



PSLX Engineering Specification

Guidance

PSLX-00

<Recommendation>

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Update History

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1. Introduction

1.1. Purpose of PSLX Engineering Specification

PSLX Engineering Specification shows the technical guidelines for manufacturing enterprises to introduce the concept of APS (Advanced Planning and Scheduling) adapted to each business environment. And the purpose of this specification is to decide a minimum of the required rules that the implemented Planning and Scheduling functions can be linked with each other in the future Internet society.

1.2. Purpose of This Specification

This specification aims at playing a part as guidance for the entire PSLX Engineering Specification consisting of five parts. This specification shows the explanation about APS outline, Engineering Architecture as a sketch of the whole PSLX engineering, and the guidelines on implementing a system by actually applying PSLX.

1.3. Intended Readers

Intended readers of PSLX Engineering Specification are as follows.

Managers in charge of IT of manufacturing enterprises, engineering staffs in IT section of manufacturing enterprises, consultants in IT strategy of manufacturing enterprises, consultants in production management, managers of SI enterprises, engineering staffs of SI enterprises, managers of software package vendors, engineering staffs of software package vendors, students of production management

Each part in this specification describes the intended readers in the above list in detail, so refer to each part for details.

1.4. Structure of PSLX Engineering Specification

PSLX Engineering Specification consists of the following five specifications besides this specification (Guidance : PSLX-00).

✧ **Part 1 : Grand Design for Manufacturing Enterprises with APS (PSLX-01)**

Various manufacturing enterprises are sorted out according to the environment where the enterprises are placed and the problems that each type and form of manufacturing enterprise faces now. The notable indicators on management to characterize those problems are explained.

This part explains some new collaboration systems applying APS to the abstract models of manufacturing enterprise clarified in this part. It also shows what effects are given to the business model of each manufacturing enterprise with individual character by the systems.

✧ **Part 2 : APS Agent Model (PSLX-02)**

This part defines the decision-making systems with Planning function or Scheduling function such as production plan or sales plan as APS agent model. Moreover it defines the functions that the systems must have. This part also shows the data required for realizing each function of APS agents.

The specification defined in this part is an appearance of use case, not the internal structure of APS system. Especially this part handles the interface forms between APS systems or between APS system and a subsystem other than APS system.

✧ **Part 3 : PSLX Domain Objects (PSLX-03)**

This part defines the concept schema for the data used in APS and explains the data content. PSLX Domain Object defined in this part is a model that the actual database schema in each manufacturing enterprise is made more abstract.

The standard APS system is defined on the basis of this PSLX Domain Object. Therefore when the system is implemented, the schema of PSLX Domain Object and each database structure must be mapped.

✧ **Part 4 : XML Standard Specification (PSLX-04)**

The specification for data exchange is decided with supposing various cases when collaboratively solving a problem between APS systems or between APS system and a subsystem other than APS system. Data exchange between the systems including APS system must be implemented under this specification.

The content provided in this part includes the definitions of business protocols between two applications exchanging data, exception processing such as an error and the detailed XML tag structure about the exchanged message content.

◇ **Part 5 : PSLX Common Dictionary (PSLX-05)**

This part defines usage and meaning of the terms used in this specification. All parts of this specification are described in accordance with the meaning defined in this part.

PSLX Common Dictionary is the information for understanding the content of this specification and also taken as a basis of communication between the related IT vendors or between a vendor and users when a system is actually constructed for manufacturing enterprises on the basis of this specification.

2. Outline of APS

2.1. Purpose of APS

The purpose of APS is to contribute toward maximizing the profit of enterprise with meeting the demand of various and unpredictable markets by advancing Planning and Scheduling engineering for the present manufacturing enterprise on the basis of IT, which is mainly Internet.

2.2. Scope of APS

The problem handled by APS is the decision-making for Planning and Scheduling on the crossing point of a supply chain (demand chain), which is the information flow in a horizontal direction, and an engineering chain, which is the flow in a vertical direction in figure 1.

The supply chain of products toward the order flow was mainly discussed in the current supply chain. In APS, however, products are corresponded to a demand (invisible demand) behind an order. Therefore a part of specification decision process and a part of product development in build-to-order production are also objects to be handled.

