framework, benefits come out easily. From the city domains point of view, *Transportation* is the most directly supported pillar, because aggregated agendas data provide a huge amount of realistic and updated information regarding movements (from one place to another one) of thousands of people, with the aim of planning the whole city traffic system. Furthermore, it allows traffic officials to organise customized mobility services for citizens who have shared their information. For instance, if a group of thirty colleagues or neighbours is going to a football match together, the city can offer them a dedicated public mini-bus in order to reduce pollution and CO_2 emissions, avoid traffic congestion and increase the satisfaction of citizens. Yet, if a small group of people, starting from the same place, has to go to the same destination, the system can let them know it and offer a shared taxi or advise to take one car and share expenses. In addition, aggregated agendas data lead benefits to other city domains too, such as Public Safety, Buildings and Energy. As for the *Public Safety* pillar, shared personal agendas provide crucial information, which let the city plan its security forces in advance. For example, the city can combine agendas and external information in order to estimate in a precise way how many people are going to an event, then correctly plan security forces and, thus, guarantee the right safety level to the whole community. Another benefit generated by our framework involves the IBM *Buildings* pillar. In fact, after collecting all this personal aggregated information for a long time, the city can infer new information by using data mining techniques and tools provided by the IBM intelligent layer (e.g., a possible inferred outcome could foresee that schools or kindergartners and gyms are built in places that are near each other). Finally, *Energy* domains, see Loia et al. (2011), can take advantage of agendas data too. Indeed, they let city redact detailed energy demand forecasts, by knowing what people are going to do at a specific time and, so, how much energy they will approximatively consume. Benefits provided via services do not end up in city domains, but come back to individuals and organizations. Each city domain, taking advantage of information, also provides customized services back to the source of

value. In order to explain better this point, we present some examples that highlight users' benefits generated by sharing information with the city and thus added to the direct advantages of using Personal or Group DSS, closely seen as a stand-alone technology. Due to the data provided, all kind of users can have a customized city, which perfectly serves their wishes, by giving them what they need when they need it. For instance, as we said before, city can offer dedicated mini-bus or shared taxis to groups of people, letting them save their time and money. Moreover, city can plan the whole transportation systems and guarantee safety to a company that is going to organise an important conference that involves thousands of people coming from all around the world. Another benefit to consider is that people can be aware of the safety level guaranteed by the city at a specific event and feel safer. These are only some examples of the overwhelming advantages that each entity gains by taking part to the proposed service-based framework.

2.1. *An interpretation in terms of SDL*

Finally, to give a complete overview of the framework, it has to be interpreted from a Service Dominant Logic (SDL) point of view, because of its perfect match with this theory. In order to elucidate this bond in an opportune way, it is necessary to provide the SDL definition of service.

Service is the application of specialised operant resources (knowledge and skills) for the benefit of another entity or the entity itself. The emphasis is thus on the process of doing something for and with another entity in order to co-create value. Service thus represents the common denominator of all exchange processes, and goods become mere vehicles for the application of service provision; *service is what is always exchanged*, see Vargo et al. (2004, 2006, 2008). According to our framework, entities, mentioned in SDL service definition, are individuals, organizations and the whole Smarter City, which co-create value exchanging services each other and thus realizing the virtuous circle, previously explained. Moreover, it is possible to affirm that, inside this circle, all the involved entities are both providers and customers of each other at the same time. Therefore, analysing this aspect via the ISPAR (Interact-Service-Propose-Agree-Realize) model, see Spohrer et al. (2008b), this co-operation creates value for all the entities and thus set a win-win collaboration. In addition, the proposed framework meets the SDL principles. To prove it, we explain why the following main SDL principles are respected. For first instance, according SDL theory as well as our framework approach, *services are the fundamental basis of exchange* in the interactions among the entities; meanwhile, goods, such as DSS, are simply vehicles for service provision. Moreover, in our framework the *customer is always a co-creator of value*, since value can be created only if entities cooperate each other; else, the whole framework does not work. Finally, another important respected SDL principle is that the *provider of each service* cannot deliver value, but *can only offer value propositions of 'potential' value*. Indeed, in our framework, each offered service can express its own value only if its customer gives it value by taking advantage of it; otherwise, the proposal will remain unused and so

valueless. In conclusion, in the framework as well as to SDL, the cooperation is the only way for entities to have benefits, which can be often objectively estimated too.

