# The Needs of Service Identification for Service-Oriented Business Process Management

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**Abstract**

Since the trend of adopting SOA into enterprise applications, the needs for definition and identification of services have been recognized. There is a growing body of research carried out on the identification of different types of services. Identifying right granularity services is important: if the service is of large size, it goes against the reusability principle of SOA, whereas if the service is of small size, then it causes unnecessary computing power for implementing any business functions. Without a formal (semi)-automatic approach to identify services, it is difficult in migrating existing systems into service-oriented systems. This paper explores the need for service identification for service-oriented business process management systems. The current approaches, techniques and methods of service identification are reviewed, and limitations of the each approach is analysed. New requirements and techniques are demonstrated in creating improved dynamic services with consideration for interoperability, modularity, reusability within information environment.

**Keywords:** Service Identification, Business Process Management, Service-oriented Architecture, Information Environment, Service Interoperability.

## 1.0 Introduction

Service computing has become a trend in computing paradigm [1], [2] to describe business logic, self-containment and functionalities [2]. Service identification is one of the most essential and challenging phases of SOA development for constructing service-oriented solutions, [3] one of the major reasons is the flexibility and reuse of services which are beneficial to organization technically and economically, which has influence the effectiveness of SOA architecture and service modelling. Also, service identification is the first stage of the service modelling architecture. Thereby, service has to be identified rightly; any mistake made can result to incorrect service specification and realization [4], [3] which will affect the overall SOA-based system and increase IT cost.

It is evident that the phenomenon of service identification is still poorly understood, presenting significant challenges to organization's service specification and realization [5]. More specifically, there are no systematic approach to process a large scale analysis [7], [8], for example identify mission critically i.e. description on how service identification in organizations evolves due to emergence and improvement of SOA. Since the adoption of SOA into enterprise applications, the needs for definition and identification of services have been recognized [9]. There have been limited number of studies [6] that focus on service identification notion, analysis, approaches and methods, which are not efficient enough to understand and present a workable identification of services approach and method, without the dependent on the human factors i.e., different results of service identification are generated with the involvement of different users or people. In facing out this issue of different people and results, our method aims to generate right size services for service oriented BPM systems, systematically with less human influents.

The emphasis of this research lies on changes to the methodological approaches that have been proposed by several publications [10] which only fit for ad-hoc or non-experimental business cases. Furthermore, this research fulfils one of the requirements for full implementation of cloud computing.

First, this paper introduces the basic notions used and reviewed 187 well-cited publications, which will give us the understanding of differences, similarities and the short-coming of all these methods based on selected corresponding evaluation criteria which are used to give an overview of the review and comparison of the related systematic literatures [6] and scientific journals [11, 10, 12, 13, 2, 14] which will pave way towards the understanding and foundation for a new service identification. Secondly, this report improves how services are identified, (re)designed and (re)used.

Aside from service identification being the first step in the service-oriented modelling and architecture and identification of "right" service, the position of the service identification has to be known i.e. how it inter-relate with service oriented architecture (SOA), service oriented BPM and other paradigms (cf Figure 1). Service identification has expands its importance from service-oriented modelling to BPM systems and cloud computing, and there are ongoing researches on improving service identification in business and software systems.

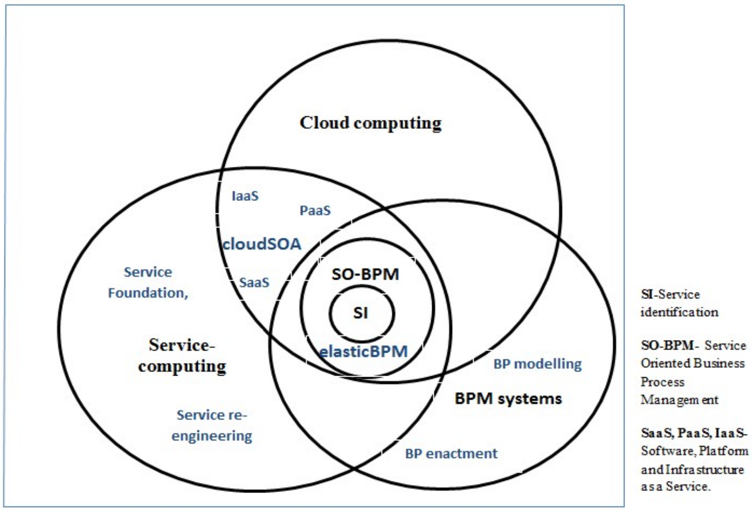


Figure 1: Position and importance of Service Identification in cloud computing, service-oriented systems and BPM system

