A new service class scheme for service innovation in Japanese automation industry

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Abstract

This paper proposes a new service scheme in the industrial automation service classification. It clearly categorizes and orders the seven types of industrial automation service from the view point of customer value. This service class depends on some previous work by GAMBICA and ZVEI, and it is modified and newly created to fit the Japanese automation industry. The proposed service scheme in this paper could bridge the gap of service value understanding between customers and service providers and enable service innovation by smoother and wider out-sourcing of traditional plant operation and field maintenance.

Keywords:

Industrial Automation, Service Classes, service categorization, product service, system integration service, plant maintenance, operation service, out-sourcing

1 INTRODUCTION

The Japan Electronics and Information Technology Industries Association (JEITA) is an industry organization that conducts research, promotes the diffusion of innovations, and makes policy proposals on the latest electronics and information technologies. The authors of this report belong to its Control and Energy Management Committee and a working group of the committee has conducted a general study of the service business in the Industrial Automation Systems business. Specifically, it researched a new service scheme to be applied in the industrial automation industry, aiming to define a value oriented mechanism and standardization.

2 BACKGROUND

Many industrial plant owners are having difficulties in out-sourcing their internal tasks, as they are urged to restructure their maintenance and operations to survive in the fiercely competitive global market. Such tasks include instrument and device maintenance, system design changes for production enhancement and upgrade, and process performance and quality optimization to maintain secure and efficient plant operation. As those tasks require a wide range of engineering skills and knowledge, it is inherently difficult to reassign internal work procedures to be executed by temporarily out-sourced service provider staff. To overcome the above mentioned service problems in the plant automation fields, the concept of service science[1), 2)] gives us new ideas on how to ensure the value of plant automation services. The service science perspective focuses on how to ensure value is created in a scientific manner[3)] and how to build new services by using engineering methodology. Some examples in project management firms[4)], machine maintenance[5)] and aerospace maintenance, repair and overhaul services[6)] are typical of similar fields.

3 ISSUES WITH AUTOMATION SERVICES

At large scale industrial plants such as oil refineries and petrochemical plants as shown in Figure 1, an enormous number of sensors and instruments are installed to enable non-stop, year-round safe and stable operations. This involves the use of many service

engineers to maintain the production process and equipment. Their tasks vary from simple routine work to dangerous and complex work which needs deep knowledge and many years of experience. For decades employees in the maintenance department of operating companies have carried out daily checks and routine maintenance in the field. As the number of skilled maintenance engineers is decreasing due to retirement and work rationalization, increasing portions of their work are out-sourced.

However, there are many cases where the plant users and service providers are not mutually satisfied with the service pricing and resulting value because the former is usually determined by man-days and hardware cost related to the work. To understand this better, JEITA's working group conducted a survey in October and November 2012. The survey comprised of 14 questions regarding service contracting clarity, service quality, service evaluation and the impact of long product life-cycles on service continuity. Each question asks how often a certain problematic situation occurs for the respondent and how it affects prioritization of service issues. The survey was conducted on 10 plant users and 5 automation service providers in face-to-face interviews. The result shows the following 5 issues are more important among both plant users and service providers.

1) In case of trouble, it is sometimes difficult to determine the specific cause of the problem
2) Many instruments and devices have been in operation more than 10 years and it is a burden for both customers and service providers to maintain those that were obsoleted years ago
3) It is difficult to choose the right service provider with enough capability required for the work
4) There are miscommunications on the scope of work and the detailed work content
5) Imported products tend to have more trouble than domestic products because of for instance, the sales representatives' sudden end-of-support.

