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**Reference:**

De Florio Vincenzo, Blondia Christian.- *Service-oriented communities : visions and contributions towards social organizations*

**On the move to meaningful internet systems : OTM 2010 / Meersman, Robert [edit.]; et al. [edit.]** - ISBN 978-3-642-16960-1 - Berlin, Springer, 2010, p. 319-328

Handle: <http://hdl.handle.net/10067/881060151162165141>

# Service-oriented Communities: Visions and Contributions towards Social Organizations

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**Abstract.** With the increase of the populations, resources are becoming scarcer, and a smarter way to make use of them becomes a vital necessity of our societies. On the other hand, resource management is traditionally carried out through well established organizations, policies, and regulations that are often considered as impossible to restructure. Our position is that merely expanding the traditional approaches might not be enough. Systems must be radically rethought in order to achieve a truly effective and rational use of the available resources. Classical concepts such as demand and supply need to be rethought as well, as they operate artificial classifications that limit the true potential of systems and organizations. Here we propose our vision to future, “smarter” systems able to overcome the limitations of the status quo. An example of such systems is the social organization that we call Service-oriented Community, which we briefly describe. We believe that such organizations—in heterarchical coexistence with traditional systems—provide the features necessary to prevent societal lock-ins like the ones we are experiencing in assisting our elderly ones.

## 1 Introduction

With the increase of the human population, resources are becoming scarcer, and a smarter way to make use of them becomes a vital necessity if we want to get rid of or at least postpone unmanageability and chaotic behaviours. Assistance of the elderly population is a typical example: The share of the total population older than 65 is constantly increasing worldwide [1, 2], while the current organizations still provide assistance in a non-efficient, inflexible way. Though effective when the context was different and a large amount of resources was available to treat a smaller demand, this approach is now becoming too expensive and thus unacceptable. Merely expanding the current organizations without properly restructuring them is simply not working anymore.

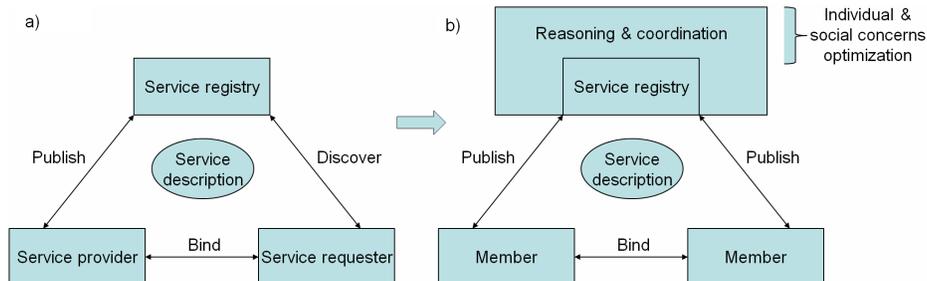
As remarked already in [3], another case of this “syndrome” can be found in other domains as well, e.g. in network software engineering. Let us consider the software principle of layered design—dealing with the problem of an ever growing design complexity by decomposing functionality into specialized layers. This strategy proved very effective in the infancy of the Internet, when hosts were limited in number and static in nature. The current scenario of a predominantly mobile Internet pervading all aspects of human society including goods and environments brought about new unprecedented requirements that are hardly compatible with the current needs for flexibility, adaptability, and personalized behavior. The extra performance granted by technology improvements is often wasted or under-utilized if we do not restructure the software architectures they are embedded into.

Business entities and even societies are no exception to this trend. Indeed, often such systems were built under similar “relaxed” conditions—market and demographic contexts that were much less stringent than the current ones. It is then no surprise that, even though ever increasing amounts of resources are being pumped up into these organizations, still they experience congestion and at times fail to meet their expected quality of service.

