Management as a Service for IT Service Management

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Abstract. With the advent of the distributed computing model, IT service management has to face ranging from simple point products to entire enterprise frameworks to address the various multi-device systems management challenges. The existing technology offerings rarely solve the entire problem because they are expensive to purchase, difficult to implement, and do not incorporate the full range of features and functions to meet the systems management requirements today's organizations face. Now, with low-cost information appliances creeping their way into the data center, the only way to truly address today's heterogeneous IT challenge is to enable systems management capabilities at the service level. IT professionals should be able to simply take management service and accumulated knowledge to improve management performance. A new approach to IT service management is emerging that enables this level of integration. Management as a service (MaaS) enable IT service management to build network management appliances, services and knowledge repository that are extremely flexible and capable of evolving as customer needs evolve. MaaS implementations unify different systems management features and products into a common management environment that spans all system management types. MaaS-based management service offer greater flexibility and more cost-effective implementation than any enterprise framework can achieve. MaaS helps to make full use of the benefits offered by enterprise's converged network by identifying and resolving problems more quickly, more accurately, less expensively, and with more visibility than silos might be able to achieve on enterprise own.

1 Introduction

Agility of a company's response to customer demand has been recognized as a critical success factor to meet the global competition in current market environment [1][2]. More and more complex IT service assets that supporting business application require an automatic and flexible ability to react to the dynamic market environment, which forces companies to improve their efficiency and flexibility on IT service management. A key challenge for dynamic IT service management is that IT infrastructure is highly complex and configurable, and business requirement often have dynamic change on IT component configurations, which require administrator who in change of IT service management has

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high professional skill about IT infrastructure in physical layer and business application in logical layer. With ever-growing complexity in the IT enterprise, IT departments have to face requirement of improving the alignment of IT efforts to business needs and managing the efficient providing of IT services with guaranteed quality [3].

To support this business requirement, more and more enterprises are adopting best practice standards in service management such as IT Infrastructure Library (ITIL) [4]. Configuration Management Database [5], CMDB, is considered as a best practice in the U.K. government's ITIL. It is used to store significant components information of the IT infrastructure [6][7][8] that helps an organization understand the IT service assets and track their configuration. Several vendors claim to provide a ready-made CMDB, such as BMC, Tideway, EMC and so on. It is common to see these vendors collaborate with the larger service players like IBM and HP who brand these solutions as their own implementations. Thus, CMDB has already been considered to be a provider that support vision on IT infrastructure information in industry field.

However, there is still no solutions for IT professionals manage IT service smartly. With ever-growing complexity in the IT infrastructure, even if all the information of the systems and operations are recorded, IT management personals can only get confused and be lost in the trivial details. IT service administrator has to face solution training for various problems in IT service management continually when business application updated. The investment on management system is always increasing with business application change.

With the question of how software delivers its functionality to users[9], Software as a service [10] (SaaS) envisages a demand-led software market in which businesses assemble and provide services when needed to address a particular requirement. The SaaS vision is a vital contribution to current thinking about software development and delivery that has arisen in the Web services and electronic-business communities.[11]

In this paper, just like as SaaS, management as a service (MaaS) is proposed to focuse on separating the possession and ownership of IT service management from its use. Delivering management function as a set of distributed services that can be configured and bound at delivery time can overcome many current limitations constraining management software use, deploy, and evolution. In addition, MaaS has a special feature unlike SaaS is that it will provide the content service that help IT professionals to improve IT service management quality. Experience and knowledge about IT service management will be accumulated within MaaS. The knowledge can be reused and shared in different environment when they have been verified in prior cases by IT professionals and subject matter expert (SME).

2 Current IT Service Management

Configuration management database (CMDB) is provided to serve as a repository and information retrieval tool for services as IT infrastructure model, and also as a platform for information integration between the other ITSM processes.

Although CMDB provides the inventories for managing IT configuration items effectively, it has not revealed the context hiding in the complex and huge IT configuration items management. The current CMDB framework has not satisfied the requirement of business application in next step such as mapping between application and IT infrastructure, reuse of management knowledge and impact analysis [12].

In fact, in a modern enterprise environment, IT components do not provide business value by themselves, but in concert with each other the business realizes benefits [13]. So, grouping one or more components into business applications from the complex and huge configuration items on a higher level is more helpful to IT service management than just report the component's configurations in CMDB.

