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Bridging the gap between citizens and local administrations with knowledge-based service bundle recommendations

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***Abstract*—The Italian Public Administration Services (IPAS) is a registry of services provided to Italian citizens likewise the Local Government Service List (UK), or the European Service List for local authorities from other nations. Unlike existing registries, IPAS presents the novelty of modelling public services from the view point of the value they have for the consumers and the providers. A value-added-service (VAS) is linked to a life event that requires its fruition, addresses consumer categories to identify market opportunities for private providers, and is described by non-functional-properties such as price and time of fruition. Where Italian local authorities leave the citizen-users in a daedalus of references to understand whether they can/have to apply for a service, the IPAS model captures the necessary background knowledge about the connection between administrative legislation and service specifications, life events, and application contexts to support the citizen-users to fulfill their needs. As a proof of concept, we developed an operational web environment named ASSO, designed to assist the citizen-user to intuitively create *bundles* of mandatory-by-legislation and recommended services, to accomplish his bureaucratic fulfillments. Although ASSO is an ongoing project, domain experts gave preliminary positive feedback on the innovativeness and effectiveness of the proposed approach.**

I. Introduction

Like other governments, the Italian government requires citizens to accomplish a number of bureaucratic fulfillments to update their administrative records when changes occur which affect their citizenship status. Indications about the required fulfillments are found either at the local authorities offices, or on dedicated web portals. In both cases, the citizen looks for a source of comprehensive information covering his specific case. At a local authority office, the employee will recommend a list of actions based on her knowledge of administrative legislation and her personal experience in historical cases. Online, the citizen can usually browse a list of services, and then look into webpages to search for applicability clauses, modality of fruition, required paperwork, contact information, and exceptions to the legislative rules. There is a gap between the knowledge acquired by the municipal employees, and what is captured in the online service descriptions. IPAS is a model of service repository that abstracts from specific service registries developed by individual administrations and support more effective interactions between administrations and user-citizens [1] [2]. IPAS is based on an extensible ontology of services that describes the features of individual services as well as the connection between the services and relevant domain entities such as providers, life events, non functional needs, business domains. These connections support the citizen-users to acquire information about services relevant to their needs in a more effective way. Not only does IPAS capture the consumers' point of view, but it also support the evaluation of the value that a set of services has for a specific user. A value-added-service (VAS) [2] is designed to maximize any of the three service value definitions [3], i.e., exchange, utilization, and social value. In particular, in the context of SMART[1], a project funded by the Italian government, VASs are realized by packaging a set of services into a *bundle*, which aims to fulfill citizen-users' needs that cannot be satisfied by individual services. The principles of service bundling are based on the recommendations that government employees provide to the citizen-users, who often lack detailed knowledge about the ever-changing public administration legislation. The paper is organized as follows: in Section II we describe the aspects of the IPAS model that support the definition of service bundles. In Section III We present ASSO, a system that assists the citizen-users to create a bundle of services that are mandatory-by-legislation or recommended based on the users' needs. The systems uses interactive user profiling, semantic links available in IPAS, and a service matchmaker to provide recommendation to the citizen-users. A discussion about some early evaluation actions that lead to the development of ASSO, which are based on a collaboration with the Italian Association of Municipalities (ANCITEL), and about related work will be presented in Section IV. Concluding remarks end the paper.

II. Core aspects of IPAS design

The IPAS repository of public administration services has an extensive design that facilitates the collection, organisation and distribution of knowledge on services. We will analyse the design aspects to understand better the application scenario in section III. We mention, for completeness, that IPAS design has a DB implementation, whose lifecycle is managed trough an online administration console, and an ontology-based implementation for its publication as Linked Open Data[2]. A primary aspect of IPAS is the separation between Abstract vs Concrete entities. This dualism is applied to services and providers, so

[1]Services and Meta-services for smART eGovernment
[2]http://siti-rack.siti.disco.unimib.it:8080/ipas

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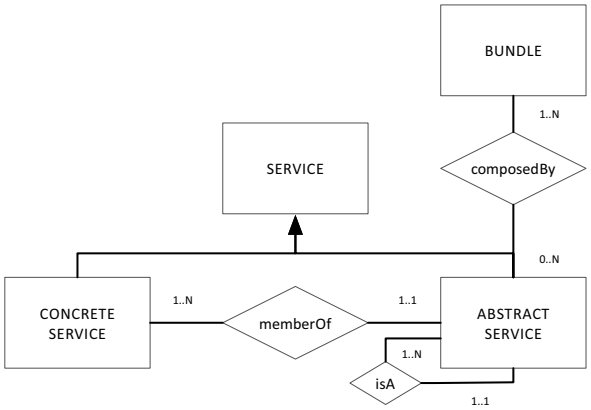