3. Personal Time Management

Personal Time Management (PTM) is the process of planning and exercising conscious control over the amount of time spent on specific activities, especially to increase effectiveness, efficiency or productivity. It may be aided by skills, tools, and techniques used to manage time when accomplishing specific tasks, projects, and goals complying with a due date. It is an extremely interesting research area, as it leads to personal and organizational advantages. They mainly help people to manage their time in an effective way, gain more free time and reduce their stress levels. Moreover, as explained in organizational literature, time management techniques applied within organizations can lead to a lot of management and organizational improvements, in term of productivity and quality of life of modern people, who are facing the increased pace of life, see Garhammer (2002).

Thus, this section is organized as follows. The next paragraph presents four main PTM methods, and compare them, in order to identify the most qualified technique, which will be used in the proposed framework. Then, in a separated paragraph, we propose a Personal Model-Driven DSS used as PTM tool, which will be implemented in our framework, as previously said.

3.1. *PTM techniques*

During the last three decades, there has been a growing recognition of the importance of time and its management in the daily life. In fact, in literature as well as in blogs or websites, it is possible to find different PTM techniques. To elucidate the current state-of-the-art, we have briefly analysed and compared four of them.

The first analysed PTM approach is The *Pomodoro Technique*, developed in Cirillo (1980). This method uses a timer to break down work into intervals traditionally 25 minutes in length, separated by 5 minutes breaks. These intervals are known as "pomodori", the Italian word for "tomatoes". The method is based on the idea that frequent breaks can improve mental agility. Indeed, after four pomodori, the user has to take a longer break (15–30 minutes).

The second PTM method is the *Seven Habits of Highly Effective People* in Covey (1989). In it, Covey presents an approach to being effective in attaining goals by respecting seven rules. However, these habits just support a long-term view, without giving any practical advices to manage personal time in a better way.

The third method is *Getting Things Done* (also referred as GTD), see Allen (2001). The GTD method relies on the idea of moving planned tasks and projects out of the mind by recording them externally and then breaking them into actionable work items, following a well-defined algorithm.

The fourth and last analysed technique is *Zen To Done* (also referred as ZTD) in Babauta (2010). He studied the three techniques previously presented and mashed them

up to create the ZTD method. According to the technique by Covey, ZTD consists of ten habits, which must be applied to be more organised and, so, productive.

Such brief review allows us to highlight strengths and weaknesses of each models, taking into account their potential adoption in an organizational environment, in order to integrate it into the framework. Thus, we need to find out the PTM technique, which can be supported by tools, classifiable as Groupware and made to provide a shared agenda among people who belong to the same organization. Clarified this key aspect, it is possible to carry on a critical comparison among the techniques and find out which one is the most qualified for our scope and involving both organizational and personal levels.

The four analysed PTM techniques are considerably different from each other. On one hand, there is the *Pomodoro Technique*, which is extremely simple and requires low-tech tools too. In addition, it focuses on daily and individual work. Therefore, this technique does not consider long-term goals and is not supported by Groupware that can promote cooperation among people. On the other hand, there is the method by Convey, which aims to change human behaviours in both personal and work life. Thus, it is surely characterized by a long-term view, but it is extremely difficult to realize, since Convey does not advise any practical tools or means to use. In this context, instead, GTD method seems to match our purpose. In fact, it gives importance to short-term tasks and long-term goals and is also supported by a lot of software tools, which are really useful to take advantages of this technique in personal and organizational environments.