Business applications are important as they intend to represent the business purpose and function across one or more enterprises, according to business application defined rules and policies. In CMDB, a business application typically defines the individual business service components, relationships among these components and the configurations of them. As shown in Fig. 1, IT service components of various IT infrastructure will be collected and integrated in CMDB, and these data is utilized to support IT service management for specified business application. This requirement of business application management brings a challenge that how to management the business application and filter the noise data from huge and complex configuration items data in CMDB, and extract the proper configuration items and their relationships about the special business application to a more simplify and effective view of business configuration management for management personal.

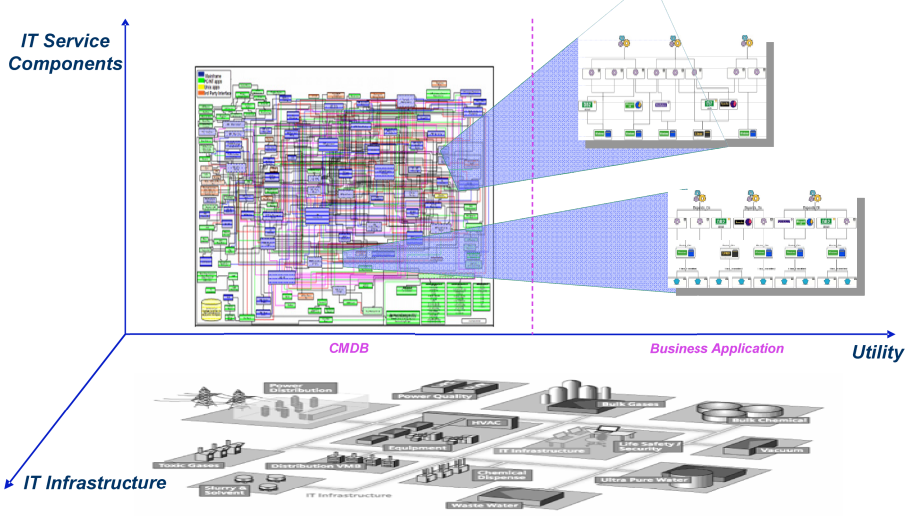


Fig. 1. Information integration and utility for IT service management with CMDB

Business application definition demands professional and rather experienced experts to define business application domain, such as what are the main components in the business application, what are the key configurations for management, etc. One of the key open challenges to experts is performing dynamic configuration management for highly configurable business application with dynamic user preferences. IT services are typically highly configurable, with significant service customization possibilities and a choice of business application purpose, e.g. CRM/Home banking, naturally each with its own application configuration. Customization is critical for them to be able to differentiate themselves from competing business services and offer a better service experience to their customers. Application administrator themselves have certain preferences on which service items and configurations they want to use and their preferences may change dynamically. Given their significance, there is a strong need to support application-oriented data services for user preference [14][15][16]. However, we are still lack of efficient methods for the representation and management on user-preference in IT service management.

Current ITSM architecture uses processes to integrate disconnected tools and configuration information into an end-to-end solution. It provides the framework to optimize the use of people, process, information and technology to deliver quality services to support business goals rather than focuses on disconnected technologies and tools. However, as we discussed above, current architecture lacks a systematic means to address an important aspect in ITSM - managing the knowledge separated in various tools and the minds of domain experts.

3 Sample MaaS Scenario

The following scenario demonstrates the ideas inherent in the management as a service concept.

In Fig. 2, SME individuals, communities with different skill levels and focuses get involved in service tasks through the Management Service Center platform. They provide the knowledge and solution for various business problems. Service Center staffs manage multiple remote customer sites, process service requests and conduct complex, knowledge intensive tasks, while customer employed administrator performs the routine management tasks for his organization.

At the customer site, a management appliance is deployed. It provides basic management functions for customer employed staffs to conduct routine IT management tasks. As an appliance, it hides the complexity of deploying and managing the management software itself.

Customer admin can access the global service catalog through the appliance to subscribe advanced management functions, or request services from the service center. The appliance will also be an agent for collecting the necessary information for required services.