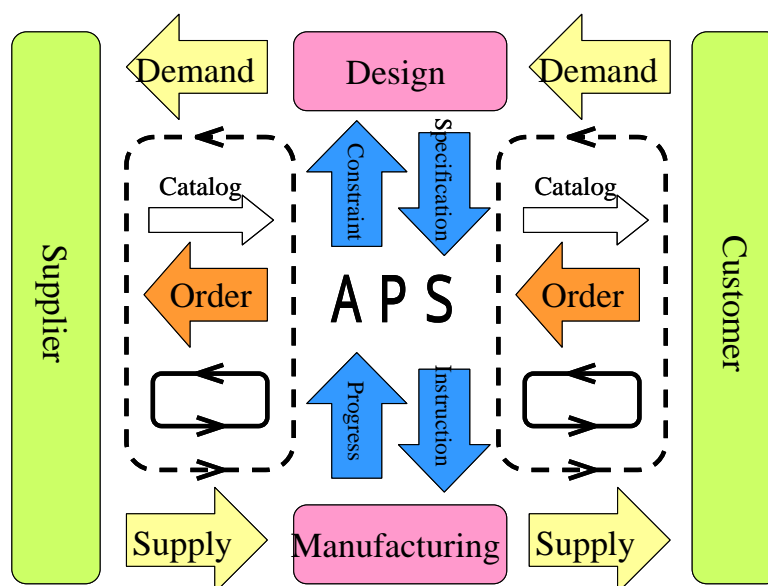


Figure 1 Scope of APS

The important target for APS is the problem of Planning or Scheduling that leads to an everyday action in manufacturing enterprise. If the speed of decision-making is regarded as important, APS is especially effective. Because the environment where the manufacturing enterprises are placed becomes more unpredictable and it is necessary to rapidly keep up with the environment change.

As any actions (operation) in business activities are discussed in APS, APS system doesn't handle the problems that directly manage products or the information structure such as financial plan, process plan and designing, on the same level. So in APS the very action to solve these problems, not the problem content, is treated as one operation in a plan.

2.3. Relation between APS and Internet

APS aims at integrating various operations in Planning and Scheduling for manufacturing enterprise as much as possible. But there is a case where each decision-making must be executed in the separated places because of physical or institutional reasons.

In such a case, APS realizes the collaborative solution by connecting each decision-making in each division or each function through the network.

In short, APS in figure 1 is a combination system consisting of some decision-making agents linkage not only one decision-making agent.

If the agent to make decision such as Planning or Scheduling is called APS Agent, the collaboration between APS agents must be realized by communicating on Internet or the intranet based on XML as much as possible.

PSLX recommends strongly that a system will keep flexibility and extension in future with progressing the system interconnection by roughly linking with each of APS systems in order that the whole manufacturing enterprises may implement APS functions.

2.4. Planning and Scheduling

APS is a new management system, which regards the important decision-making like Planning and Scheduling for manufacturing enterprise as a core of system. The terms, Planning and Scheduling have meanings as follows and they are the important concepts on discussing APS.

✧ **Planning**

Planning is an action to specify a target or means for making up the gap between demand and fact and to decide the structure and a parameter between them. In short, Planning shows the problem itself and the concrete ways of solving the problem.

However, the main purpose of Planning is to specify the structure and a parameter value with considering the relation between cause and effect. Therefore the gotten result does not always guarantee the possibility of execution on the actual time. And so Scheduling is required for making the plan information, which is Planning results, more positive.

✧ **Scheduling**

Scheduling is an action to get rid of a time competition between individual real items or resources and to decide start time and end time of the concrete operation and the allocation of time for each item or resource in order to guarantee that the targets and the meaning specified in Planning can be executed.

The input information for a Scheduling problem is the plan information obtained by Planning. In a word, only one part of possibility obtained by Planning is considered in Scheduling. Even if the best-suited solution is obtained for a Scheduling problem, the solution is not always guaranteed that the best-suited solution will meet the original requirement.

Thus Planning and Scheduling have the close relation each other.

