PSLX Engineering Specification

Grand Design for Manufacturing Enterprises

PSLX-01

Version 0.2

Update History

Date	Author	Version	Explanation
2003.3.18		0.1	Translate to English
2003.7.23		0.2	Insert English figures

Contents

＜Note＞

PSLX Consortium Japan and the members don't take on the responsibility for any losses caused by using this specification and the contents of this specification.

1. Introduction

1.1. Purpose of This Specification

This specification explains how to draw the grand design for manufacturing enterprises when the manufacturing enterprise introduces APS. Besides this specification aims at designing the information system that leads APS engineering proposed by PSLX to contribute to the total optimization of manufacturing enterprise, not to partial improvement.

The contents of this specification are the guideline, not the rules to be kept. However it is recommended reconstructing a business model and advancing the required system development following the contents shown in this specification when the manufacturing enterprise introduces APS.

1.2. Intended Reader

The intended readers of this specification are as below.

Manager in charge of IT of manufacturing enterprise, consultant in IT strategy of manufacturing enterprise, consultant in production management, manager of SI enterprise, student of manufacturing management

1.3. Structure of Specification

The next chapter and the following chapters consist as below. First, Chapter 2 “Classifying Business Models and Indexes” shows the required information for the manufacturing enterprise to construct a new business model. Chapter 3 “Constructional Elements of APS System” explains the required constructional elements for embodying the business model using APS most efficiently.

Chapter 4 “ Basic Form of Collaboration” describes the basic collaboration forms by APS applying to the basic elements of production management. Chapter 5 “ APS Expansion Collaboration

Model" describes the collaborations to realize some specific business processes, which APS can execute. Lastly, Chapter 6 shows the collaboration forms only by APS enabling the plans and the scheduling problems in the separate sites to link with each other.

When arguing in APS Engineering Architecture shown in the guidance, Chapter 2 corresponds to " Manufacturing Business Model Layer", and Chapter 3 and the later correspond to "APS Collaboration Layer".

1.4. Policy on Copying Specification

2. Classifying Business Models And Indexes

This chapter gives the basic way of thinking required for manufacturing enterprise to redefine a business model by itself, and the useful information for settling on the actual business model.

2.1. What Is A Business Model?

To begin with, Business Model has many-sided elements and can be described in various ways according to the standpoint or the purpose of a person modeling the business. This specification takes a business model for manufacturing enterprise as one system in a wide sense. And it selects the special features out of the relations among the external environment, the internal environment of the individual manufacturing enterprises and the active functions of the manufacturing enterprise itself. Thus it takes the approach that makes a business model outline clear.

When deciding on the business model, this specification places the tactics or the strategy possessed by the manufacturing enterprise in the relations with customers, with suppliers, with other competition companies or with the inside resources or assets. Finally this specification forms them into an index or a subject. The indexes and the subjects given there are constructed and the relation with each function possessed by the manufacturing enterprise is defined. It is very important here to define that who the true customer is, who the true competitor is, what the true management resource to be protected and developed is.