For the management service center, the staffs can manage multiple customer sites remotely through the service portal. They can deliver advanced management services to customers by using advanced management functions and the

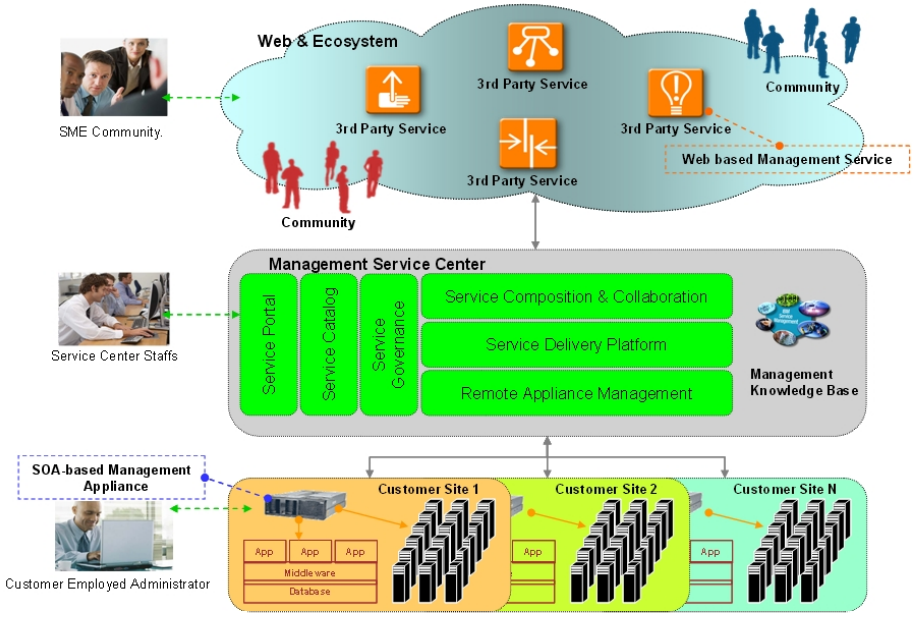


Fig. 2. Deliver management as a service

knowledge base. Some required functions to enable the services will be deployed to the appliance dynamically.

The service center is also the platform to involve external communities to serve the customers. It can integrate services through the web to complement existing services and it can involve selected expert communities for specific tasks. Meanwhile, the service center will manage the service delivery process with good governance.

4 Implementation of the MaaS for ITSM

In this section, a proof of concept (PoC) project BIANCHIN is developed to validate the vision of management as a service (MaaS), as shown in Fig. 3. It is built on the Eclipse Toolkit with Java technology, and implements a container for data capture platform, information extract, business application topology design and visualization, SME's knowledge management and impact analysis service for system management in global within distributed computing environment.

4.1 Data Capture Platform

This platform is in charge of collecting IT infrastructure data from various domains including configuration, operation, business-level performance indicators and others. Two adapter-based mechanisms, data federation and snapshot, are