The rest of this paper is organized as follows: Section 2 discusses benefits of service identifications. The existing service identification methods are reviewed in Section 3. In Section 4, we discuss requirements of a new method of service identification. Finally, conclusion and future work are summarized in Section 5.

# 2.0 Benefits of Service Identification

This research is driven by both the academic and industry, there have been several publications in the academia where the approaches are static i.e. they are built for a tailored case [15], [3], [16], which does not satisfy the needs of industries. Motivation: it is based on the knowledge of service identification depending on the right granularity of the services i.e. too large size of service which is against the re-usability principle of SOA, while too small size of service causes unnecessary computing power for implementing any business functions. With industries having requirements of migrating legacy systems into service-oriented systems, there is no formal (semi)-automatic approach to identify services for supporting and building business process management systems (BPMS).

*Purpose*: to develop a design method that is able to identify large amount of service using (semi)-automatic approach. There is no unified approach or method in identifying services, which the industries need to implement SOA systems [17]. This research provides a clear understanding and recommendations in achieving the right service identification method for supporting and building BPMS.

Once again, the identified business services in their right sizes are important because too small size of services requires too much time to compose for achieving any interesting functions and too big size of services required might not be reusable which is against the principle of SOA, therefore the “right-size” of business service has to be identified which fits for purpose, by knowing the “right” service granularity.

This research also contributes to understanding the notion, importance of applicability of service identification in BPM, cloud computing, and other service-oriented paradigms. Also, it introduces new concepts, approaches of identifying services and new ways of thinking about business services.

In 2005, organizations adopted enterprise architecture (EA) [18; 19] for the reduction of complexity and alignment of their business with information technology (IT), resulting into reduction in organization’s cost [4]. Lampe et al. (2013) [20; 21] highlighted “....15% to 20% of banks’ overall administrative expenses are attributed to the IT cost [20].

Figure 2 depicts the information technology (IT) spending on Information technology (IT) overhead 1%, infrastructure 24%, application operations and maintenance 45% and application development 29%, corresponding to 12-16 years of operation. In a study of the IT cost on various continent, DB research [46] stated that IT costs differ substantially, ranging from USD 270 billion to USD 460 billion for their 2013 budgets as shown in Figure 1,resulting to 7.3% of their revenues, as found by Forrester Research Inc. [22]. Financial institutions have to fulfil the banking regulatory requirements which contributes to the higher increase of IT cost, if the bank sector wants to reduce its IT cost, if the following things must be considered: (a) adoption of cloud computing will reduce the number further down from 24% on infrastructure spending, (b) the introduction of SOA into the application operations and maintenance, and application development will reduce the numbers, and further increase productivity.

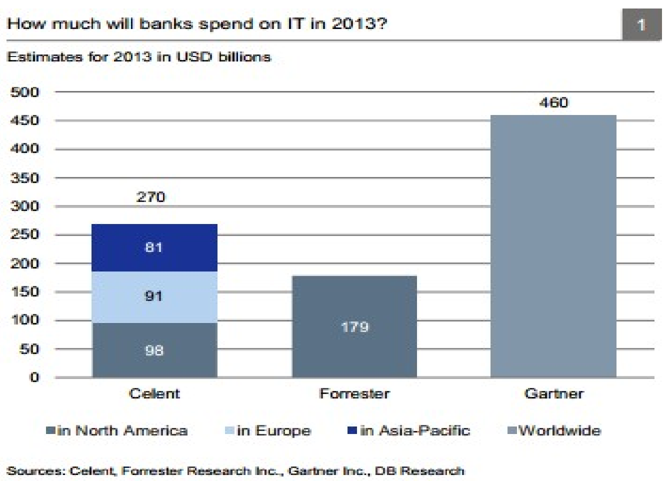

Figure 2: Estimating total spending on IT by banks [22]

*Scenario*: Schulte et al [21] demonstrated an example scenario which depicts a simplified business process scenario from banking industry. Figure 4 depicts the involvements and collaboration of international banks in different continents like Asia, Europe and America. Each of these continental banks has their own data processing facilities existing in the public or private cloud. It is important to know that service usage and exchange in cloud computing (public and private cloud) as shown in Figure 4, the services has to be identified rightly, else it will cost the organization technically or financially.

