Functional service description on service marketplaces

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Abstract. Software customers increasingly externalize the operation of software applications and use software as a service (SaaS) via cloud service platforms. During the service search and selection process on a service marketplace, customers depend on comprehensive and detailed descriptions of service offers as a basis for service comparisons and for well-grounded service selections. Functional-oriented service descriptions are of particular importance here. In practice, service descriptions on marketplaces tend to be not as precise as required, and therefore they cause increased effort for service customers to understand the real scope of software services. Most approaches addressing business-oriented service description in scientific literature only consider functional aspects marginally and provide no further, application-domain specific functional description patterns. For this reason, this research paper analyzes the state of the art concerning functional-oriented service description on four selected cloud service marketplaces in the special domain of analytical services in order to obtain insights for the subsequent creation of a design proposal of a set of functional description attributes for analytical services on service marketplaces.

Keywords: cloud service platform, service marketplace, functional service description, analytical service

1 Introduction

Cloud software service marketplaces (like *Amazon Web Services Marketplace*) assume the role of an intermediary / service repository between multiple software service vendors and the customers. As in other service repositories, software service vendors have to fill sets of attributes predetermined by the marketplace with service-related information to explain and describe the specific design and scope of their service offers. Some service description attributes allow a great latitude in the information presentation, e.g. attributes like “service description”, used to explain the essential aspect of software service functionality and associated use cases. Such descriptions, by means of free text or heterogeneous and vendor-specific function lists, impede the intersubjective understanding and the discriminability of service functionalities [1]. Therefore, search queries in service repositories and service marketplaces often return a large amount of services, and extensive human intervention by the service customers is needed to develop a functional understanding and to compare services [1,2].

Multikonferenz Wirtschaftsinformatik 2018,
March 06-09, 2018, Lüneburg, Germany

In contrast to this, a service search, which is supported by advanced models considering functional facets, would generate reduced result sets and would provide a consistent vocabulary [3]. Although there are some previous research approaches addressing business-oriented service description models (find an survey in [4]), there is no approach providing a precise functional substructure (compare chapter 2). To sum up, there is a need to create domain-specific service description models [5] representing the precise functional range of software services from a customer´s point of view. One domains is the sector of analytical / big data services, which is an emerging topic in e-commerce research and still contains open research questions, e.g. regarding IT infrastructure and service selection [6]. Analytical services are addressed in the current research because the functional content of various analytical services can be traced back to basic functional characteristics (e.g. provided analysis algorithms, data diagrams, metrics and data import formats), which facilitate a service comparison.

Due to the lack of functional-oriented service description models in literature, an analysis of description models of analytical service offers on market-leading service marketplaces (compare chapter 3) was conducted to obtain information regarding the handling and attributes of functional service description. Afterwards, these findings were combined with a literature review regarding general analytical functions to create a first set of description attributes of analytical services for cloud service marketplaces. Based on these insights, this paper answers the following research questions: 1.) Which functional service description structures are used to provide information about analytical service offers to customers on the most prevalent service marketplaces?; 2.) What does the structure of a functional-oriented set of description attributes for analytical services on marketplaces look like?

Chapter 2 shows the status quo regarding functional service description approaches in research. Chapter 3 contains the examination of analytical service offers focusing the functional service description on four service marketplaces. Chapter 4 presents a service description model aiming at functional-related aspects in the domain of analytical services. The paper ends with a conclusion in chapter 5.

2 State of the art concerning functional service description models

Widely used standard service description models in practice (e.g. WSDL, USDL, UDDI) are aware of the aspect of providing service information to service customers (e.g. attribute “description“ in the area “BusinessService” of the UDDI specification [7]), but they leave the modeling of further service description concepts and detailed semantic models and ontologies to the model users [5,8]. In addition, there are few approaches in research addressing business-oriented service description models, which were collocated and compared by [4]. These approaches consider varied dimensions, but in most cases they focus on generic service description aspects irrespective of user functionality and application domain (e.g. hardware platform, pricing). As an exception in the model set compared by [4], [9] suggest the attributes *individualization of the web interface* and *usability of services*, but provide no further details. [10] distinguish

taxonomy levels, e.g. *intended user group* and *customer/application domain*. These attributes are useful to classify services and to reduce the overall amount of offered services via filters, but they are not sufficient for giving deep functional insights to support final service selection.