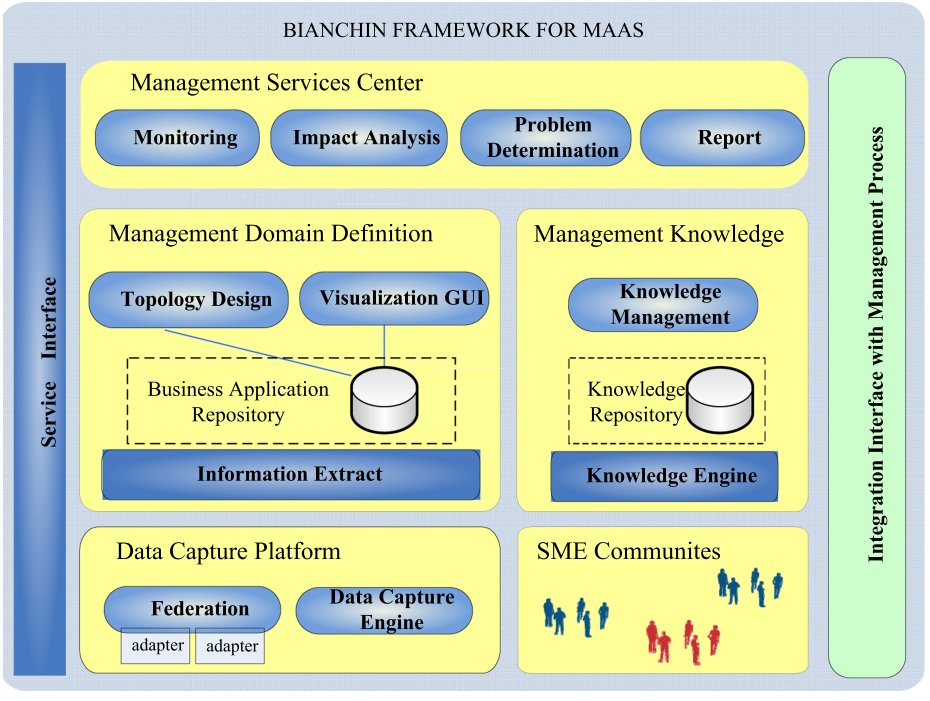


Fig. 3. BIANCHIN framework for MaaS

designed in the platform. For data already discovered and stored in existing monitoring tools such as IBM Tivoli Monitoring product and IBM Tivoli Application Discovery Dependency Manager (TADDM) [13], adapters can be developed for data federation. For other necessary data not stored in any existing data repositories, snapshot adapters can be developed and plugged in to broaden the width of data collection. The Data Capture Engine controls the data capture process. It decides which adapters should be enabled or not to control the capture scope. It also controls the frequency of data capture by trigging the adapters at different time points according to a pre-defined schedule.

4.2 Information Extract

IT infrastructure data collected from various data sources are mainly for showing the details of IT service components such as configuration items (CIs) and their relationships, normally not reflecting a special business application and its topology. The data available in an enterprise with complicated IT environment is always too huge and complex to management. What data should be provided for managing business applications, which one is in the charge of administrator, is still a pain point for ITSM.

In BIANCHIN, information extract module provides a platform to help administrator to specify the data set that belong to a certain business application. Once defined, the target management domain (subset of IT infrastructure data) can be reused for various management task associated to the business application. And it is knowledge that can be shared with other administrators in the same management domain for improve management efficiency, because target management domain definition is a time-consuming work that requiring high skill on IT infrastructure analysis.

4.3 Business Application Topology Design and Visualization

Business application topology vision is very helpful to user to visualize a mapping from business application to IT infrastructure, which provides a view to know what hardware, software, middle-ware, service are dependent by the application. Then a management on financial, security, resource, etc. can be operated well-founded. Moreover, it provides a potential asset report to IT infrastructure investor about the IT service utilization on the business application.

BIANCHIN provide a customized IT infrastructure topology layout for various management scenarios. End-user can design their preference visualization about the target management domain. It allows data filter in different topology to highlight key components related to specified application, transfer different layout between various user preference styles.

4.4 SME's Knowledge Management

Knowledge Repository and Knowledge Management module provide a service to accumulate and share with SME's knowledge about IT service management. The knowledge coming from SME is stored in the knowledge asset repository. These assets serve as basic constructing pieces to build more specific and meaningful forms of knowledge for various operational tasks. The knowledge for different management task groups is organized as knowledge management categories such as problem determination, configuration recommendation and impact analysis. For example, a service outage can be defined as a problem data pattern along with a symptom description in the knowledge asset repository. The pattern detection facility can automatically discover from the captured data to notify if the problem occurs. Once the problem is detected, data comparison facility can figure out the most possible root causes of the problem by presenting the changes between the current version and the latest healthy version. Once the root cause is confirmed as a combination of incorrect or conflicting system configurations, it can be recorded as another data pattern as a root cause to the known problem. The management staffs can associate the root cause data pattern with the problem data pattern as well as textual descriptions and the fixing solution in the knowledge asset repository. And then, when the problem happens in the future, the system can automatically check if it is caused by the same reason and if does.

4.5 Management Services Center

As mentioned above, IT service management is becoming more complex in distributed IT infrastructure than before. It need more experience and knowledge coming from high skill staffs for improving management quality and efficiency. Take management as a service provides a cooperation framework for sharing management knowledge with more quickly, more accurately, less expensively than silos might be able to achieve on enterprise own.

Management services center in BIANCHIN for different management task groups is organized as IT service management categories such as monitoring, impact analysis, problem determination and report service. Those services can be invoked when perform a remote IT service management work with SME knowledge on demand for various management scenario. They can be embedded in web-based management platform, SOA-based management application and so on.