Finally, there is ZTD model, which combines several techniques, mushing up their best features. However, it is still hard to apply because Babauta, like Covey, aims to change human habits; and achieving this goal needs a huge amount of time spent on internalizing some habits. To sum up our comparison, we have the scheme in Table I, which compares the four techniques via these five criteria:

a)   Usability and availability of the tools required by the specific PTM method.

b)   Rapidity of learning and introducing its use in daily life.

c)   Practicality of tools provided by the specific PTM method or implemented to support it.

d)   Adaptability to organizational needs.

e)   Possibility to have a long-term view.

The a_{ij} element of this matrix can assume one of the following symbols: "✓" if technique i fully complies criteria j; "–" if technique i barely complies criteria j; "X" if technique i does not comply criteria j.

Table I. Comparison among the four analyzed techniques.

Methods	Usability	Rapidity	Practicality	Adaptability	Long-term view
Pomodoro	✓	✓	✓	–	X
Covey	–	–	–	X	✓
GTD	✓	✓	✓	✓	✓

ZTD	–	–	–	X	✔

In conclusion, as we can deduce from the table above, GTD is the most qualified method for our scope. Thus, we are going to use it in developing our Personal Model-driven DSS.

3.2. *The proposed PTM tool*

As we said before, the main GTD lack is that it has not a good model that is able to schedule what the user has to do at a specific time. Thus, we have developed a Personal Model-driven Decision Support System, which can optimize users' agenda by clustering his activities and then scheduling them, minimizing the passive time wasted moving from one place to another or waiting for something or someone. According to our approach, the user inserts input data provided by GTD technique, such as calendar items or next actions, in his/her electronic agenda (e.g. Evernote or Google Calendar). As shown in Fig. 2, these inputs are now available to be processed by the DSS, which gathers, then clusters and finally schedules them, taking into account also personal user information which were previously inferred or provided by the user.
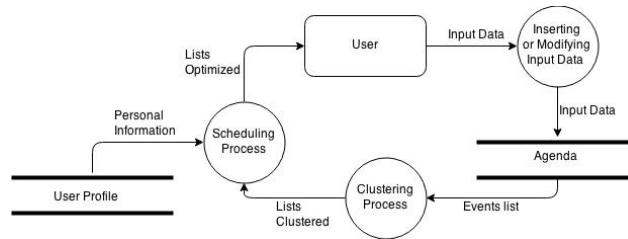

Fig. 2. Data Flow Diagram of the proposed Personal Model-driven DSS.

To clarify the logic behind the proposed DSS, clustering and scheduling processes are explained below.

Regarding the former, we have used customized cluster techniques based on the priority level and geographic location of events. First of all, location criteria is applied to group events, which can be executed in the same location; then, items of each cluster are sorted by their priority levels. Thus, the output of this process is a to-do-list, containing events organised in sub-lists (clusters) set by the two previously proposed criteria. Therefore, clustering process can be formalized as follows: *"Given a list Ω of M events, ω_i, i = 1, 2, ... , M, it is possible to obtain p location-related sub-lists. The k-th sub-list is referred as Ω^k and contains m_k items ω_i^k, i = 1, 2, ... , m_k, (k = 1, 2, ... , p), which are sorted by their priority levels."*

Subsequently, in order to obtain a smart plan of events, it is necessary to schedule each sub-lists by using planning algorithms, which consider user profiles too. This last

detail is fundamental, because it implies that the scheduling process, while optimizing user time, takes into account user deadline, commitments, other events, user preferences and so on. To simplify notation, we refer to the *k*-th sub-list as "α" and to its events as A_i, $i = 1, 2, …, m$. Moreover, each generic event A_i is characterized by a duration, represented by $d_{ij} \geq 0$. In addition, a precedence relation among two distinct events A_i, A_j, ($i, j \in \{1, 2, … , m\}$) can be defined and it is represented as "$A_j \propto A_i$", i. e.: A_j can start only when A_i finishes. A precedence relation is set using two factors suggested by Covey: importance and urgency. So, each *k*-th sub-list can be represented by an acyclic weighted graph $G = (V, \alpha)$, where each edge is an event and has a weight which represents the event duration d_{ij}. This graph has *m* edges – one for each event – and *q* edges required to make it acyclic. Notice that its vertices are named by a specific topological sorting algorithm.