Therefore this specification strongly recommends that Planning and

Scheduling be handled by integrating them as much as possible in the building process of APS provided by this specification.

3. APS Engineering Architecture

3.1. Part of Engineering Architecture

The following APS Engineering Architecture is guidelines to prevent from unnecessary confusion when APS is discussed or considered variously. Each of engineering information comes under each layer in APS Engineering Architecture. So directly connecting two techniques in the different layers must not be handled. However, it is possible to connect techniques in two different layers, which are located vertically, by defining the interface between layers.

3.2. Outline of Each Layer

APS Engineering Architecture consists of five layers as follows.

Layer 1 : Manufacturing Business Model Layer

Layer 2 : APS Collaboration Layer

Layer 3 : APS Agent Layer

Layer 4 : Domain Object Layer

Layer 5 : Data Implement Layer

◇ Layer 1 : Manufacturing Business Model Layer

This layer shows the environment of each manufacturing enterprise, and the values and the purpose of the manufacturing enterprise. And also it discusses a business model for embodying an industrial strategy. This layer takes the whole manufacturing enterprises as one system and decides the external specification of system itself on the relation between the system and the external environment.

APS Collaboration Layer is a layer to discuss the structure and the mechanism of manufacturing enterprise. Meanwhile in Manufacturing Business Model Layer, the environment or the problem of manufacturing enterprise can be objectively discussed by expressing individual manufacturing enterprises with a specific indicator.

◇ Layer 2 : APS Collaboration Layer

This layer discusses the internal mechanism of manufacturing system by taking each business as a unit of Planning and Scheduling elements. This is a layer where APS is realized with collaborating individual decision-making agents in the enterprise. The structure of collaboration has various patterns and so the individual enterprise business consists of the combinations of such patterns.

In this layer, the internal parts of APS system are black boxes and their relationship and patterns of communication are discussed. In short, the external specification of APS system is given in this part layer. This layer handles Booking-type production system, Mixed production and order allocation system, Collaborative option decision system, Project-oriented batch production and the system for multi-site federation planning.

✧ **Layer 3 : APS Agent Layer**

This layer takes an agent making decision with elements of Planning and Scheduling in manufacturing business like production order planning, manufacturing order scheduling, sales plan, purchase plan and design workflow plan as an APS agent. And it discusses the internal specification. Moreover the standard domain objects required by each agent are specified and the interface between them is discussed in this layer.

APS agent may consist of only programs on a computer but there are many cases where a human has something to do. APS agent isn't always fixed and it is possible to suppose that APS agent moves between systems as occasion demands.

✧ **Layer 4 : Domain Object Layer**

This layer specifies the domain object required for realizing APS. The domain object defined in this layer is conceptual and the implementation form is not mentioned. This layer concentrates on selecting the common parts in as many manufacturing enterprises as possible as a template of data schema which is actually owned by each manufacturing enterprise.

The domain objects handled in this layer are the conceptual models existing in many manufacturing enterprises and so it is impossible to

include all of various data of each enterprise. Therefore it is necessary to separately add data to the part that cannot be made common in each manufacturing enterprise example.

✧ **Layer 5 : Data Implement Layer**

This layer brings up the concrete structure and the content when implementing PSLX Domain Object on the actual database. Even if the conceptual models are the same, they have the different implementation form according to the design idea of each information system. However the actual data structure must be mapped between conceptual models defined in Domain Object Layer as much as possible.

To discuss this layer is very important to develop systems and this layer must be considered individually. It is supposed that the know-how and the engineering that system development enterprises have in their own right are handled individually in this layer. Therefore PSLX Engineering Specification doesn't discuss this layer in detail. However only implementation that must be standardized such as the specification for data exchange with XML is taken as a common discussion.

3.3. Relation with This Specification

Table 0-1 shows the relation between this specification and APS Engineering Layers.