5 Case Study

The example selected to demonstrate the cooperation of IT service management based on management services within solution matter experts (SMEs) that sharing the management knowledge for a special business application, "Online Trade", a benchmark of distributed J2EE business application. The services provide a platform for IT service topology of a business application, and delivering the topology defined by application experts to the business impact analysis SMEs. Then, with knowledge integration on various impact rules of business impact by IA SMEs, an impact analysis service is invoked for analyzing a starting point change, such as a database server outage, operation system patch, etc. It returns the impact scope including hardware, software, service, application and so on. Moreover, the reason can be attached on the report because of the SME's impact rules. This function was originally implemented in expert system within the scope of problem determination project. Then it was decided to reuse it as a service in SOA.

5.1 Extracting Business Application Management Domain

Within the CMDB of IT service management, the target components of business application that will be monitor and management were mix with other redundant IT service components as shown in Fig. 4, so the first step in ITSM was to extract target management domain from the complex environment with thousands of IT service components and to place it in a separately compliable module with its own components division. This work needs special skill that the operator is very familiar with the target application domain, especially the topology of IT infrastructure about the application. The candidates might be the engineer who designed the application, who deployed the application and the execution administrator. In the "Online Trade" application case, the application

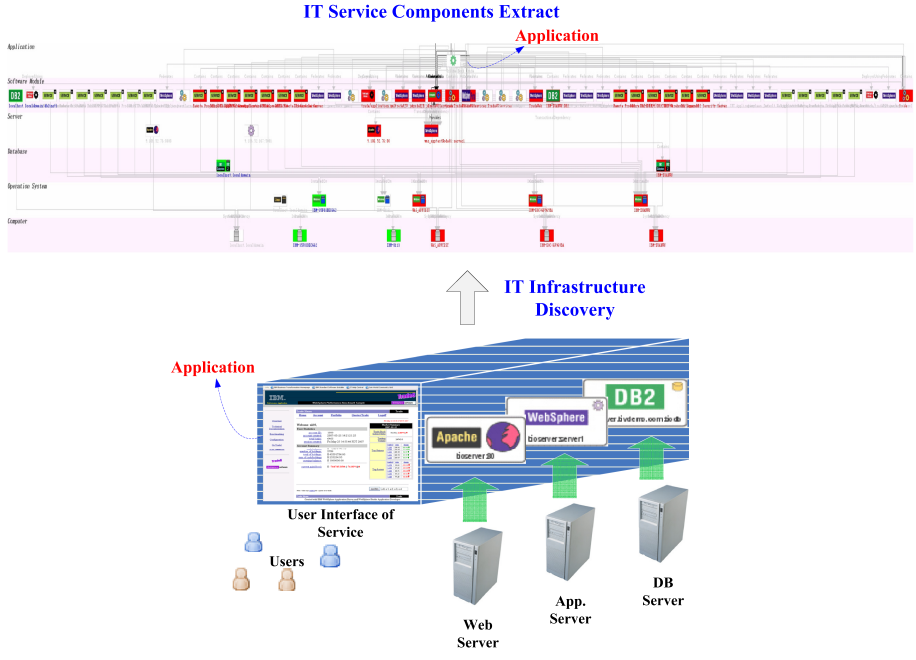


Fig. 4. IT service components extract for business application from IT infrastructure of "Online Trade"

is extracted that contains 32 components from 73 IT service components, and 73 relationships from 122 relationships.

Besides the target components extraction, a service of customized business application topology vision for different context is import for special scenario. Different angle of view will highlight some specified details to help audience to understand the target object easily. Especially, the user preference style will make user to learn efficiently that will improve the communication within different users based on the same data set with user-preference visualized layout. As shown in Fig. 5, a bottom-up business application topology layout and a top-town layout from application indicate two management scenarios. The former is the system administrator's preference layout, and the later would be helpful for application administrators.