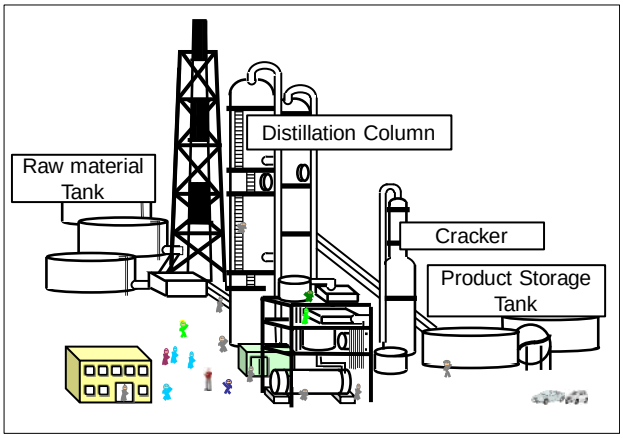


Figure 1. Petrochemical Plant

These issues not only obstruct the proper out-sourcing of the work but also cause mistakes which may even result in serious accidents at the plant. Table 1 shows an excerpt of the survey results.

Table 1. Industry Service Survey Result (excerpt)

Business issues	Frequency of occurrence: frequently	sometimes	rarely	never	n/a
In case of trouble, it is sometimes difficult to determine the specific cause of the problem	13.3%	66.7%	20.0%		
Many instruments and devices have been in operation more than 10 years and it is a burden for both customers and providers to maintain.	40.0%	33.3%	20.0%		n/a
It is difficult to choose the right service provider with enough capability required for the work	26.7%	46.7%	20.0%		n/a
There are miscommunications on the scope of work and the work content	20.0%	46.7%	26.7%		n/a
Imported products tend to have more trouble than domestic products because of sales reps' sudden end-of-support.	26.7%	33.3%	33.3%		n/a
Service coverages are not clear depends on vendors.	13.3%	40.0%	40.0%		n/a
Service should also cover other providers' products.	26.7%	26.7%	20.0%	13.3%	n/a
It is difficult to judge if the pricing of service is adequate.	13.3%	33.3%	46.7%		n/a
It is difficult to make fair evaluation of service providers and personnels.	13.3%	33.3%	33.3%	13.3%	n/a

more important issues

4 EUROPEAN AUTOMATION SERVICE CLASSES

The issues raised in the previous section are common among large industrial plants worldwide, including those of Japan. Three European automation industry societies; GAMBICA in Great Britain, Zvei in Germany and Gimelec in France, are cooperating and acting to establish a unified service scheme called 'Automation Service Classes' to classify various types of service work in the automation industry. They defined various criteria with examples to divide automation service work into seven classes.[7),8),9)] They aim to eliminate misunderstandings about the service content, quality and work level between plant owners as the customer and service providers, so that a greater portion of automation service work can be out-sourced with the correct value and pricing. In their scheme, all automation service work is categorized into seven classes (Class 0-6) according to the following 3 criteria:

1) Which party takes the primary responsibility for decision making; either the service provider or the customer?
2) What is the target; either a product (instrument or device) or an integrated system with several products?
3) Is the work predefined, routine and repetitive, or customized for each activity?

Table 2 shows a survey of European service classes and explains the seven class definitions of the European societies showing service class names, descriptions, party with primary responsibility and the service outcome provided to the customer. The service complexity tends to increase as the class number increases, but it should be

noted that the higher classes do not necessarily include lower classes.

Each class definition is basically equivalent in GAMBICA and ZVEI definitions, but there are some differences. It is notable that advising on application aspects is also included in Class 3 definitions of GAMBICA, which might indicate business practice differences between the UK and Germany. It is also notable that holistic asset management (parts management) to enable plant availability is only included in Class 6 of GAMBICA, while that of ZVEI focuses more on enterprise management level services such as management of a multidisciplinary company group relative to the process.