Table 0-1 Relation between APS Engineering Layers and this specification

Layer 1	Manufacturing Business Model Layer					
Layer 2	APS Collaboration Layer					
Layer 3	APS Agent Layer					
Layer 4	Domain Object Layer					
Layer 5	Data Implement Layer					
Part 1 : Grand Design for Manufacturing Enterprises						
Part 2 : APS Agent Model						
Part 3 : PSLX Domain Objects						
Part 4 : XML Standard Specification						
Part 5 : PSLX Common Dictionary						

Firstly, Part 1 "Grand Design for Manufacturing Enterprises" takes charge of two layers, Manufacturing Business Model Layer and APS Collaboration Layer. Manufacturing Business Model Layer handles the outer environment of manufacturing enterprises and individual problems in order that each enterprise draws a new grand design. Besides APS Collaboration Layer handles the concrete structure.

Part 2 "APS Agent Model" takes charge of APS Collaboration Layer, APS Agent Layer and Domain Object Layer. APS Agent Layer has the deepest relation with APS Agent Model. But the internal logic executed properly in APS Agent Layer is not taken up in this part. Because the internal logic is the know-how owned by each package vendor.

Part 3 "PSLX Domain Objects" takes charge of Domain Object Layer and Data Implement Layer. However the great majority of part 3 handles the data schema structure of Domain Object Layer and shows only the guidelines to map between Domain Object Layer and Data Implement Layer concerning Data Implement Layer.

Part 4 "XML Standard Specification" aims at APS Agent Layer, Domain Object Layer and Data Implement Layer. APS Agent Layer defines a business procedure for exchanging data by APS system. Domain Object Layer

defines the data model content to be exchanged. Data Implement Layer defines the tag structure of the actual XML data.

Part 5 “PSLX Common Dictionary” aims at all layers. However the purpose in this part is to explain the terms in each layer. The relation between layers is not described. The same term may be used in some layers. If the meaning is different in every layer, the term is put to proper use.

4. Guidelines on System Implementation

4.1. How to Use The Guidelines

The guidelines on system implementation shown in this chapter indicate the basic way of thinking when each manufacturing enterprise implements the APS concept. This specification recommends that the project be advanced referring to the following guidelines in order that manufacturing enterprises may prevent mistakes, which they apt to fall into in process of making IT, and in order that APS may give the maximum effect.

4.2. Notes on System Implementation

✧ Importance of Grand Design

When considering whether a new system is introduced, avoid picking up and handling a partial phenomenon. And this specification doesn't recommend consideration with supposing that an existing business package is applied. At first it is important to draw the grand design for manufacturing enterprises that starts from the entire image --- what a true enterprise should be. Especially APS often changes basically the decision-making mechanism of enterprise and so the development without deciding partial improvement and a target must be avoided.

✧ Business Progress and System Strength

The more innovative the enterprise is, the more improved the information system is. Whenever shifting the system to a new business model, the information system must change its form. But actually the system cannot keep up with a business speed whenever a new system is developed. It is necessary that the system be beforehand built in the form that completely separates into the front end (business process) and the back end (database). And the system mechanism must be rebuilt flexibly according to a business change.

✧ Communication with XML and Function Division

In the system realizing APS, it is unnecessary to gather data together for processing the data. There are some cases where database should be dispersed physically. If anything, the point of APS implementation is how the package and the legacy system specialized in individual Planning functions are linked. And then each subsystem must be independently designed in a functional unit as much as possible. The data linkage between applications using XML must be put on the core of engineering. The mechanism must have flexibility and expansion.

✧ **From Development with Vertically Divided Business to Layer-oriented**

In APS Engineering Architecture, the engineering on APS is arranged in every layer. It is recommended that the discussion and the development be advanced with dividing engineering into every layer as much as possible for introducing the APS engineering. If anything, the usual development is vertically divided and the development from a business model to DB structure has been advanced as one package. It is the present condition that mismatch is often found in the relation between business operations or on data linkage later. In APS, the linkage between individual systems, which is a unit of decision-making, is especially important and so it is recommended advancing the development in layer-oriented from beginning.