5.2 Impact Analysis Rules Management

A distributed business application always includes various components for composing a complex function for special business purpose. It may be include hardware components (host, hard disk, memory, CPU, etc.), operating system (Windows, Linux, UNIX, etc.), database (DB2, Oracle, MySQL, etc.), application server (Websphere Server, J2EE server, WebLogic server, etc.), software module (J2EE module, IIS module, Web module, etc.) and so on. As to impact

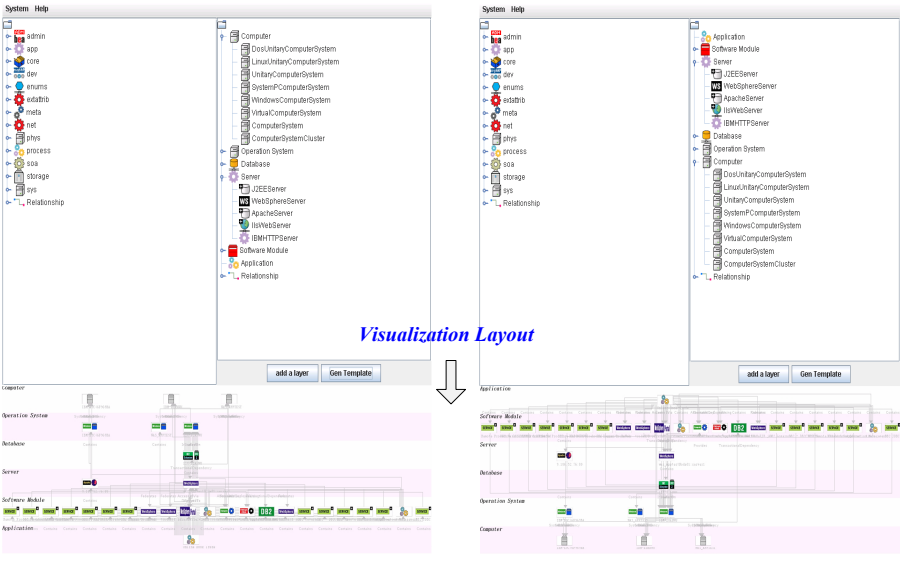


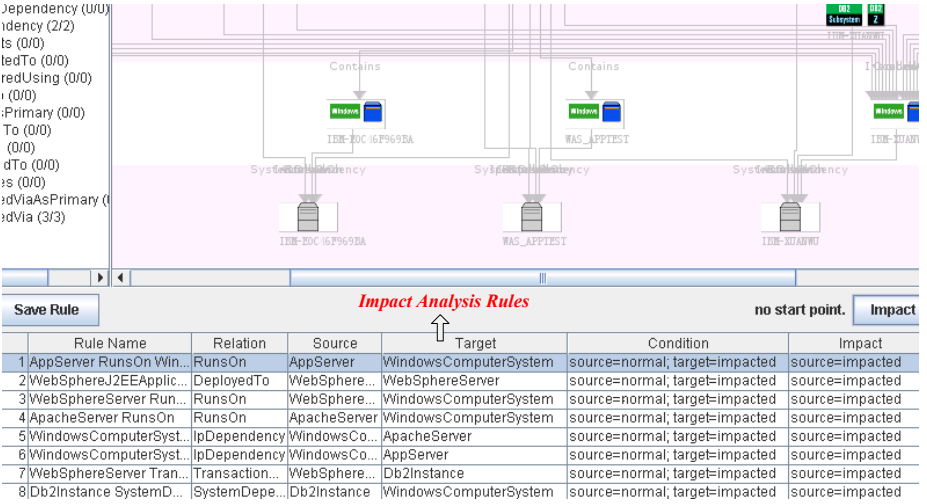
Fig. 5. Customized Business Application Topology Design GUI

rule, there is no an omniscient to define all rules about various fields. Hardware engineer should be the best candidate to define the impact rules about hardware components such as memory problem might cause blue screen problem. And windows SP2 patch will impact all software running on it because it will cause windows operating system reboot. Till now, those knowledge stored in different SMEs, and do not incorporate the full range of features and functions to meet the systems management requirements today's organizations face.

Management as a service is not only provide service to remote system management, but also sharing the management knowledge in various SMEs' knowledge for dealing with emerging complex business application.

In our case, different knowledge coming from various SME are combined in impact analysis knowledge repository. The BIANCHIN provide impact analysis service with professional knowledge to solve management problem. Customers can invoke the service and associated knowledge to archive their management purpose.