Already, financial industries like banks faces 15 to 20% of their overall administrative expenses to IT cost [20], which can be reduced when services are identified in its right size. The use of the word "right" is the best terminology for this domain which satisfies the technical metric (low coupling and high cohesion) and managerial metrics (low reuse cost principles).

Currents financial institutions like banks need to maintain the competitive advantage, so they install large information system which is different ranging from location to location, this graphical system in different country. In such, same banks can have separate systems which are mostly tailored to suit that particular branch of the bank, depending on the type of customer needs (some applications in the systems can be the same like the payment and withdrawn services. This makes banking administrative expenses higher, majority banking administrative expenses are partially classified as IT cost (figure 1). This IT cost is becoming more manageable because it is global-wise, distributive non-single systems, the inclusion of cloud computing into their systems helps to further reduce the IT cost. Considering the security of banks, the bank systems consider both private cloud computing (Figure 4) and for other reason like collaboration with other financial institutions, they use the public cloud computing.

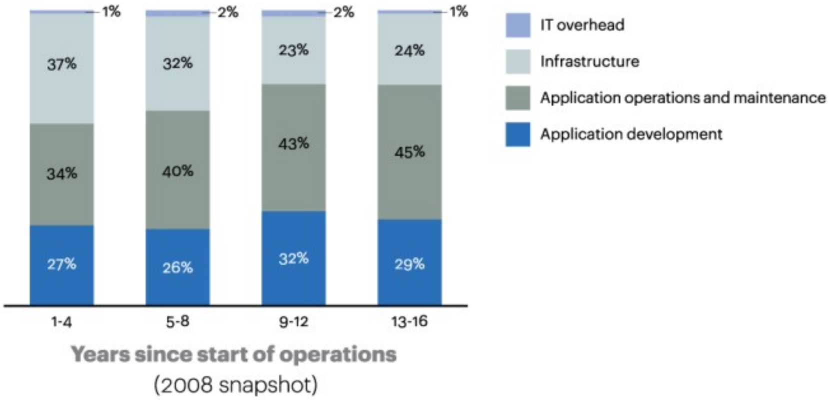


Figure 3: As operations age, maintenance spending increases and infrastructure spending falls [8]

With the increasing expenses for application maintenance and IT spending will end-up to be rigid. As shown in figure 2, huge business cost comes from IT overhead cost (1%), infrastructure (24%), application operations and maintenance (45 %) summing up to 70% cost, this cost can be reduced if they are service-oriented and they can out-source for other people to maintain, because they system is easy to integrate and they can pay-per-use. Thereby reducing the administrative expenses and cost to nearest minimum.

The practicality of service identification in service oriented BPM systems, and cloud computing has been delivered in different researches that can be used to guide the professionals users to manage or improve their business services and continually re-use, and monitor its dependencies, attributes and organization's expenses i.e., SOA reduces expense and cost by reuse and likewise, cloud computing reduces the expenses by pay-per-use. In other sectors like manufacturing, e-retail and Smart Grids, the overall administrative expenses will be higher than financial or e-health sectors. Today, SOA, cloud computing could further reduce the cost, and if the right service is created and (re)used, even when the organization's needs change dynamically.

The lack of developing and supporting tools for extensive support for simulation, business intelligence, business re-use, case management and many more [24] and the novel rise of new technologies, combination of existing features, components and principles gave rise to business process management. The combination of IT and business process redesign transformed organization and improve BPM [23]. In recent year, there are growing research in service-oriented BPM [25] and elastic BPM [21] which will further improve business process re-use, flexibility and reduce the gap that exist between the business process, their realization and alignment with technologies and software systems. As known that organization service might changes due to several factors (deregulation of market, global competitions, and increase of business or customer needs [6]).