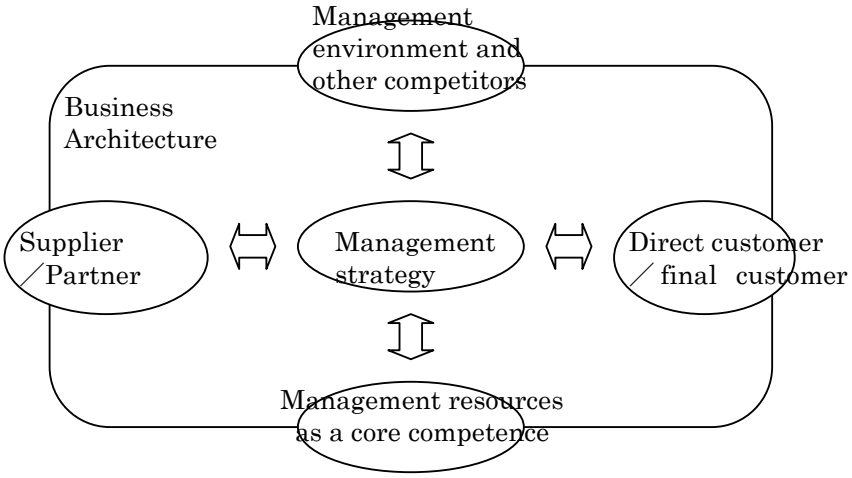

Figure 1-1 Basic Elements of Business Model

In this chapter, the business model is handled with considering the business architecture in a wide sense. Business architecture is the structure that becomes a prerequisite when the individual manufacturing enterprise develops business, and beforehand exists depending on the industry type or form.

For example, the prerequisite for a personal computer maker differs entirely from the prerequisite for an automobile manufacturer in product structure, process structure and sales method. Therefore the business model cannot be handled with ignoring the business architecture. However, each enterprise can select the business architecture. Because even if products are same, there are many cases where the architecture dealing with the low-cost general products differs from the architecture dealing with the customer-made quality goods.

Business process is what a business model is handled from a viewpoint of information flow, or a viewpoint of value. In the business process, each element of a business model is placed as one conversion function in the flow. Thus the outline of a business model can be decided concretely to some degree by regarding a business model as an aggregate of business processes and defining a constructional element

in every function. However it is necessary to recognize that only one side of a business model can be described

This chapter doesn't define the business model actually, but presents only the information required for each manufacturing enterprise to redefine its own business model. At first, it gives the business functions to be a constructional element of a business model. Then it shows the index to objectively evaluate the achievement degree of the subject related with the functions.

2.2. Functional Element of Business Model

As the guidance points out, when discussing APS function, two viewpoints are important: the viewpoint of supply chain and the viewpoint of engineering chain like the chain in figure 1.2. This chapter reconfirms the general functions of a manufacturing enterprise in line with these two viewpoints, because a lot of operational business can be classified with these two axes except high marketing or strategic investment items.

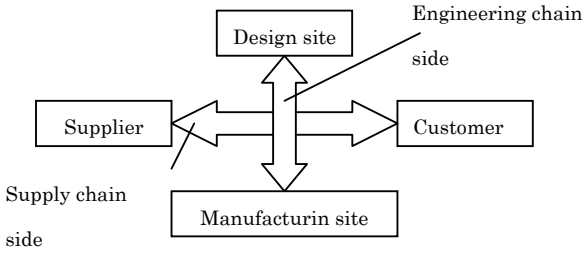

Figure 1-2 Classifying Function by Two Sides

The functions listed here individually execute the autonomous decision-making to a certain extent. For placing the functions in the whole enterprise accurately, the functions must be able to link with each other with putting the integrated decision-making by APS in the manufacturing enterprise on the core. It is important to separate the peculiar information of function and the information to be shared between functions, to open the way of accessing, and to use the original execution and the cooperative execution for each activity appropriately.

When defining the business model for manufacturing enterprise, all of functions shown here need not be contained inside the enterprise. Because it is the important point that the boundary between the inside and the outside of enterprise is fixed. It is natural that the business model must have the element of integrated decision-making placed on the center of enterprise.

✧ **Supply chain side**

When considering a supply chain, manufacturing industry pays attention to how to make the chain work smoothly between customer and supplier. Figure 1-3 shows the work functions related with the supply chain. When thinking about dealing with a customer, three functions --- sales scheduling, supply management, shipping management--- are given.

Sales scheduling	The management section mainly creates the medium and long-term sales scheduling. The scheduling is decided with considering forecasting, opinions from each customer and salesman's target value.
Sales management	manages various processes from an inquiry to an actual order as actual exchange with a customer. The estimated order by a person in charge of management and an unofficial order by customer are also targets.
Shipping management	ships products according to the order from customer. Sometime the form or the timing for shipping may be adjusted, if needed.