A thorough analysis of the reasons behind these inefficient organizations is beyond the scope of this text; what we would like to remark here is that one of the factors that most likely play an important role here is that of the so-called “lock-in”, defined by Stark as “the process whereby early successes can pave the path for further investments of new resources that eventually lock in to suboptimal outcomes” [4]. When applied to society and its organizational structures, lock-ins represent the loss of the ability to rethink or at least revise well established services such as health-care. Interestingly enough, Stark refers to this ability as *adaptability*. A system (be it e.g. a computer system, or a business entity, or a societal service) is called by Stark adaptable when it is able to actuate “ongoing reconfigurations of organizational assets”. Lock-ins are the result of a loss of adaptability, that is the loss of the ability to *innovate* (evolve, best-fit etc.) *through recombination* [5].

In what follows we propose our vision to future, “smarter” systems able to overcome the limitations of the status quo. Our position is that such systems require what Boulding called “gestalts” [6], namely concepts able to “directing research towards the gaps which they reveal”. In this paper we elaborate on this and show how such gestalts can pave the way towards novel reformulations of traditional services able to reach a better and more sensible management of the available resources and cope with their scarcity. A way to achieve this is also briefly sketched as a generalization of our concept of a “mutual assistance community” [7], which we called Service-oriented Community.

The structure of this paper is as follows: First in Sect. 2 we briefly recall the design of our first mutual assistance community. Section 3 discusses guidelines, conceptual tools, and hypotheses of such socio-technical systems. Next, in Sect. 4, we briefly introduce our Service-oriented Community and show how this may be



**Fig. 1.** In a), the classical service-oriented model is recalled. In b), a simplified representation of the MAC model is displayed.

considered as an example of what Boulding calls a social organization [6]. Finally in Sect. 5 we draw our conclusions.

## 2 An Exercise in Innovation Through Recombination: The Mutual Assistance Community

What we call the mutual assistance community (MAC) is a service-oriented architecture [8] coupling services provided by smart devices with services supplied by human beings into an alternative organization for AAL services. Semantically annotated services and requests for services are published into a service registry (the coordination center) and trigger semantic discoveries of optimal responses. Such responses are constructed making use of the available resources and of the available context knowledge so as to optimize both individual and social concerns. Figure 1 summarizes the peculiar differences between the classical service-oriented model and that of our MAC. A detailed description of the MAC may be found in [7].

The key idea behind MAC is that, in order to find an effective and also cost-effective solution to big societal problems such as those addressed by AAL, the whole of society must be included in the picture. When considering most of the available approaches to AAL (as surveyed e.g. in [9]), one may observe that a common aspect is often that people are divided into classes, e.g. primary users (the elderly people themselves), secondary users (carers) and tertiary users (society at large). This artificial classification limits the effectiveness of optimally recombining the available assets into an effective and timely response to requests for assistance. Furthermore, this classification into an active part of society, able to contribute with worthy services, and a “passive” part only on the receiving side is already a source of discomfort for people that are thus brought to feel they were *once* part of a society that now confines them to a lesser state and dignity. Trying to reach emerging behaviours such as so-called e-Inclusion [10] starting from assumptions such as these is probably not the best course of action. When designing the MAC we started from a different, more peer-to-peer

approach in which people—be them elderly or otherwise—are just members of a community—for instance the citizens of a small village or the people who subscribed to a gym course. Members are *diverse*, and this translates into a rich variety of services. Diversity of course implies here different know-hows (e.g. those of a general practitioner, or of a gardener, or of a retired professor of biology), different policies in providing their services (e.g. well defined time schedule and associated costs, or dynamically varying availability to provide free-of-charge services as occasional informal carers), different value systems, and so on. Another important characteristic here is that members are not “stationary” but *mobile*: They would “wander around” getting dynamically closer to or farther from other members. When a request for assistance is issued, a response can be orchestrated by considering the available members, their competence, their availability, and their location with respect to the requester. A key aspect here is the ability to reason in an intelligent way about the nature of the requests and that of the available assets. Unravelling analogies through semantic reasoning [11] promotes both a higher level of resource utilization and a stronger degree of e-Inclusion [12].