✧ **Case of Small and Medium-sized Enterprises**

What can small enterprises do? They are the enterprises that cannot spend a large amount of money on IT, or doesn't have specialists on IT. It is reality that many enterprises are worried with expensive IT tools and packages and wonder whether they can use them efficiently. In this case, it is likely to be more acceptable that the expensive IT tools or packages aren't introduced without preparation. However the basic infrastructure such as personal computer or Internet must be prepared and at the same time the data preparation and the business flow must be re-inspected. The level of IT will make rapid progress only by making the information that has been handled unclearly a digital format.

4.3. Concrete Procedure for Project

✧ Understanding Environment and Problem

Before forming a project, the environment where the manufacturing enterprise is placed must be understood rightly. At first it is necessary to recognize how the business environment has changed until now and how the present or future environment will change on a large scale. And then handle completely what results will be brought in the future business environment by the original engineering or network that the enterprise has now. The purpose of this specification is that the whole enterprise recognizes the subject executed for defining a rightful state and the direction to go with reference to the reality.

✧ Determining the Quantity of Target and Policy Decision

Continuously decide a target and a policy. The target must be expressed in a concrete numerical value. For that purpose, specify some indicators characterizing the enterprise performance. Then analyze the present conditions and conform the present position of the enterprise on the selected indicator. After that, discuss what the specified indicators must be for solving problems of the enterprise and take the agreed value as a project target.

At this point, the means to achieve its aim is not clear yet. The casual relationship between aim achievement and various means must be classified and prioritized and the efficient action plan with adaptability must be created in order to specify the concrete plan executed by the project. Since there are many means to solve a problem and achieve the aim, it is important to decide the policy as a framework for making up the means into one action plan.

✧ Business Model Redesigning

If concluding that the concept of APS must be introduced positively and the usual business must be reformed, start redesigning a business model. At first, dig up the decision-making component executing Planning and Scheduling for various business activity levels out of various business operations of the enterprise. Then clarify the collaboration relation between components.

Next, select the model that seems to contribute to objective achievement of the enterprise out of APS collaboration models and apply it to the present business from top to bottom. The important point is that the point where the data in business occurs and the point where the data is used cannot be moved. And so it is possible to compare the present decision-making component and the selected component on APS collaboration.

Use APS collaboration model in this specification as a template and redesign the original collaboration form of enterprise and define the necessary conditions for individual subsystems clearly.

◇ **Data Preparation and System Development**

Shift to the phase of system development after completing designing. However it takes more time to prepare data than to develop a system. Therefore start preparing the required data with developing a system or before developing a system according to circumstances. Consider executing the pilot project for the purpose of preparing data step by step.

The important common point of data preparation and system development is that a common data schema must be decided in the whole industries beforehand. Thus, it becomes easy to apply the prepared data to individual APS systems. Domain object in this specification must be a guide to the common scheme design.

Systems are developed in a unit of module for individual decision-making. There are some cases; a system is developed newly; only interface is developed with using a legacy system; and a package software system is bought and applied. In all cases, it is necessary to consider that the functions in individual subsystems and the linkage with the outside are important.

Data exchanging method with XML must be adopted for exchanging data between APS systems or between APS system and a subsystem other than APS system. Thus the decision-making process can be linked between various application programs with a different design ideology including human. When developing an interface under XML Standard Specification

shown in this specification, the system can be linked without deciding a specification individually.

◇ **Actual Use and Feedback of Results**

The newly developed system is operated actually in a unit of APS system or in the entire APS collaboration system. As the business operations in manufacturing enterprises always move and the planning system is a very important problem as a framework of manufacture decision-making, the system must be shifted to the actual operation very carefully.

It is recommended that a system be shifted to the actual operation step by step for keeping the risk to a minimum. The speed and complication of decision-making should gradually increase after confirming that the decision-making as a core is surely executed and that the business is carried out without delay. When executing collaboration, the way of gradually synchronizing peripheral subsystems after starting up the main APS system is suggested.

Evaluate the final APS introduction effect with the concrete indicator in comparison with the target and policy of the specified project. According to circumstances, it is necessary to repeat the above project for surely getting effects without being eager for good results.

5. Appendix : Questions

✧ **What is the difference between scheduler and APS?**

Scheduler is a constitutive element of the APS core. Thus the scheduler must flexibly be able to be linked to Planning functions such as a capacity plan or a requirement plan. Moreover the latest scheduler includes the Planning functions and the scheduler that can be called APS system by itself appears.