Furthermore, [11] conducted a systematic literature review to find approaches regarding the evaluation and selection of software services, and [12] provide an overview of research approaches in the area of cloud service selection. In both compilations, approaches related to service functionality were rarely represented, and an analysis of the mentioned articles revealed no further contribution to the specific research topic of this paper. Due to the absence of a detailed functional service description model in research literature, it is necessary to analyze service marketplaces in practice to collect suggestions for functional description patterns.

3 Analysis of functional service descriptions on marketplaces

3.1 Selection of service marketplaces and analytical services

With reference to [13], the service platforms of *Amazon*, *Microsoft*, *IBM* and *Google* had the largest market shares in 2016. For this reason, four analytical services on each of the following multi-vendor service marketplaces were examined in January 2017: *Amazon Web Services Marketplace*, *Microsoft Azure Marketplace*, *IBM Cloud* and *Google Cloud Launcher*. Four Services offered by a set of seven top vendors of analytical information systems (derived from [14]) were only available on *Amazon* and *Microsoft* marketplace, whereas the four analytical services on *Google* and *IBM* marketplace were picked by random selection. The analysis revealed, that each marketplace uses a uniform set of descriptive attributes for all analytical services.

3.2 Functional service description and classification

All marketplaces use one- or two-tier hierarchical classification models to cluster and filter their service offers (e.g., the model of *Amazon* is built on terms of software applications (e.g. 1st tier: business software, 2nd tier: business intelligence)). However, these models are insufficient for two reasons: First of all, the classifications are not detailed enough to reduce the amount of service offers to a small service set (e.g. on *Amazon* the sub-category *business intelligence* contains ca. 380 services). Secondly, they do not contain sub-categories or additional remarks for the structuring of analytical application systems / functional areas.

On all marketplaces, service offers include a textual service description regarding the purpose and key functions on a high abstraction level using running text (Table 1), which provides only a vague and fragmentary impression of the real service functionality. The same applies to the headwords of service product highlights. Nevertheless, the listings of included sub-modules / products (*Amazon*, *Google*), and especially the so far heterogeneous and service vendor-specific listings of service functions (*IBM*) are first steps towards a detailed and systematic presentation of service functions. But until now, there are no further guidelines / standard models with regard

to service functionality provided by the marketplaces. A closer analysis of the function lists of the selected service offers on *IBM Cloud* led to a first short list of mentioned analytical functions (e.g. data profiling, multidimensional data operations, static reporting, dynamic dashboards). This list of analytical functions was used as a basis of comparison during the literature-based development of the set of functional service description attributes presented in chapter 4 because all functions from the list had to be related to at least one attribute.

Table 1. Functional service description attributes used on cloud service marketplaces

Amazon Web Services (AWS) Marketplace	*Microsoft Azure Marketplace*	*IBM Cloud*	*Google Cloud Launcher*
- Textual service description - Service product video - Individual headwords of service product highlights - List of sub modules / products integrated in the service	- Textual service description - Screenshots	- Textual service description - Link to service documentation - Screenshots - Service product video - Individual headwords of service product highlights - Individually structured lists of service functions with textual function descriptions	- Textual service description - Link to service documentation - List of sub modules / products integrated in the service

4 A set of functional analytical service description attributes for service marketplaces

A detailed functional-oriented set of service description attributes has to cover the most important functional items and usage aspects of the particular software application domain. Information on the inner structure of a software artifact is stored in system architecture models or function models. To refer to the special section of analytical services, there are a couple of approaches regarding the architecture and functional layers of analytical software systems. The approach of [15] subdivides the *presentation layer, information allocation layer, data storage layer,* and *data collection layer.* This structure was selected because it includes a strict functional-oriented separation of layers. These layers are suitable for forming the first level of the set of analytical service description attributes. In this connection, the *presentation layer* refers to the aspects web interface and usability suggested by [9] (compare chapter 2). A literature search in monographs (e.g. [16,17]) and research papers regarding the functional range of analytical software systems on the different analytical architectural layers revealed single functions representing an own description attribute (e.g. display of a graphical diagram) with different attribute values (e.g. bar diagram). On the other hand, there are single functions (e.g. sending analysis results via email; providing analysis results in an XLS file) with a functional contiguousness which belong to a superordinate attribute (e.g. information distribution - instruments) (Table 2). As mentioned in chapter 3.2, the successful comparison of the functions derived from *IBM Cloud*-services with the analytical description attributes in Table 2 served as a first access point towards a more

extensive and still outstanding evaluation. The example of an energy consumption analysis service shows, how the functional aspects of this analytical service offer would be displayed for a customer on a marketplace.