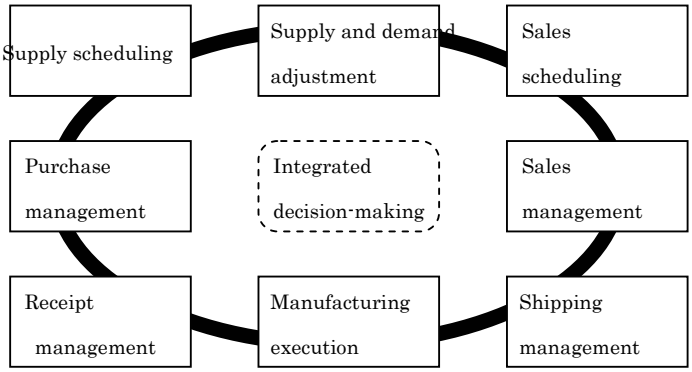

Figure 1-3 Functional Elements of Manufacturing Enterprise
（viewpoint of SCM）

When watching the relation with supplier, the following functions --- supply scheduling, purchase management, receipt management--- are listed.

Supply scheduling	creates the plan for supplying the required materials including supplier selection. It keeps an outside factory, which executes the in-house process instead of the company such as the subcontracted process.
Purchase management	manages ordering materials from suppliers and subcontracting processes. It manages purchasing and the due time according to the calculation results by MRP and the method of ordering materials.
Receipt management	receives, examines, and accepts the materials ordered from suppliers. The additional supply may be required if the plan is different from the actual condition.

On the other hand, two functions --- supply and demand adjustment and manufacturing execution--- exist between two sides, which are the work function for customer and the work function for supplier

Supply and demand adjustment	adjusts the amount of supply and demand from the viewpoint of the whole enterprise. Sales scheduling and capacity planning may be changed if necessary.
Manufacturing execution	actually executes manufacturing according to a plan and scheduling results. The way of manufacturing may be changed to take measures to the unexpected events on the manufacturing side.

Production scheduling and scheduling function are placed on the core by integrating the above functions.

✧ **Engineering chain side**

From the viewpoint of engineering chain, which is another important side of APS, the flow of production development to meet the true demand from customer is backed up. All functions required by manufacturing enterprise are fulfilled only by having both supply chain and engineering chain. Figure 1-4 shows the important functions from the viewpoint of engineering chain.

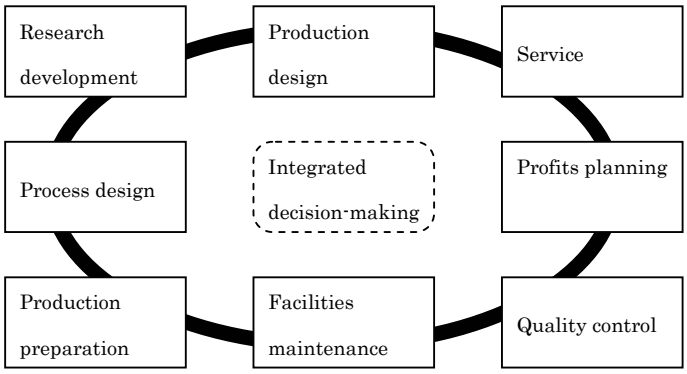

Figure1-4 Functional Elements of Manufacturing Enterprise

（viewpoint of ECM）

In the engineering chain, various functional elements are classified into two sides, which are the target and the means for manufacturing product. The targets are the service function at scene of using a product, profits planning for connecting the market value of product to the cost, and product management for answering the market demand.

Service	supports the scene where a product is actually used in the market, and offers the service to meet the request from customer after selling the product for connecting the market needs with a product.
Profits planning	plans and manages the cost for guaranteeing that the result of making productions leads to the profit exactly. Especially it grasps the production activity from the viewpoint of how the profits are gained by the activity, not from the viewpoint of the cost, and it makes the decision.
Quality control	argues what actions are taken to correctly understand the quality of product or the manufacturing process and to have the quality for target.

Research development, process design and production preparation can be given as a function for the concrete means to achieve these objectives. The engineering is embodied more in order of research development, process design, and production preparation.