In a nutshell, our MAC is a socio-technical system in which AAL services (human or otherwise) can be queried, located and dynamically orchestrated. In a MAC, elderly people would not always be passive receivers of care and assistance, but occasionally they could play active roles. As an example, if member *A* feels lonely and wants to have a walk with someone, while member *B* feels like having some physical exercise with someone, then the MAC is able to capture the semantic similarities of those requests and realize that *B* could be the care giver of *A* and vice-versa—through the so-called “participant” model [12] of our system. Societal resources can then be spared, at the same time also preserving human dignity. Simulation [13] indicates that systems such as this—able that is to intelligently exploit the dynamically available resources—have the potential to reduce significantly societal costs at the same time increasing efficiency, manageability, and e-Inclusion. Evidence of the widespread of such ideas can be found also in the text of the third call of the European AAL Joint Programme [14], whose main focus is on “solutions for advancement of older persons’ independence and participation in the *self-serve society*”.

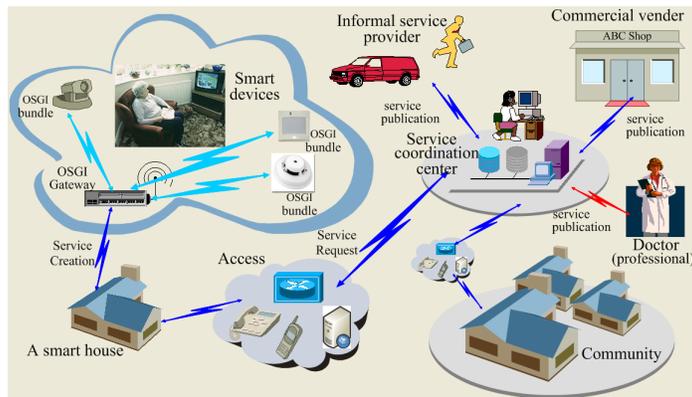
Figure 2 sketches our prototypic implementation of the MAC based on the OSGi middleware.

### 3 On Reflection

In what follows we provide our reflections on two issues: What guidelines and tools are most needed when trying to devise adaptable organizations? And what are the necessary underlying hypotheses of organizations such as our MAC?

#### 3.1 Conceptual Tools and Design Guidelines

As already stated, we refer to our MAC as an exercise in the above mentioned “innovation through recombination”: No new assets are on purpose devised in



**Fig. 2.** Representation of our prototypic OSGi-based implementation of a Mutual Assistance Community [7].

our community; instead, a new organization of already existing assets is proposed where the inherent potentials of our societies (mobility, diversity, density, etc.) are exploited in a different way to the benefit of society itself.

What are the main lessons we can derive from our exercise? How can we generalize it and use it as a model to tackle the problem of other societal lock-ins? We found an insightful guideline to answer these questions in the work of Kenneth Boulding and especially in his classical paper [6]. In such a relatively short text we found a number of important concepts that reverberate throughout our overall research experience. In particular, Boulding provides his interpretation of General Systems Theory as a unitary conceptual framework in which “to point out similarities in the theoretical constructions of different disciplines, where these exist, and to develop theoretical models having applicability to at least two different fields of study”. Being able to capture the similarities in the theoretical construction of two or more disciplines allows the theorist (or the designer) to identify what Boulding calls a “gestalt”: Concepts that are devised in the framework of a specific discipline but can find a direct application or a direct analogue in another discipline. Gestalts are greatly important: As disciplines in general evolve at different paces, identifying gestalts in related disciplines permits to direct research towards gaps or local minimums. In our experience, gestalts also allow *lock-ins* to be identified and provide practical guidelines to treat them.

As an example, the concept of *feedback loop* is a gestalt that can be identified in as different a discipline as cybernetics, biology, control theory, computer architectures, and social science [15]. Organizations that are based on or make use of feedback loops are able e.g. to structure their function in accordance with a subset of the current endogenous and exogenous conditions—that is, a subset of the current *context*<sup>1</sup>. Such subset represents a choice of context variables that

<sup>1</sup> Context is defined in [16] as “any information that characterizes a situation related to the interaction between humans, applications and the surrounding environment.”

are deemed as “sensible enough” to steer optimally the function of the system. Another important aspect in these context-aware organizations is the type and quality of the response they can provide.