Finally, according to Critical Path Method (CPM) in Fondahl (1962), the following notations is defined:

- *BS*(*i*): set of edges coming in of the vertex *i*;
- *FS*(*i*): set of edges coming out of the vertex *i*;
- $V = \{1, 2, …, n\}$: set of vertices of *G*, named by topological sorting algorithm.

The following assumptions have been made:

- $BS(1) = \emptyset$;
- $FS(n) = \emptyset$;
- $t_i \geq 0, i = 1, 2, …, n$, which represents the moment when the event A_{ij} begins.

Hence, the scheduling problem is formalized as follows:

$$\min t_n,$$
$$t_1 = 0,$$
$$t_j \geq t_i + d_{ij} , \forall (i, j) \in \alpha,$$
$$t_i \geq 0, i = 2, … , n.$$

It is extremely suitable to our application, because it allows us to identify the critical path, comply user deadlines, and consider user available time with respect to the precedence relations. Moreover, combining it with user profiles, we have achieved a highly sophisticated PTM tool. In fact, the developed DSS considers user personal data (e.g. date of birth) or preferences expressed in the past, but still true, such as buying something online rather than using traditional channels or moving by car rather than taking public transportation. User information are seen as filter by the CPM algorithm. For instance, if the user is more than sixty years old, then user Personal DSS can deduce that its user is less efficient than a younger man; thus, his/her events last more than same events done by younger people. Yet, knowing that the user is used to shopping online let DSS advise the user to do online all the activities that can be done to save time. Finally, the proposed Personal Model-driven DSS has been tested on two users (X and Y) and results show a considerable optimization of the agenda, as explained by the following comparison.

Without Optimization: X is able to execute seven activities in one day; each event is independent; not scheduled events are not included in the agenda; modifying user profile while maintaining the same events, agenda does not change.

With Optimization: X can do twelve activities and have also 80 minutes free; events made in the same place are put together if possible; not scheduled events are inserted in the agenda, according to when user has time and where he is; modifying user profile while maintaining the same events, agenda changes.

4. IBM Smarter City

One of the latest definition of Smart City is given in Bakıcı (2012) and defines Smart City as a high-tech intensive and advanced city that connects people, information and city elements using new technologies, with the aim of creating a sustainable, greener city, competitive and innovative commerce, and an increased life quality. This concept is not far from the IBM one, which considers the Smarter City as one that uses the interconnected information available today to better understand and control its operations and optimize limited resources. Moreover, IBM has also defined a smarter city model, shown in Fig. 3. It displays five key domains that play an important role in a city, although they are not always equally developed.

Such domains are: Water Management, Energy, Traffic, Public Safety, Buildings. Moreover, the Smarter Cities approach focuses on managing the city from a fully integrated and interconnected holistic point of view. Hence, every city has to develop a new capability that is not a specific domain, but is the necessity to integrate and coordinate cross-domain information. This focus requires convergence of information into a Cross-Domain Operations Centre (CDOC) in order to manage meaningful events and directives flowing through the different domains. Moreover, Fig. 3 also shows an operations centre within each domain, so that the domain can use information and data to make better decisions and take action. Finally, notice that taking action leads to rebalancing and, therefore, optimization, which includes two dimensions: the goals of the individual domains and the ones of the city as a whole.
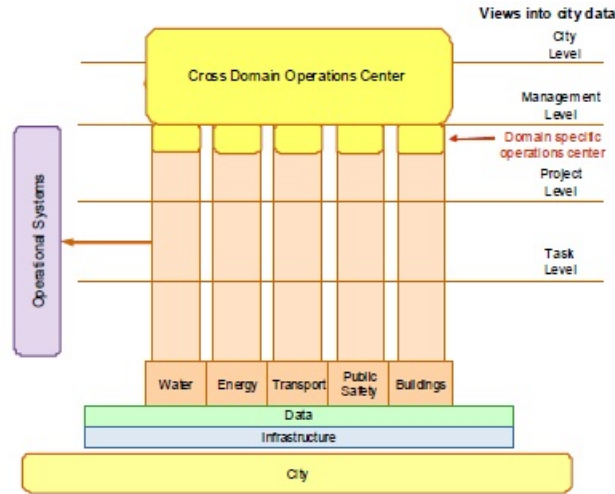
Fig. 3. Smarter Cities model with the cross-domain operations center, see Kehoe et al. (2011).