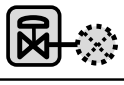
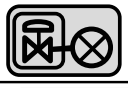
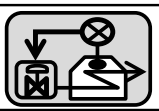
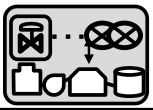
Table2. A Survey of European Automation Service Classes

Class	Name	Description	ZVEI and GAMBICA comparison	Prime Responsibility	*Supplier* provides
0	Basic Services – product related	Services directly related to a product, required to comply with statutory requirements which should be expected of any *supplier*.	Equivalent	Customer	Product Level
1	Standard Services – product related	Pre-defined, standardized services directly related to a product.	Software upgrade is included with ZVEI		
2	Customized services – product related	Customer-specific services adapted to the customer's environment. Services for fitting a standard product to the customer's environment.	The customer provides direction to the *supplier*, and retains overall responsibility with GAMBICA.		
3	Application-specific services	The *supplier* provides services for adapting / configuring products to the specific application. The *supplier* assumes responsibility for the proper functioning of the application within the scope of the deliverable.	In addition to the common definition, the *supplier* also advises on or verifies aspects of the application with GAMBICA.		Solution Level
4	System-related services	Services supplied for designing, configuring, implementing or maintaining an automation system.	In addition to the common definition, system commissioning is included with GAMBICA.	*Supplier(*)*	
5	Plant-related Services	Services supplied for integrating an automation system into the process environment and/or the production information system of the customer.	Participation in feasibility studies and budgeting are included with ZVEI.		
6	Extended Plant-related Services	Services supplied for achieving a specified process performance for a customer's plant.	Holistic asset management (parts management) to enable plant availability is included with GAMBICA.		

*) European service classes use the term '*supplier*' equivalent to 'service provider' in Japanese service classes

In addition to each service class definition, Table 3 shows the service scope of each class. Within the product related services from Class 0 to 3, Class 0, 1 and 2 cover the delivered product only, whereas Class 3 covers the usage of the product including the adoption to the application environment and the interface to 3rd party products. In Class 4, multi-vendor products integrated as a system are the target scope of the services, but do not include the production process. Therefore, following on, the main target of Class 5 is the production process and the target of Class 6 is the complete plant operation with the combination of multiple production processes.

Table 3. Service scope of each class

Class	Name	Service Scope	Service Type
0	Basic Services – Product Related	 Delivered Product only	Product Support (Free of Charge)
1	Standard Services – Product Related		Product Support
2	Customized Services – Product Related		
3	Application-Specific Services	 Adaptation to a specific application including the interface to other suppliers product	Project Support (Project Assistance)
4	System-related Services	 An automation system including other suppliers product	Project Management
5	Plant-related Services	 An automation system including the process environment	
6	Extended Plant-related Service	 A whole plant, production site	Project Contract

5 JAPANESE SERVICE CLASSES

As many of the members of the JEITA Working Group belong to automation service providers, they studied their own business services and categorized them into the seven classes. While keeping the basic concept of the European Automation Service Classes, a new standard and guidelines have been made, suited for Japanese work practices.

The following 3 points apply to the re-definition of Japanese service classes:

a. Japanese service classes will replicate European class definitions if those of Zvei and Gambica are equivalent
b. Japanese service classes will make new or merged definitions if they currently exist and are different
c. Japanese service classes will not define their own if both European service class definitions are insufficient or missing. These will be kept open for each service provider to define.

Table 4 shows the overview of Japanese Service Classes. It elaborates important discussion points for categorizing various service works.

1) **Scope and objective of the service**
The objective of a service is to help the customer to achieve his/her target. One of the important factors of classification by service classes is whether the delivered product and/or system functions properly or the production system and/or process function properly meets the customer's targets and satisfaction. In other words, the class is differentiated according to whether the service target (i.e. the target product, system or application of a service) is what the service provider delivered or the plant owner operates. In Class 1, 2 and 4, the service completion is judged by the product or system providers' criteria, whereas in Class 3, 5, 6, the service completion is judged by the plant owners operation and work standards or criteria

2) **Primary responsibility of the service**
Although the customer reserves the right to make the final decision, the service provider undertakes primary judgment of the work in some of their service work. In Class 1, 2, 4, the plant owner as the customer defines the precise service requirements. Service execution scheduling constraints depend on the plant operation, so the customer takes the main responsibility for the service and the service provider supports them. On the other hand in Class 3, 5, 6, the service provider undertakes the definition of service requirements and the service execution responsibility by fully understanding the customers operations, work procedures and constraints.