It is again Boulding’s cited paper that provides us with a detailed analysis of classes of context-aware organizations. The bottom level of Boulding’s classification is given by so-called “frameworks” and “clockworks”. Such systems have a “predetermined, necessary motion” [6] that is they are quasi context-agnostic. Next level is the one of “thermostats,” or systems that “move to the maintenance of any given equilibrium, *within limits*” [6]. Such systems focus on a very limited set of context variables and ignore all the rest, exactly as a thermostat does with any variable other than monitored temperature. The only response they can exhibit is also intended to affect that same variable only. Continuing his classification, Boulding proposes other organizations (“cells”, “plants”, and “animals”), each of which is characterized by a more sophisticated degree of feedback loops, with a larger amount and quality of sensory and actuation apparatuses. It is only with the level of “human beings” and especially with that of “*social organizations*” that systems are able to introspect, analyze and locate their limiting factors—that is, their **lock-ins**—and to some extent can learn how to reconfigure and reshape themselves so as to face a dynamically varying set of environmental conditions. In other words, at this level Boulding introduces Stark’s adaptability. Our conjecture is that this is the feature we need to seed or steer in our organizations in order to let them face unprecedented harsh conditions such as the ones our society are experiencing today. Thanks to the generality of this gestalt, we have been able to apply successfully this concept to two different contexts: The mutual assistance community described in Sect. 2 and a software framework called ACCADA [17]. In the former, the subset of context variables and actuation actions was extended so as to include both technological and social aspects and services. The latter case is an attempt to encode the reconfiguration capability into the feedback loop process itself so as to create truly adaptable component-based software architectures.

### 3.2 Underlying Hypotheses

A key aspect in the effectiveness of our scheme is that members of our communities must be successfully motivated to use the service and to offer their own services—our studies show that the more this happens, the more the general welfare of the system increases [12]. From this we derive two main “lessons”: First, that systems such as these must be designed so as to adaptively restructure themselves according to each and every user. This adaptive personalization would allow to overcome “usability barriers” such as the so-called “grey digital divide” [18] and foster the participation of the greater part of society. Secondly, we observe how another important key to a successful spread of a heterarchical system such as our MAC calls for an overturn of social negative values. Unfortunately, often a clash exists between this need and those social techniques and trends that favor personal profit over the public interest [19–21]. This model’s indiscriminate use of negative values to manufacture consent is often used even in

politics (stir social division, draw fake enemies, fight diversity etc.) and results in the widespread loss, embezzlement, or misuse of a sort of “Social Energy”—*viz.*, the self-serve, self-organization, and self-adaptability potentials of our societies.

## 4 Extending the Concept: Service-oriented Communities

As already remarked, effective adaptable organizations are characterized by an “ongoing reconfiguration of organizational assets”. When trying to design socio-technical systems such as our MAC an important requirement is then the ability to reorganize dynamically a set of computer-based and human-based services. Service orientation [22] becomes *the* privileged choice to designing complex adaptive systems, its main characteristic being a set of well-defined, standard-regulated policies to recombine loosely coupled atomic functionality. In recent years such functionality were extended so as to include human-based services [23–25].

It does not come as a surprise, then, how such *gestalt* is being successfully applied to several and seemingly unrelated domains. The organization presented in Sect. 2 is indeed just another example of service-oriented architecture, in this case applied to AAL. A similar example is given by openAAL [26]—an open source service-oriented middleware also addressing ambient-assisted living.

Our question here is: Would it be possible to extend an organization such as our MAC to other socio-technical domains? Would it make sense? What would be the societal returns in so doing?