Hence, the IBM approach involves designing a model to optimize the individual domains in real time. This model uses technology to enable these domains to be interconnected, monitored, and controlled in separate and combined fashions. In particular, from a technological point of view, IBM has defined a high-level component diagram that consists of three layers.

The lowest one is the instrumented, which includes various data sources, such as sensors, meters, cameras, and unstructured data. Such sources measure and feed data back to systems via generally wireless local connections. The activities found at this level can measure water quality, collect electrical meter readings for a grid, or provide all kinds of real-time information captured by intelligent or physical sensors (e.g. cameras, Personal DSS, and so on). Aspects of this data can be sensed and used to generate events and alerts, which in turn can be published by using an Enterprise Service Bus (ESB). Then, climbing up to the IBM diagram, there is the interconnected layer, where data provided by the instrumented level is combined with other event-related information occurring throughout the city or domains, with the aim of creating a rich source of data that are used to enhance decision making processes. In fact, in this layer, the data from individual domain control systems and other data sources are linked together and transformed into event-related information, which are sent to the intelligence layer for further processing via an information bus, commonly called enterprise service bus. Finally, there is the *intelligent layer*, which processes relevant city data in a broader context to identify city-relevant events that need to be analysed or acted upon. A Service-Oriented Architecture (SOA)-based model, along with existing applications and management systems, is used to transform data and perform analysis. Analytics along with additional related data (such as weather) can be applied to provide further insight. Hence, this layer provides the tools and user interfaces (e.g. dashboards) for the city officials, suggesting them solutions or supporting their decision making processes.

5. The architectural representation of the proposed framework

The implementation of our framework requires the collection of high-quality data, which provide real-time, or better anticipated, information, and use them to let smarter city react to events and trends that are affecting the city itself and provide customized services back to whoever has shared information.

For a better explanation, we propose the scheme shown in Fig. 4, which is a simplification of IBM technological three-layer view previously described.
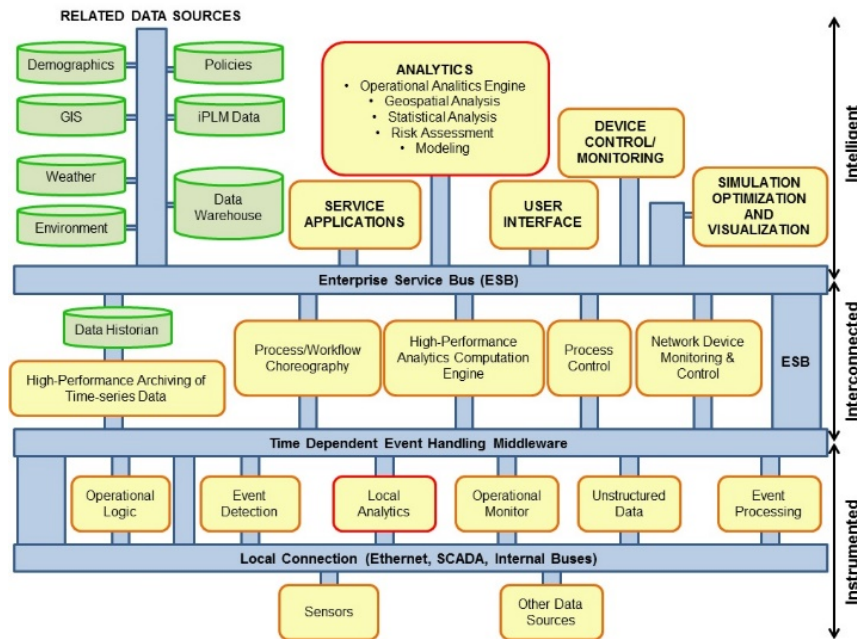