Table 4. Japanese Automation Service Classes

Class	Name	Description	Customer Benefit	Engineer Skill	Note
0	Basic Services – product related	Standard built-in service at the purchase of product including free-training, product update information, return, etc.	Customer can expect the standard warranty from the service provider including the standard return / exchange service in case of initial problems	Sales document level	Included with product purchase
1	Standard Services – product related	Pre-defined, standardized services including periodic maintenance, inspection and optional service extension	Customer can easily select from a pre-defined service menu with clear contents and level.	Service manual and product specification level	Select from menu
2	Customized services – product related	Customer-specific services adapted to the customer's environment. Services modified from the standard menu e.g. special programming or product material selection	Customer can modify the service to fit specific requirements or constraints for using the product.	Product internal design level	Scope is the target product
3	Application-specific services	Service provider provides services for adapting / configuring products to the specific application e.g. product sizing or anti-environment measures	Customer can expect to adapt/configure the product to the specific operating environment or purpose.	Customer application and engineering knowledge	Scope is the target application
4	System-related services	System provider integrates the automation system including 3rd party products such as computers, network devices and sensors/actuators.	Customer can expect the integrated system to start and operate as expected.	System integration knowledge including 3rd party products	Scope is the automation system
5	Plant-related Services	Plant unit start-up and operations improvement or tuning performance is included.	Customer can expect the specific production unit (e.g. Boiler, Turbine, Distillation Column, etc.) to operate as expected.	Plant unit operation skill and knowledge	Goal is the expected operation of production unit
6	Extended Plant-related Services	Extended from 5, plant throughput, cost efficiency, safety index improvements are included in the service scope.	Customer can expect the plant production KPI(Key Performance Index) to be improved	Plant operation knowledge including financial and management skill	Goal is to improve the efficiency of production performance

6 EXAMPLE OF SERVICE CLASS APPLICATIONS

As a practical use case for the Service Class Scheme, Table 5 shows the comparison between a repair service and an engineering service for each class.

6.1 Repair Services

A repair service is the service to restore malfunctioning instruments and devices to a normal condition. In this case, the plant owner consigns a repair service for a product which cannot be repaired during daily maintenance work. The service contract can take several forms from a spot repair order after the trouble to an annual plant-wide maintenance contract. A certain level of field customization could be included as part of Class 1 if it is clearly described in the service menu or contract as a differentiating advantage of the service provider. Occasionally in Class 2 field services, some field engineers customize the service at their discretion. This should theoretically be classified to Class 3.

Some service providers offer a customized package service to cover yearly maintenance including product diagnostics and repair, parts maintenance and replacement which can be regarded as Class 2 services.

Class 4-6 are marked as “n/a: not applicable” on this table, because an automation system is a combination of products and in these cases repair services can be regarded as a combination of lower classes.

6.2 Engineering Services

An engineering Service includes various work procedures from selecting control instruments and systems to match the process design, specification and piping and instrument definition to installation and startup of the selected products. Front End Engineering Design service (FEED) is the control design work including the piping and instrumentation diagram (P&ID) definition. There are also engineering services to take over the complete construction planning and test run of a plant, as well as consulting services for plant operation.

Engineering services are defined and customized for each plant; therefore there are no Class 0 and 1 services. The service providers are required to have consulting capabilities in the higher classes. Class 4 system and application services may include some elements of Class 5 services when they cannot be clearly separated or the service provider decides to combine as part of their marketing strategy. The consultation service here is to investigate the current plant operation and to make proposals for control design/configuration changes to improve or optimize its production performance, improve productivity or quality index, etc.