An impact analysis rule in BIANCHIN consisted of five parts, rule name, source, target, relationship, condition and impact. Rule name is a simple description about the impact rule. Relation denotes that a dependency between source point and target point in IT service components. Condition is the fire point of the rule, such as condition in rule 1 shown in Fig. 6., "source=normal; target=impacted" means that "if Application server that runs on a windows computer system, and the windows computer system is impacted" is true, then the rule will be fired, and the application server will be impacted too, which is as a impact result in the rule.



	Rule Name	Relation	Source	Target	Condition	Impact
1	AppServer RunsOn Win...	RunsOn	AppServer	WindowsComputerSystem	source=normal; target=impacted	source=impacted
2	WebSphereJ2EEApplic...	DeployedTo	WebSphere...	WebSphereServer	source=normal; target=impacted	source=impacted
3	WebSphereServer Run...	RunsOn	WebSphere...	WindowsComputerSystem	source=normal; target=impacted	source=impacted
4	ApacheServer RunsOn	RunsOn	ApacheServer	WindowsComputerSystem	source=normal; target=impacted	source=impacted
5	WindowsComputerSyst...	IpDependency	WindowsCo...	ApacheServer	source=normal; target=impacted	source=impacted
6	WindowsComputerSyst...	IpDependency	WindowsCo...	AppServer	source=normal; target=impacted	source=impacted
7	WebSphereServer Tran...	Transaction...	WebSphere...	Db2Instance	source=normal; target=impacted	source=impacted
8	Db2Instance SystemD...	SystemDepe...	Db2Instance	WindowsComputerSystem	source=normal; target=impacted	source=impacted

Fig. 6. Knowledge management module of impact analysis rules

With the rule management in BIANCHIN as shown in Fig.6, various SME can cooperate with each other for editing and verifying the rules through Internet in global, which accumulates the rules coming from SME to knowledge repository for various business solutions. In the case, they could be OS patch impact analysis, DB2 maintenance impact analysis, hardware updating impact analysis and so on.

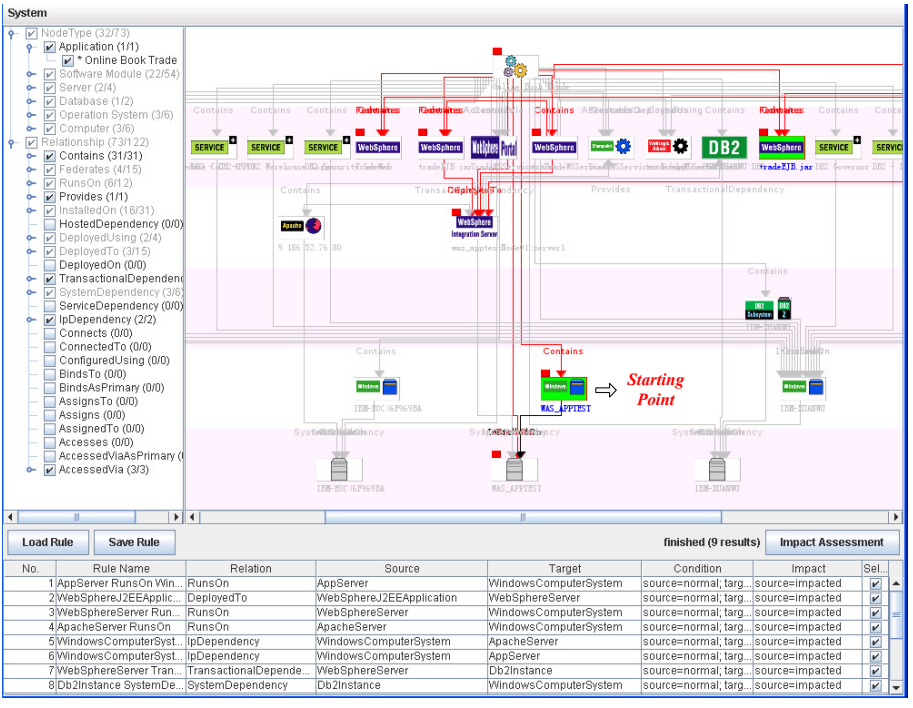
5.3 Invoke Impact Analysis Service

After user import the target management domain that defined by domain experts and knowledge base coming from SME, impact analysis service can be invoked to deduce a impact scope for a specified starting point. In BIANCHIN, it has been packaged in applet, and use the sample code as follow to invoke the service for web application.