Fig. 4. The architectural representation of the framework from a technological point of view, see Kehoe et al. (2011).

According to this view, the proposed Personal Model-driven Decision Support Systems (that implements PTM too), aggregated in Group DSS, are *local analytics*, as they belong to the lowest IBM layer, named *Instrumented*. Indeed, they execute local commands to take action (e.g. scheduling optimization) and are linked to the whole system via local connections, which also provide security to these distributed services and their data. Subsequently, the IBM *Interconnected* layer aggregates agendas data, which come from different organizations, and integrate them with existing ones. Finally, *analytics*, which belonging to the IBM *Intelligent* layer, capture such information and use them to plan and then provide the previously explained services back to the users. Then, all these customized serviced are communicated to users via data coming back to the Group, and then Personal, DSS.

6. Limitations

This paper implies several limitations, mainly summarized in analysing massive volume of data (known as big data analysis) and privacy. These are highly interesting topics, which have been challenging researchers for years. As for big data, its main cause concerns the fact that huge amount of city data must be collected, stored, transformed, and analysed to provide actionable information. There is not a simple way to face this issue but, in order to make it easier, we have consciously decided to use organizations as mid-layer between the huge amount of individuals and the city.

Indeed, by collecting individual shared agendas to feed Organizational DSS, we are also aggregating and hence reducing the amount of data crossing the whole city system, without losing semantic important information.

For instance, by putting data together the city still knows that a group of two hundred people is moving from one specific place to the same destination, but does not care about their names, which is an information that remain within organizations. Moreover, this solution helps overcoming privacy limits, since single user data are firstly depersonalized and then spread.

Indeed, though individuals gain advantages due to this cooperation, they can be wary of sharing their personal agendas; so, convincing every single user would be impossible for the city.

For this reason, using organizations as mid-layer can be the only available solution to implement such a system. However, choices made during the research process help (but are not sufficient) to solve these problems, which require further and deeper studies.

7. Conclusion and implications

This study has examined the main Personal Time Management techniques and IBM Smarter Cities vision to bond them in a service-based framework, which has aimed to create a win-win co-operation based on service theory principles.

Moreover, this work has led to two findings. From one side, the realization of a Smart Personal Agenda, based on the integration of existing clustering, scheduling and optimization algorithms and improved by collected information on user profiles. On the other side, the definition of a scalable and reusable service-based framework, which integrate the proposed Personal Model-driven DSS in the IBM Smarter City technological model via Group DSS, consisting of sharing Personal DSS of individuals who belong to the same organization have been considered.

Therefore, several practical implications for personal, organizational and city purposes. By a personal point of view, the proposed approach is a highly efficient procedure, capable to re-schedule personal events, appointments and activities and support them thanks to customized services provided by the city. By an organizational perspective, Group DSS itself, if used, supports scheduling activities considering single user commitments automatically and, if integrated in a Smarter City system, helps handling important events, such as conferences or big meetings. By a city view, the

framework, using data coming from these local analytics, provides precious anticipated information, which allow city to plan itself in advance.

In conclusion, the proposed Personal DSS, spread into the city via Group DSS, represents a highly valuable prototype of a local analytic, able to manage the Personal agendas. Thus, it can be considered as a starting point to develop new more valuable and easier manageable sources of information for Smarter Cities.

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