Table 2. Description attributes of analytical services for cloud service marketplaces

Description attributes	*Comment*	*Possible attribute values*	*Example: energy consumption analysis service*
Presentation Layer			
Reports	Static presentation of analytical information without user interaction	- Yes/no	- Yes
Information distribution - instruments	(Technical) interfaces / instruments, whereby the analytical service pushes predefined structured analytical information towards a user	- File (doc, pdf, csv, xls, xml, …) - External database entry - Fax, email, SMS	- Email - File (csv, xls)
Information distribution - intervals	Specified interval for the supply with analytical information	- Fix time interval (every year/month/day/hour/…) - Specific date/time - Event-based (after data updates, ...)	- Fix time interval (user-defined) - Specific date and time
Dashboards	Dynamic presentation of analytical information in an interactive graphical user interface	- Yes/no	- Yes
Diagrams	Techniques of information visualization	- 2D, 3D - Diagram type (table, bar diagram, net graph, ...)	- 2D - Bar diagram
Alarm - instruments	Information distribution in the course of threshold violation	- Communication medium (display, email, fax, SMS) - Audio alarm	- Email
Alarm - escalation management	Functions to adjust alarm instruments or intervals in the course of continuing threshold violation	- Yes/no	- No
Information allocation layer			
Statistical methods	Mathematic methods to analyze basic data including data mining	- Methods of descriptive, inductive or explorative statistic	- Sum calculation - Average calculation
Multidimen-sional data operations	Methods to adjust views on multidimensional data	- Pivoting - Drill down, roll up - Slice, dice - Split, merge	- No
Analysis information	Labeling of concrete information objects provided by the service	- Performance indicators	- Active energy consumption (MWh)
Free data query	Function to create individual database queries	- Yes/no	- No

Description attributes	*Comment*	*Possible attribute values*	*Example: energy consumption analysis service*
Data storage layer			
Database architecture	Type of database model used by the service	- Hierarchic, relational, network, object-oriented, document-oriented	- Document-oriented
Integrated database	Name of a database product integrated in the service	- DB2, MySQL, …	- MongoDB
Data histo-riography	Handling of outdated data in the case of data updates	- Data update, data snapshot, delta historiography	- Data update
Data collection layer			
Data import	Predefined interfaces/data formats for the import of data into the database	- Standard interfaces/data formats	- CSV
Data export	Predefined interfaces/data formats for the export of data from the database	- Standard interfaces/data formats	- CSV
Data trans-formation	Functions to check data structure/quality and proceed data adjustments	- Data profiling - Data harmonization - Data enrichment	- No

5 Conclusion

The analysis of four cloud service marketplaces revealed an insufficient level of detail and a limited comparability regarding the functional description in the special domain of analytical service offers. On all marketplaces, classification models used for filtering don´t contain additional sub-categories underneath the level of analytical application systems, and textual service descriptions are not standardized and just provide heterogeneous structured content that is more or less related to analytical functionality. Only *IBM Cloud* considers the provision of a function list as a single description attribute, but a pre-configured functional structure is missing here as well. Due to this insufficient starting position, it was necessary to create a first draft of a functional-oriented set of service description attributes largely based on a literature review regarding the functional range of analytical application systems and supported by a set of analytical functions derived from the service-specific function lists of *IBM Cloud.* Additional research is necessary to evaluate the description attributes and to adjust the whole attribute set's level of detail to make it suitable for marketplace customers by means of expert interviews and a comparative study regarding the perceived comprehensibility and comparability of standard and enlarged service offers from a service customer´s perspective. The final attribute set could be used as a basis for analytical domain-specific enlargements of service description attributes on service marketplaces in practice and as a basis for further developments of functional analytical information system ontologies (e.g. in the context of OWL-S).

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