✧ **Is the interest in APS short-lived popularity?**

The term “APS” may be in fashion or out of fashion. But the way of thinking and the theory behind the term will be taken over in every ten years from now on. If anything, there are a lot of incomplete parts and plenty room for development in APS.

✧ **Does APS deny the present legacy system?**

If the legacy system is regarded as a component of decision-making, it will survive as assets of enterprise literally and the effect will be display in the whole collaboration by APS. On the other hand, systems, which cannot be linked with other systems, will be left behind the times in future.

✧ **Is the content on XML the main part in this specification?**

In PSLX, XML is regarded as the important engineering to implement APS concept, however APS cannot be realized only with XML. This specification contains a lot of important guidelines and technologies for succeeding projects such as Grand Design for Manufacturing Enterprises.

✧ **Must XML be used for exchanging data?**

Data exchanging with XML is suitable for the rough linkage on balance. Therefore in PSLX, it is recommended exchanging data between APS systems or between APS system and a peripheral system in XML format. However this is not an indispensable condition.

✧ **Is it impractical that schedulers are linked beyond enterprises?**

Generally it is impractical that schedulers are individually linked beyond the wall between enterprises. Usually the decision-making by the business department stands between them. However the number of cases where schedulers are directly linked in an enterprise or between cooperated enterprises for doing the more dynamic plan linkage will gradually increase.

✧ **Must a human make decision finally?**

In Planning and Scheduling managed by APS, a solution is gotten with computer ability as much as possible. However there are many cases where a human should finally decide the solution. APS aims at the mechanism that specifies the range decided only with a computer and the range decided only by a human beforehand and can make the cooperation between computer and human flexibly.

✧ **Are designing and transportation scheduling included in APS ?**

Design and transportation schedule are also a kind of Planning. But it is difficult to directly manage them with APS because the object is a shape of item or transportation route. However it is possible to put a part of design or transportation schedule into APS from the point of APS, because they include a lot of common problems to be handled such as designing or transporting.

✧ **Will MRP (Material Requirement Plan) not be required in APS?**

APS can include MRP in a wide sense. But most of the present MRP cannot be called APS by itself. Many MRP functions are taken as a very important element for APS, on the other hand faults are also recognized. It is expected that MRP will be assimilated into APS with largely changing its shape in future.

✧ **How much investment is needed to introduce APS?**

If you take the method that a system is gradually improved more effectively with restricting the application range, a large investment is not needed at a time. If anything, an investment in human resources is required. Invest the larger money in consideration for purchasing

packages or developing, data preparation and support after introducing a system than the amount of money for purchasing packages and the external consignment development.

◇ **Do XML specification in PSLX and the specifications in other EDI compete?**

Basically their structures don't compete. PSLX assumes the linkage of decision-making modules mainly inside of an enterprise or enterprises including the cooperated companies and so PSLX is used differently from other specifications for Electronic Commerce between general enterprises. However when PSLX is exchanged between enterprises, PSLX assumes the form of using EDI standards in some cases and operating the system in combination with PSLX specification.

◇ **Can the program developed on the basis of the specification be sold?**

The corporate members of PSLX Consortium can originally develop and sell the program based on the content of this specification for business. In such a case, specify "Based on PSLX" on a catalog and please notify PSLX Consortium of it. People other than the corporate members may not use the content of this specification for commercial use.

◇ **Can the content of the specification be extended originally?**

Basically it is possible. But the content cannot be modified. The greatest merit of XML is that the shortage of function can be added and the present function can be expanded in accordance with XML specification established in this specification. The result of specification expansion may become a new standard on the next step and so notify PSLX Consortium Japan of the content as much as possible.

◇ **How is a specification added or how is a version revised?**

The content of this specification is maintained by a new organization taking over the result of PSLX Consortium Japan. Therefore a specification will be added and a version will be revised in future under the more certain and open organization management. The specification

of PSLX will also progress to solve a specific problem in every industry and to realize APS with a high-performance function in a wider range.