Fig. 1. IPAS core concept

that abstract services/providers represent specifications defined by the legislation, while concrete services/providers describe actual services provided by local authorities. In other words, abstract services describe categories of services (e.g., update of the address in the public records) offered by abstract providers (e.g., municipalities), while concrete services describe actual of services offered by specific providers (e.g., update of the address in the public records from the Milan municipality). This dualism is useful to deal with changes, which are more frequent at the concrete representation level and less frequent at the abstract representation level. In addition, the abstract-concrete model pattern offers homogeneity to designers and developers, since IPAS provides also the base for software applications dealing with nation-wide services. In the following sections we explain how the IPAS model supports ASSO in assisting the citizen-users with the composition of mandatory-by-legislation and recommended services for their request.

A. IPAS core concept: service

The entity around which the IPAS model is built is "service". A service consists in an activity or series of activities that take place in an exchange between a supplier (service provider) and a customer (service user); the object of this transaction is an intangible good [4]. The goal of a service is to satisfy the need of the customer; the value is generated between the provider and the customer for the time the service is in fruition [5]. In Figure 1 we show how the services are organised hierarchically (IS-A) [6] to identify a broader-narrower relationship e.g. `Service of Payment` is specialised by `Payment Housing Rates (IMU)`. Accordingly, a system that takes a life-event, a user-segment and/or a thematic-area as input to recommend some public administration services will also list services that are more specific than the services linked the input life-event/user-segment/thematic-area.

B. Rich aspects of services: life-events, user-segments, thematic-areas

As we are building a system for citizen-users IPAS includes the concepts of life-event and user-segments as shown in Figure 2. The latter introduces in IPAS theories of marketing applied to the domain of services for the public sector [7]. A

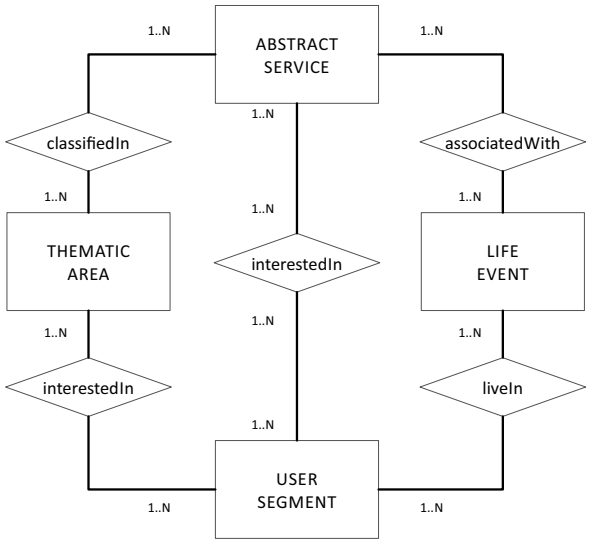

Fig. 2. Rich aspects of services

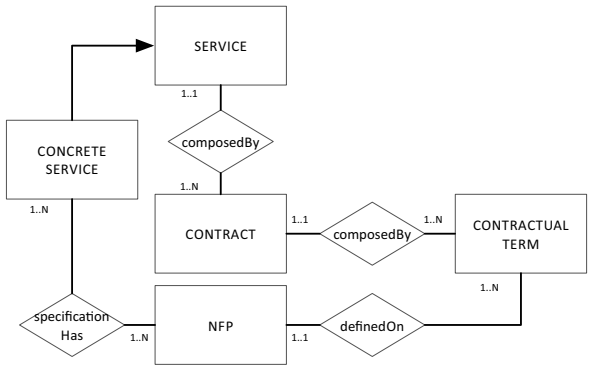

Fig. 3. Functional aspects of services

life-event is connected in a many-to-many relationship with a user-segment (the rationale behind these links is explained in details in previous work [8]). As a result, the combination of potential customers for a services is widely expanded, thus the recommendations to individuals of the same segment are as well increased. Examples of life-events can be *moving into a new house*, *becoming parent*, *acquiring a citizenship*, *starting a new business*. The principle of combining a service with cross domain concepts (e.g. life-event) is also applied to thematic-areas. A thematic-area defines the context of fruition for a service; examples of thematic areas are *Education*, *Tourism*, *Business*, and so on. Life-events, segments, and thematic-areas define aspects of the user profile that will be used to support the recommendations; a highly connected network of life-events, segments, thematic-areas and services will improve the capability to recommend mandatory-by-law and relevant services to the users based on their profiles.