## 3.0 Service Identification Method

In our research, we studied over 90 research works related to service identification. We analysed the service identification method in each work, comparing the basic characteristics, technical context, design principle and their method of engineering of each service identification methods. To derive a concrete comparison results, we short-listed the service identification method based on certain criteria for choosing the 10 publications which are as follows:

*a)* Formality of the technique: One major criterion is the formality used, whatever the method or approach proposed by authors, it is important to see the background terms of usage or implementation process. Majority of the service identification methods chosen, documented their methods by using case studies, formal or informal techniques. Therefore, the chosen of selection is based on formal technologies which is (semi)-automatic approach to identify a good amount of services.

*b)* Popularity of the papers, reuse or improvement of the method by other service identification methods or same author: In choosing the service identification methods, the methods that have been referenced i.e. well-cited more than two times or improved upon are considered, for instance, Bianchini et al. [14] method was improved upon in 2014.

These criteria give us the understanding of the differences, similarities and the short-coming of several numbers of publications in service identification methods. Selected corresponding evaluation criteria are used to give an overview of the review and comparison of the related systematic literature and scientific journals [6, 10, 11, 12, 13, 14, 26] are selected to pave way towards the understanding and foundation for current service identification methods. From the comparison of the service identification methods, most of the approaches lack rigorousness, constructiveness and reusable features in (re)-creating service(s) in any business case with the right level of granularity for maintainability and re-usability purposes across the enterprise. Therefore, it is important to note that our method will consider and develop upon the shortcomings of the current service identification methods. In achieving these, we adopt the top-down.

With the growing numbers of service identification methods (SIMs) in the past decade, there has not been an intense in-depth comparison of the methods. To create a new SIM, basic knowledge about the type of service to be identified has to be known i.e. understanding of services. There have been several publications which are business process-oriented, software process-oriented and also consolidated approach which is both software and business process oriented.

To further understand the characteristics of SIMs, the following are looked into namely: *(a.)* understanding of services- SOA paradigm of each SIM proposed, business-oriented granularity, development direction, *(b.)* Technical context of SIMs- this criterion describes the technical knowledge and quality of SIM namely: orchestration vs choreography, criteria of information technology, interaction with user, call frequency, strong cohesion and loose coupling, technical standardization, functional standardization, use of open standards, service performance, *(c.)* Method of engineering in SIMs - activities, results, sequences of activities.

## 3.1 Comparison of Service Identification Methods

It can be seen that publications used more of business process model as their input type showing that more work is been done into realizing the right identification of business services, but the downside of comparison is that same publications has illustrated informal techniques in the identification of business services, which means manually case by case analysis involved, [32] demonstrates their approach using algorithm, which could deal with requirements of large and complex systems.

Publication [15, 27] presented the principles of identifying services using the quality metrics (e.g. low coupling, high cohesion and high level of granularity). Also publication [16] presented their approach by considering the enterprise business process model and enterprise entity model and proposes a method for enterprise software service identification. [7, 28] describes what an overall approach could look like, but they fail to give more information, as their approaches are proprietary.

# 4.0 Requirements for the method

There are two types of requirements, industrial and academic requirements. Industrial requirement involves large amount of processes, each process involves at least over 100 activities, and several numbers of services can be derived from the activities. A survey shows that there are increasing research interest in the management of industrial collection of process since 2005. Examples of such collections, often described in the literature include: the BIT process library (735 process models), the SAP reference model (604 process models), and a reference model for Dutch municipalities (around 600 process models). Suncorp's process repository contains more than 3,000 process models for their insurance sector, with models ranging from 25 to 500 activities [21], while China Mobile's process model repository contains more than 40,000 models [27]. In total, a legacy system could easily have over 302,000 activities and over 600,000 data elements. In migrating the legacy system to service-oriented BPM systems, it is impossible to identify all the services manually which satisfy all constraints (such as reuse principle). Based on the drawbacks of the existing methods and the comparison generated, the weaknesses of the current service identification approach (value-based service identification [13], goal service modelling, domain decomposition, asset analysis, Use case analysis, enterprise service modelling, in-depth business process analysis, asset analysis and goal service modelling approach).Therefore in developing new service identification methods, there are series of requirements have to be considered