<applet archive="lib/ImpactAnalysis.jar, lib/jxl-2.4.2-s.jar, lib/UIframework.jar, lib/sdl1.0-s.jar" code="com.ibm.research.component.ImpactAnalysisApplet.class" codebase="." service_url = "http://192.168.100.33:8080/axis2/services/IAService /ieInterface" width="980" height="680" align="center"> </applet>

The above sample code shown that an SOA-based approach, impact analysis service "http://192.168.100.33:8080/axis2/services/IAService/ieInterface"is invoked for deducing the impact scope with the starting point and SME knowledge automatically.

For example, a management operation request will cause windows operating system outage on component "WAS-APPTEST"in Fig. 7. Expected components that will be impacted are mark with red cube when the "Impact Assessment"is



No.	Rule Name	Relation	Source	Target	Condition	Impact	Sel.
1	AppServer RunsOn Win...	RunsOn	AppServer	WindowsComputerSystem	source=normal; targ...	source=impacted	☑
2	WebSphereJ2EEApplic...	DeployedTo	WebSphereJ2EEApplication	WebSphereServer	source=normal; targ...	source=impacted	☑
3	WebSphereServer Run...	RunsOn	WebSphereServer	WindowsComputerSystem	source=normal; targ...	source=impacted	☑
4	ApacheServer RunsOn	RunsOn	ApacheServer	WindowsComputerSystem	source=normal; targ...	source=impacted	☑
5	WindowsComputerSyst...	IpDependency	WindowsComputerSystem	ApacheServer	source=normal; targ...	source=impacted	☑
6	WindowsComputerSyst...	IpDependency	WindowsComputerSystem	AppServer	source=normal; targ...	source=impacted	☑
7	WebSphereServer Tran...	TransactionalDepende...	WebSphereServer	Db2Instance	source=normal; targ...	source=impacted	☑
8	Db2Instance SystemDe...	SystemDependency	Db2Instance	WindowsComputerSystem	source=normal; targ...	source=impacted	☑

Fig. 7. Impact assessment from a specified starting point in target management domain

finished. There are 9 components will be impacted because of the starting point operation in the target application domain with 32 components. From the starting point, computer "WAS-APPTEST" will be impacted because the windows operating system running on it is outage. A websphere application server runs on "WAS-APPTEST" will be impacted because the computer is impacted. Then the components "tradeEJB.jar", "tradeWebModule", "tradeJ2EEapplication" will be impacted because they were deployed on the websphere application server. Farther on, a business application "Online Trade" will be impacted because its components have been impacted.

This case provides a whole picture for user to review what will happen when a component is changed, which will help to do a just operation more quickly, more accurately, less expensively, and with more visibility than silos might be able to achieve on enterprise own.

6 Discussion and Future Work

In this paper, we present a vision of management as a service for improving IT service management performance, and a case of impact analysis service in MaaS is shown that the performance of system management is not only depends on the

software system of management, but also the knowledge in administrator and experts. People need to change their mindsets. IT service management solution has to think in terms of providing a service itself, not just providing technology. Take management as a service will identify and resolve management problems more quickly, more accurately, less expensively, and with more visibility than silos might be able to achieve on enterprise own.

Although MaaS has some problems need to identify and solve, such as in our case, impact analysis service, how to evaluate the quality of knowledge, how to acknowledge and benefit the SME who contribute their knowledge, how to authorized the knowledge and data can be used in properly, are still open questions. As an emerging solution for improving IT service management in global enterprise, MaaS has shown some potential chance in current dynamic market environment.

Management as a service (MaaS) allows companies to maintain full internal control of their IT investment and existing infrastructure while outsourcing the day-to-day management and monitoring of their infrastructure such as the operating system, database, networking and application layer.

MaaS vision manages and supports distributed business application in enterprise that includes IT infrastructure such as operating system, application and database layers, providing experts' knowledge to ensure that IT infrastructure is performing optimally.

MaaS extends into four levels of service - conveniently packaged and easily scalable to help administrator adopt remote management for routine and time-sensitive tasks. Remote management assistance service can be used as a consultant service for explore more business chance. With continual knowledge accumulation on seamless management and technical support by the SMEs - these packages ensure that end-user experience and key business functions are improved continually. Finally, all these come to end-user at an affordable cost without maintaining complex management system reside in user's enterprise.

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