C. Contractual aspects of services

The fruition of a service from a customer (e.g. citizen-user) is governed by contracts. Authors of [9] explain service contracts as constraints for service fruition accepted by the

provider and the consumer. The constraints are formalised with contractual terms which are defined using *non-functional properties* (NFP) [10]. NFPs characterise the service fruition, making explicit the duration for completion, the price, the service access, etc. Ranking mechanisms use NFPs to order equivalent services in the recommendation set, on the base of how they score when compared to the needs expressed by the user. Figure 3 displays how the NFPs are collected in a contract and specify the *concrete* service, since this is the one consumable as opposed to the *abstract*service. Equivalent contracts are hence compared along the same NFPs with a technology named PoLiMar [11]. In the practical example (see Section III.C) we explain how PoLiMar evaluates the global score as the combination of local NFP comparisons.

D. Bundle of services

As said above, in IPAS the services can be also clustered in "bundles" [12] [13]. A bundle is a set of services packaged together by the provider for reasons relevant to its marketing strategy, and to satisfy the needs that are expressed or remains unexpressed by the customers. The provider can sell the service bundle to a price that is lower than the sum of the service that compose the bundle, and the bundle can be associated with NFPs that are not applicable to each individual services. A bundle is therefore a group of services offered to the customer in a single solution, which has a prospected benefit both for the customer, who finds a set of needs fulfilled by a unique recommended solution, and the provider, who can make more profit. Figure1 shows that service bundles are created in IPAS around life-event scenarios. The bundles are designed to satisfy *real-life needs* of the users, some of which might be even unknown to the inexperienced citizen-users, rather than to fulfill functional requirements of service integration. As an example, a bundle of services that cover the event "becoming a parent" will include: 1) Declaration of birth 2) Assignation of a doctor 3) Request mandatory vaccinations 4) Sign for the infantry school 5) Parenting course.

III. ASSO: Support the citizen in composing a bundle

The Assistant to Citizens for Service Selection (ASSO) is the tool we developed to deliver the benefit of service composed into bundles. Deployed as a web application accessible by multiple devices, the current deployment of ASSO showcases a scenario where a citizen-user in need to *change his residential address to a new place*, is recommended a set of mandatory-by-legislation services, and a set of other relevant services (e.g., a service that support the search of a new school for the citizen's children). ASSO works with an intuitive step-by-step wizard. The citizen-user interaction starts with the formulation of a request (e.g. I need to change my residential address), and concludes with a ranked list of service providers by which he can request the service fruition. We want to prove that where local authorities make accessible elementary services for elementary need through their web portals, we improve by capturing most of the background knowledge on administrative legislation involved, in a network of relationships among services, and among services with life events and user categories that underlie ASSO.

ASSO leverages the network of relationships to support citizen's non trivial questions: *what my government requires me to fulfill when I change my residential address? What other services can I invoke if I am married or have children? What is the best service provider for my needs?*

The interaction with ASSO is a workflow of 6 steps: 1) citizen request, 2) selection of an abstract service, 3) citizen profiling, 4) composition of a bundle, 5) bundle summary, and 6) ranking of services in the bundle when multiple providers are available. For reason of space we will zoom in the details that characterise the step: 3) 4) and 6); the reader can perform a complete workflow on the ASSO web portal[3].

A. Citizen Profiling

At this step the citizen-user has performed a request in the homepage describing his life-event: "I need to change my residential address", and this is all the system takes as input. At the second step the citizen-user has selected one item among a number passible abstract services in the IPAS collection matching his request, i.e., "change of residential address for multiple people". The system navigates links between the life event selected by the user and other IPAS elements to derive high-level user-segments (called *categories*, in the following) that are relevant to the citizen-user: *married couple*, and/or *parent*. With this information ASSO enters the fine-grained *citizen-profiling* step, by formulating a short questionnaire adapted to the category the user belongs to, whose aim is to gather important contextual details, e.g., to determine whether the citizen owns her new house, has children, has a bank account, has a job, has a driving license, and so on. Figure4 shows how the user selects YES/NO answers. The result of the questionnaire drives the extraction of mandatory-by-legislation and other relevant services from the IPAS repository. In the citizen profiling step, we are already leveraging the links between services and life-events through user categories (see Figure2), as opposed to having isolated services referencing punctual user needs. To refine the segment the citizen-user belongs to, which was inferred at the second step, ASSO does not make the user browse a long list of categories she can belong to, but it collects this information from intuitive questions, e.g., "do you own the old or the new property?". The underlying process uses the positive answers to infer the fine-grain user category the user belong to; these categories are linked to a list of relevant services, thus preparing the ground for the bundle composition.

