PSLX Engineering Specification

Guidance

PSLX-00

<< DRAFT >>

Version 0.2

Update History

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<Note>
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for any losses caused from using this specification and the contents
of this specification.
1. Introduction

1.1. Purpose of PSLX Engineering Specification

PSLX Engineering Specification indicates the technical guideline 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 composed of five parts. This specification shows the explanation about APS outline, Engineering Architecture as a sketch of the whole PSLX engineering, and the guideline for implementing a system with actually applying PSLX.

1.3. Intended Reader

Intended readers of PSLX Engineering Specification are as below.

Manager in charge of IT of manufacturing enterprise, engineering staff in IT section of manufacturing enterprise, consultant in IT strategy of manufacturing enterprise, consultant in production management, manager of SI enterprise, engineering staff of SI enterprise, manager of software package vendor, engineering staff of software package vendor, student 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 (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. A notable evaluation index on management to distinguish those problems is explained.

This part explains some new collaboration systems applying APS for the abstract models of manufacturing enterprise that are clarified. 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 scheduling or sales scheduling as APS Agent Model. Moreover it defines the functions that the systems must have. This part also shows the data required to realize each function of APS Agent.

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

Part 3: PSLX Domain Object (PSLX-03)

This part defines the concept schema for the data to be used in APS and explains the contents of data. PSLX Domain Object defined here is the model that a schema of actual database 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. This specification explains also the procedure for mapping with simple samples.

Part 4: Rules for XML Data Exchange (PSLX-04)
The rules for data exchange are decided with supposing various cases when cooperatively 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 rule.

The contents provided here include the definitions of business protocols between two applications exchanging data, exception handling such as error handling, and the detailed XML tag structure on the contents of message to be exchanged.

**Part 5: PSLX Standard Dictionary (PSLX-05)**

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

PSLX Standard Dictionary is the information for understanding the contents 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.

**1.5. Policy on Copying Specification**

PSLX Consortium Japan owns copyright on this specification. However it is free to copy this specification and distribute the copies. It is also free to translate the contents of this specification into foreign languages except English. But it is prohibited to modify the contents of this specification without the permission of PSLX Consortium Japan. When referring to a part or all parts of the contents in this specification for another document, write URL (http://www.pslx.org) of the applicable item on the WWW site of PSLX Consortium Japan preserving 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 flow of information in a horizontal direction, and an engineering chain, which is the flow in a vertical direction in figure 0-1.

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

Figure 0-1 Scope of APS

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The important target for APS is the problem of Planning or Scheduling that leads to an everyday action in manufacturing enterprise. When 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 change of environment.

As APS discusses any actions (work) in business activity, it doesn't handle the problems that directly manage products or the structure of information, for example financial plan, process scheduling and designing, on the same level. So in APS the very action to solve these problems, not the contents of problem, is treated as one work 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 cooperative solution by connecting each decision-making in each division or each function through network.

In short, APS in figure 0-1 is a combination system composed of linkage of some decision-making agents not only one decision-making agent.

If the agent that makes decision such as Planning or Scheduling is called APS Agent, the cooperation between APS agents must be realized by communicating on Internet or intranet on the basis of XML as much as possible.

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

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 indicates the problem itself and shows the concrete ways of solving the problem.

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

✧ **Scheduling**

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

Input information for a Scheduling problem is the planning 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 satisfy 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 structure process of APS provided by this specification.
3. APS Engineering Architecture

3.1. Part of Engineering Architecture

The following APS Engineering Architecture is a guideline to prevent from unnecessary confusion when APS is discussed or considered variously. Each engineering information falls 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 under two different layers, which are located vertically, by defining the interface between each of layers.

3.2. Outline of Each Layer

APS Engineering Architecture consists of five layers as below.

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 value and the purpose that the manufacturing enterprise has. 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 the layer that discusses 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 index.

Layer 2: APS Collaboration Layer
This layer discusses the internal mechanism of manufacturing system by taking each work as a unit of Planning and Scheduling elements. This is the layer where APS is realized with collaborating each decision-making agent in an 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 here. This layer handles a booking-type production system, a cooperative specification decision system or a system for multi-site planning linkage.