To provide our answer to such questions let us begin by introducing a real-life case, given by the Belgian enterprise Cambio ([www.cambio.be](http://www.cambio.be)). Cambio (and possibly other similar enterprises) provide simple car renting services to their clients. Unlike other big players in car renting, Cambio allows cars to be rented with shorter notice and for reduced durations and rates, thus fine-tuning the traditional concept of renting a car. Obviously this concept could be further extended with e.g. intelligent car sharing policies: Instead of just renting one car to one person, the system could reason about incoming requests such as “user  $u$  needs to leave from source  $S$  and reach destination  $D$  within time  $t$ ” and try to build up an optimal schedule that match several criteria. Meaningful explicit criteria could include cost, number of hops, speed, reliability, and so on. Implicitly, such system would also have an effect on important social matters, such as pollution from fuel combustion, traffic congestion, road dimensioning requirements, intermediate consumption [27], et caetera. Note that no new resource would be especially required to provide such services—which actually were already common at the beginning of last century when people used to advertise for a traveling companion to share expenses [28]. A novel organization based on service orientation, custom semantic reasoning, and proper human computer interaction devices, could provide the necessary socio-technical foundation for such a service.

It is our conviction that an organization such as our MAC could be easily tailored towards such new service context. Moreover we believe that several other

classes of services could be supplied by tailored MAC's. Should our conjecture prove true, then it would be possible to conceive a sort of multi-purpose system where devices and human beings with different capabilities, competence, and information could be optimally orchestrated to devise intelligent responses to situations ranging from a stroke to an earthquake or a fire, or to needs such as connecting people together to share knowledge or collaboratively achieve a common goal. Such “service-oriented community” would make use of a higher level feedback loop to reorganize itself and its services to better match the current context—from both a personal and a general, societal perspective. Our ACCADA middleware [17] could be used to set up such “meta-adaptive” loop.

## 5 Conclusions

Currently resource management is mostly carried out through traditional, well established organizations, policies, and regulations that are often regarded as immutable to the point that any restructuring is considered as unthinkable or even dangerous. The current trend to deal with this problem is to complement the existing systems with other “compatible” approaches based e.g. on information and communication technology. One such approach is given by the use of smart devices and houses for elderly people. Our position in this paper is that merely *complementing* the traditional approaches be not enough. We believe that systems and their ecosystems must be radically *rethought* if we want them to achieve a truly effective and rational use of the available resources. Concepts such as demand and supply, as well as roles such as producer and consumer, need to be thoroughly revised too, as their artificial classifications prevent systems and organization to achieve their true potential. The peer-to-peer “participant” model [12] of our model provides a concrete example of this, removing when possible the unnecessary distinction between care-givers and patients.

In this paper we have proposed our vision to future, “smarter” systems able to overcome the limitations of the status quo. Such systems require what Boulding called *gestalt*, namely concepts able to “directing research towards the gaps which they reveal”. In this text we elaborated on this and showed how such gestalts can pave the way towards novel reformulations of traditional services that are able to exhibit a better and more sensible management of the available resources and to cope with their scarcity. Our vision of a Service-oriented Community was also introduced as a generalization of our concept of a Mutual Assistance Community. We believe that such communities—in heterarchical coexistence with traditional systems—provide the necessary diversity and innovation orientation to prevent societal lock-ins such as the ones we are experiencing today in assisting our elderly ones.

Our position is that the traditional, hierarchical model of governmental- or enterprise-driven and -regulated services could be replaced by a more “heterarchical” view [4, 29] of concurrent providers based on different approaches and possibly different values and missions. Such a new model would allow our societies to function as Boulding’s social organizations, in which “the unit [. . .] is not

perhaps the person but the *role*—that part of the person which is concerned with the organization or situation in question. Social organizations might be defined as a set of roles tied together with channels of communication” [6]. A dynamic management of such roles—as foreseen in our vision of a service-oriented community and promised by recent trends and emerging concepts such as Web 3.0 and the Internet of Services—is possibly a necessary condition towards turning our societies into effective social organizations.

Finally, we would like to highlight how preliminary experiments and common sense suggest that another important prerequisite to truly reaching this highly ambitious goal is learning how to channel the potential of our “Social Energy” to the true benefit of society itself.

### Acknowledgments

We like to acknowledge how several of the key ideas discussed in here are the result of many discussions with M. Tiziana Bianco. Also our gratitude goes to Hong Sun and Ning Gui, with whom we carried out several of the research activities discussed in this paper [7, 9, 12, 13, 17, 30], as well as to our reviewers for their useful suggestions.

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