Table 5. Comparison of Service Contents utilizing Service Class Scheme

Class	Name	Repair Service	Engineering Service
0	Basic Services – product related	Embedded warranty service upon the purchase of a product such as repair and return	n/a
1	Standard Services – product related	Standard repair service after the warranty period. Usually customers uninstall and send back the product to the factory and the service provider diagnoses and repairs it. A certain level of field customization could be included as a part of Class 1 if it is clearly described in the service menu or contract.	n/a
2	Customized services – product related	Customized services arranged from the above standard repair service. Some customers can have a product replaced before uninstalling the malfunctioning unit to avoid stopping production. Extending the support period after the basic warranty term expires is another example of Class 2. Occasionally, some field engineers customize the service at their discretion. This should theoretically be classified to Class 3.	Predefined fixed engineering service related to a delivered product. Product customization to match the customer requirement is included, but the customer defines the customization specification for the service.
3	Application-specific services	A special repair service done at the customer plant. Service contents are determined by the customer environment and requests.	Services including product selection to meet the requirement of the target production process. The product installation and configuration are included to support a smooth start-up. E.g.) - Field engineer attendance at the customers site - PLC(Programmable Logic Controller) control application software design and implementation - Consultation and diagnoses of the product adoption to the process

4	System-related services	n/a	Automation system design and performance evaluation based on explicit requirements made by the customer. System and application design may include some elements of Class 5 services. E.g.) - Automation system integration - Control application design - System performance evaluation - Installation and deployment engineering
5	Plant-related Services	n/a	Total automation system integration for a specific production process, in which the system includes computers and instruments provided by multi-vendors. Replicating engineering of an automation system to another production process. E.g.) - Plant integration test, start-up tuning - Tuning report - Participation in the feasibility study project, budgeting - Basic system design work to match the plant requirement
6	Extended Plant-related Services	n/a	Total contract for process optimization design to improve production performance System upgrade planning based on the plant life cycle E.g.) - Financing and Resource allocation planning - PFI(Project Finance Initiative) - ESCO(Energy Saving Company)

7 DISCUSSIONS

Essentially, the class definitions are consistent among 3 service classes of ZVEI, GAMBICA and Japan. However actual implementation can be differentiated to meet local business practices. In that sense, examples of services in each class are very important to unify the service class scheme in each country.

The benefits of clear definition and adoption of the 'Automation Service Classes' follow:

1) **Customer benefits**
   - enable the comparison and selection of the right service products and service providers using objective criteria
   - enable optimization of service expenditure by evaluating the service contents and completion criteria
2) **Service provider benefits**
   - promote service value oriented pricing (not by head count and man-days)
   - service providers can differentiate their expertise from others by value, not price competition
3) **Customer and Service provider benefits**
   - avoid misunderstanding and miscommunication between both parties with clear separation of responsibilities
   - a smooth contract can be realized by sharing a common business platform

These benefits can contribute to overcoming the issues listed in Chapter3 of this paper.

The current status of 'Automation Service Classes' in Japan is still in draft form. , It is being reviewed by the relevant industry experts. According to GAMBICA which published the automation service classes in the United Kingdom, the new scheme has been well accepted among some of the automation system providers and it has been applied to their service menus. However, it is not widely accepted among the plant operators and the new scheme does not seem to be spreading. GAMBICA thinks good understanding by the plant owners is essential for the further diffusion of the new scheme. They are providing on-line service classification tools for the easier adoption of existing services to 'Automation Service Classes'. JEITA's working group discussed ways to diffuse the scheme with plant owners and other service providers. For the next step, a certification system for the 'Automation Service Class' providers, government guidance and standardization should be considered.

8 CONCLUSION

This paper has explained a new service scheme named 'Automation Service Classes' whose goal is to realize easier and more effective out-sourced contracting of automation services at industrial plants. 'Japanese Automation Service Classes' has been re-defined with reference to preceding 'European Automation Service Classes' cases, while supplementing their differences with each other and missing definitions. The industrial plant owners are being urged to transfer expert work which used to be executed by their internal engineers.

Classification is not merely subdivision or fragmentation of existing service practice but is rather a logical mapping of tacit knowledge in the field work to explicit knowledge so that the optimal management of out-sourced service is enabled, while keeping the unique Japanese advantages of flexible and reasonable mindset for services. The 'Automation Service Classes' is expected to contribute to overcoming the issues related to service outsourcing and realize an innovation for the industry.

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