Layer 3: APS Agent Layer

This layer takes the agent that makes the decision with elements of Planning and Scheduling in manufacturing business, like production scheduling (medium scheduling), scheduling, manufacturing scheduling, sales planning, purchase planning, design workflow planning, as 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 to realize APS. The domain object defined here 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 the data schema actually owned by each manufacturing enterprise.

The domain objects handled here 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 the data to the part that is unable to be made common for each example of each manufacturing enterprise.

Layer 5: Data Implement Layer

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

On developing systems, the discussion in this layer is very important and 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. A part of implementation that must be standardized such as the rules for data exchange with XML is taken as a common discussion in this layer.

3.3. Relation with This Specification

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

<table>
<thead>
<tr>
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<tr>
<td>Layer 4</td>
<td>Domain Object Layer</td>
<td>○</td>
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<td>0</td>
</tr>
<tr>
<td>Layer 5</td>
<td>Data Implement Layer</td>
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Part 1: Grand Design for Manufacturing Enterprises

Part 2: APS Agent Model

Part 3: PSLX Domain Object

Part 4: Rules for XML Data Exchange

Part 5: PSLX Standard Dictionary

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 here. Because the internal logic is the know-how owned by each package vendor.

Part 3 “PSLX Domain Object” 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 guideline to map between Domain Object Layer and Data Implement Layer with reference examples concerning Data Implement Layer.

Part 4 “Rules for XML Data Exchange” 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 contents of data model to be exchanged. Data Implement Layer defines the tag structure of the actual XML data.

Part 5 “PSLX Standard Dictionary” aims at all of layers. However the purpose here is explaining terms appearing in each layer. The relation between layers is not described. Same term may be used in some layers. If the meaning is different in every layer, the term is put to proper use.
4. Guideline for System Implementation

4.1. How to Use This Guideline

The guideline for system implementation shown in this chapter indicates 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 guideline in order that manufacturing enterprise may prevent mistakes, which they apt to fall into in process of making IT, and 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 it is not recommended considering that an existing business package is applied. At first it is important to draw the grand design for manufacturing enterprise that starts from the entire image --- what true enterprise should be. Especially APS often changes the decision-making mechanism of enterprise basically and so the development without deciding partial improvement and a target must be avoided.

✧ Business Progress and System Strength

The more innovative enterprise is, the more improved information system is. Whenever shifting 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 (work process) and the back end (database). And the mechanism of the system must be rebuilt flexibly according to a business change.

✧ Communication by XML and Function Division
In the system realizing APS, it is unnecessary to gather the 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 in 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 engineering on APS. 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 specially 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, which 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 here is that the whole enterprise recognizes the subject to be 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 indexes characterizing the enterprise performance. Then analyze the present conditions and conform the present position of the enterprise on the selected index. After that, discuss what the specified indexes must be for solving problems of the enterprise and take the value agreed there as a project target.

At this point, the means for achieving 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 to be 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 relation of collaboration between each component.
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 here 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, or package software 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 rules 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 evaluation index 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 core of APS. Thus the scheduler must be flexibly able to be linked to Planning functions such as ability planning or requirement planning. 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 large spaces to be developed in APS.

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

If 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.

✧ **Are the contents 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 for instance 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?**

Designing and transportation scheduling are also a kind of Planning. But it is difficult to directly manage them in APS because the object is a shape of item or transportation route. However it is possible to put a part of designing or transportation scheduling 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 Planning) 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 rules 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 rules.

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

Yes, it is possible. Whether you are a member of PSLX Consortium Japan or not, you can originally develop and sell the program based on this specification for business. In such a case, write “Based on PSLX” on a catalog clearly. And notify PSLX Consortium Japan.

Can the contents of the specification be extended originally?

Basically it is possible. But it 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 rules 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 contents as much as possible.

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

The contents of this specification are 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 the 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.