B. Composition of a Bundle

In the previous step we obtained a profile of the citizen-user starting from a scenario of "change of residential address for multiple people" that is, the life event he is undergoing. The knowledge of administrative legislation, coupled with user categories and the services captured in ASSO, draw the paths to reach which (abstract) services are mandatory-by-legislation, and those who are anyhow relevant for the citizen based on his profile. The path is marked along the relationships connecting the nodes of life-events, user-segments and services. The interaction with the user is kept friendly by mean

[3] http://siti-rack.siti.disco.unimib.it:8080/ipas_portal/firenze

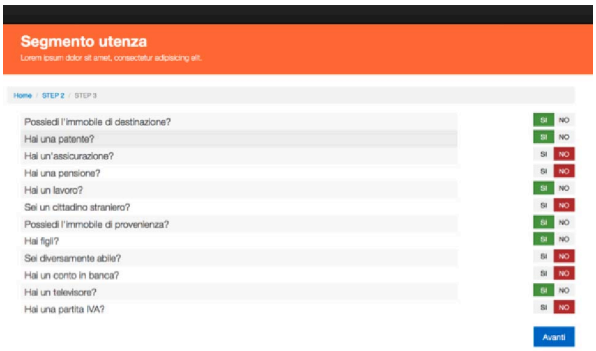

Fig. 4. A questionnaire materialised from the user-segments and used to profile the user

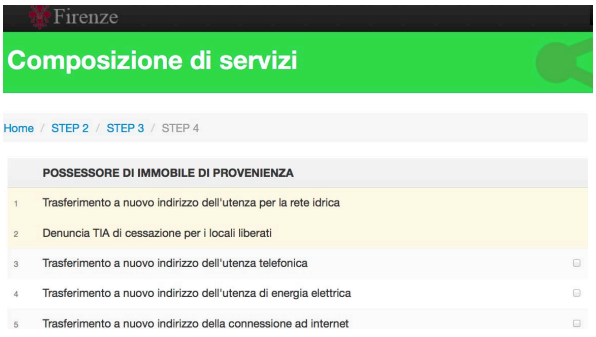

Fig. 5. Mandatory-by-legislation and recommended services in a bundle generated by ASSO

of coded-color elements (see Figure5) for the mandatory-by-legislation services, that the users cannot eliminate from the bundle composition (e.g. transfer water supply contract to the new address), and other optional services considered relevant by ASSO to the user profile (e.g. start new internet contract). Hence the bundle composition step relieves the citizen from knowing the constraints imposed by the legislation, (it actually provides a self learning environment), while asks to confirm optional services selected by ASSO that interprets the scenario and the user profiling with a list of other services.

C. Ranking of Service Providers

As the citizen-user composes and confirm his bundle of abstract services, ASSO enters the step in which it lists the (concrete) providers of the selected services. Since service providers can be public administrations or private entities, the user can often choose among alternative providers, in a competitive scenario. ASSO includes support to rank the service providers based on preferences expressed by the users. Service NFPs, described by means of contractual terms, are attached to service descriptions (see Figure3) and tail the path of relationships captured in the ASSO domain knowledge. By asking to the user to express her preferences about service properties such as price range, time of provision, fruition modality, or progress monitoring, ASSO can rank the providers that best match the user preferences using the PoLiMar service matchmaker [10]. Figure6 shows a form where preferences on NFPs described for the selected services are collected from the user. The form captures a relevance weight that the user