## 4.1 Formal definitions, techniques and model

Besides the strong economic and technology benefits (mentioned in Section 1.1), the whole point of comparison is to improve on the weaknesses or short-comings of past research work, thereby creating a tweaking and fine-tuned service identification methods. This is one of the motives for new method which give an intense formal definition of each approach, technological terms and techniques that will be used in realizing the aim of the research, adding a layer of universal solidity into the service identification, creating workable solution for different organizations.

Formal techniques are codifying formulas or rules to specify how services are identified [28], such as algorithm [1, 8, 11, 16, 29, 30, 31], ontology [2, 14, 32], pattern [33] and information manipulation [34]. Informal techniques are gives a guided routine or advice on how to identify services [35], such as guidelines [15, 36, 37] and analysis [2, 6, 12].

In creating a new service identification methods, the development direction intend to follow the following steps: manipulate the information elements (top-down strategy), the analysing and determination of the values for respective information elements using cluster algorithm, the structural analysis and formalization of the alternatives operations based on ontology and patterns, service quality analysis using the quality metrics like cohesion and coupling, and service performance like processing time, service response time and other considerable and applicable time.

## 4.2 Repeatable approach and undefined data type size

It is important that the workable approach should go through cycle of (re)checks for any error i.e. variability in the result for a given case can be detected early. Most of the current approach and method never considered this factor. Also, it important that our approach will not have a specified number of data type to use. It is required to take more or less data types for any case given.

## 4.3 The Information Environment

All organizations achieve their business goals, interest and needs through service sharing, usage and exchange, which contains information. This information could contain free flow or secretive data which can be accessed by the right agencies or individuals of a company. In business sense, an organization may demonstrate a clear position and service use but in the real world it may be heterogeneous in its feature and application i.e. it may be open or competitive in one context and protected and closed in another context. In identification of services around these contexts is an issue that has to be addressed. The current service identification methods and techniques possess unique features which might not be fitted for different business context.

### 4.3.1 Service Inter-Operability

It describes the technicality (e.g. transfer protocols, data formats), conceptual details (clearly unified and specified terms and standardized data models) which are intended to be in (open, competitive, protected and closed) information environment, platform independent and widely diffusible. None of the past publications considered the service inter-operability. In supporting ever changing business demands, the degree of service inter-operability should relate to the service change which is resistant to changing information environment.

### 4.3.2 Modularity and Autonomy

Some researchers consider the modularity and autonomy based on their design requirements which conforms to the principle of cohesion and loose coupling. Byrd et al. [23] highlighted that "...the benefit of modularity is that it provides organizations with the ability to add, modify and remove business processes with little or no widespread effects". Current methods does not consider the feasibility of add, modifying and removing of services especially when business requirement changes, this increases the agility and versatility of organizations. The metric for getting these principles are heterogeneous, reason why the resulting services do not have a guaranteed fit into inter-organizational functional needs. Publication [41] highlighted that "…the autonomous nature of services implies that services communicate to maintain control over the resources and to coordinate with other components of the SoA". Majority of the methods by other authors are independent, therefore the method proposed can be fully implemented on any platform including the cloud.

## 5.0 Conclusion and Further Work

The investigation shows that organization has always been a complex environment whose functions, processes and resources are daily thirsty for improvement. This improvement has not been fully achieved over the past years of servicing the need of customers and itself (organizations' business process).

In this paper, we presented the possible problems in achieving right identification of service presenting background knowledge, comparison of the existing methods and formal criteria for identification and enhancing right services and, finally give room for improvement related to the highlights of the drawbacks of Service identification. With the results generated from the comparison, drawbacks and requirements for new method, new methods can be created.

This paper will allow us to develop a comprehensive requirement for identifying services within different information environment considering the degrees of service orientation (inter-operability, adaptability, reusability, composability and autonomy).

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