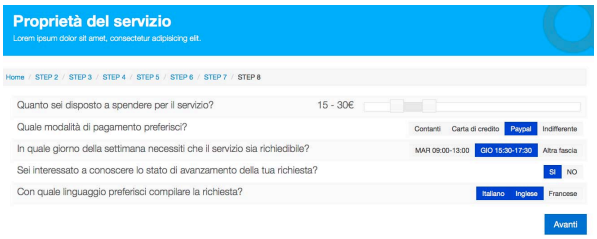

Fig. 6. A form materialised from input NFPs

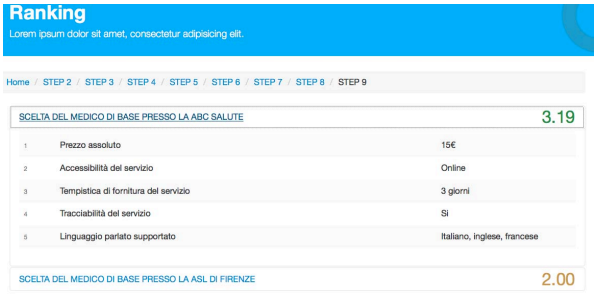

Fig. 7. Ranked services; global scores and evaluated NFP are visible

associate to each NFP; the preferences are sent to PoLiMar, which evaluates a matching score for each provider and returns a ranking (see Figure7).

IV. Discussion and Future Work

The development of ASSO went through three prototype releases; each release has been (qualitatively) evaluated by domain experts from ANCITEL, a company held by the Italian Association of Municipalities (ANCI) and a leader provider of ICT services to Italian municipalities. ANCITEL, which has strong relationships with a large number of municipalities interested in IT innovation, acknowledged that ASSO is an important step in closing the distance between a complex legislation in the matter of public administration, and the citizens. Several features of ASSO described in this paper have been designed based on the feedback of ANCITEL domain experts on previous releases. ASSO currently instantiates its business case for one single scenario centered in the *change of residential address*; new activities are planned to expand towards scenarios in the domain of tourism e.g. *stay to a BB in Lazio*. The IPAS repository in its current state, which is based on the Linked Data Paradigm, is more mature than the ASSO application and went through several refinements since its first proposal [2].

ASSO can be considered a knowledge-based recommender systems. ASSO adopts the distinction between the user profiling phase and the recommendation phase common to several recommendation systems proposed in the literature [14]. ASSO does not adopt at the moment methods for profiling users by means of user behavior analysis, and adopts an interactive method based on a dedicated knowledge base. From this point of view the approach more similar to the approach described in this paper can be found in previous work on service recommendation in the eGovernment domain [15]. However, the concept of service bundle and the marketing-driven recommendation

approach is a novel contribution of this paper. Compared to recent proposals, where cross-domain Linked Open Data are used to support recommendations in several application scenarios [16], our approach uses a dedicated knowledge base; this choice find a motivation in the the specificity of the domain knowledge required to recommend mandatory-by-law services. For such knowledge-driven recommendations, we found difficult to apply also content-based recommendation approaches, e.g., such as the ones based on encyclopedic knowledge [17]. Instead, we believe that these content-based recommendation approaches can be plugged into ASSO in two ways in the next future: by recommending to domain experts potential links between life events and services, which have to be validated before being added to IPAS registry; by recommending to citizen-users relevant services which are not linked to any life event in the IPAS knowledge base.

In future work we also plan to a) collect functional service descriptions from Web sources using information extraction methods and connect them to the IPAS knowledge base; b)improve the grain of user-segment to better capture the market for the two scenarios envisage for ASSO; c) model the historical records of users' preferences, and use them as feedback in the recommendation process.

V. Conclusions

In this paper we presented ASSO, an assistant to Italian citizens in need to discover which fulfillments are requested by the legislation, driven by a life-event, and which additional services can be recommended given their profile. Our objective is to prove that the where Italian municipalities lack of the instruments that drive the citizen in the daedalus of services, we complement their online publication of service description with a smart assistant capturing the domain knowledge, and leveraging the notion of value-added-service, combined with marketing principles, and real-life aspects.

ASSO is a knowledge-based recommendation system; it interactively collects user profiles and suggests service bundles and service providers by leveraging links in the IPAS registry and the PoLiMar service matchmaking tool. ASSO has been designed and deployed with a limited effort by leveraging the stack or re-usable open source technology, and results our previous research on service modeling and matchmaking. Moreover, other applications to improve the interaction between Italian citizens and public administrations can take advantage of the IPAS knowledge base, which is available as Linked Open Data.

The preliminary feedback we received from the Italian Association of Municipalities encourage us to plan the deploy of a distributed infrastructure that replicates ASSO principles in the large, by involving a set of innovating municipalities.

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