Research development	designs new engineering to fill up the gap between customer's needs and the existing engineering when the engineering cannot be applied for embodying the needs into a product.
Process design	Hardware and software consisting of manufacturing facilities and workers are required to make products. In process design, the direct system for producer's side is designed.

Production preparation	completes various facilities and a production line including trial manufacturing for making products with actually operating the production process. It includes the actions that rearranges the line or extends a factory.

Production design and facility maintenance are the functions that apply the means of realizing the targets of enterprise for the targets of the market demand as shown above. The former is non-continuous function, but the latter is a continuous function.

Product design	clarifies the customer's needs and gropes for the function of product and the way of realizing the customer's needs. As the result, the production structure and the manufacturing method are decided and the master information is clarified.
Facility maintenance	Even if a production line is excellent, fault or failure always occurs. Facility maintenance always keeps a factory in the best condition for meeting the maximum of customer's needs.

In the same way as supply chain, the integrated decision-making is placed on the center of engineering chain with unifying the above functions. For the integrated decision-making in the engineering chain, the important elements are the plan and scheduling in the case of grasping a product in the entire product lifecycle.

2.3. Classifying Evaluation Indexes

There are numberless indexes to evaluate manufacturing enterprise. Therefore in the present circumstances, it is very difficult to decide which index is used for evaluating the mechanism of the company and for measuring the effect of APS introducing. This section shows the important viewpoint for classifying various evaluation indexes, and some samples on each viewpoint.

When settling on the grand design, each manufacturing enterprise must choose the indexes supposed to be important for the enterprise out of the indexes listed here or the originally added indexes, and construct the indexes. The information obtained here must be a valuable map on advancing IT in manufacturing enterprise.

In APS, four viewpoints are important: customer viewpoint, supplier viewpoint, viewpoint of making efficient management resource and viewpoint of information system in figure 1-5.

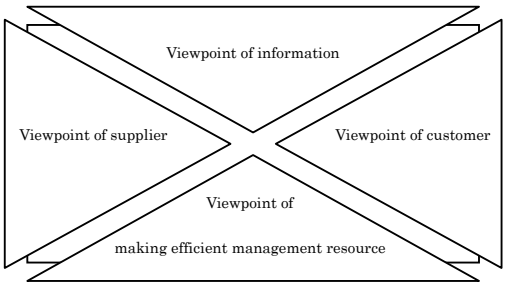

Figure 1-5 Constructing Index

✧ **Viewpoint of customer**

The index representing how the customer for a manufacturing enterprise is satisfied is shown in the viewpoint of customer. When considering that the start point of enterprise activity is from a customer, this viewpoint is the most important among the viewpoints. The followings are the viewpoints of customer.

Instant supply rate	rate of the case where a product is shipped instantly for an order without keeping a customer waiting.
Sold-out rate	rate of the case where the product required by a customer cannot be provided by the customer due date conceded to a maximum extend.

Supply lead-time	average number of days from the time when a customer orders a product to the time when a customer receives it
Due date promising rate	rate of the case where a product can be shipped on the due date promised to the customer
Rate of availability to promise	rate of the case where the due date for customer's inquiry can be promised within the term expected by the customer
Selection range of specification	range (defined index) where a customer can set up an individual specification of the product according to each request
Design change cycle	cycle where a model and design can be changed according to the change in needs
Grievance procedure speed	speed of processing the grievance against failure of a product on the production side

✧ **Viewpoint of supplier**

How easy to make a product or how easy to get profits for supplier is shown with an index in the supplier viewpoint. For keeping the cooperative relation between a maker and a supplier, it is very important to construct the better business relation for both sides, not to achieving the aim at the cost of supplier.

Precision of unofficial order	rate of the actual order to the unofficial order notified to a supplier
Number of days for receipt	number of the preceding days with the responsibility of purchase in the purchase scheduling notified beforehand as the unofficial information
Time to spare	rate of the average supply lead-time specified at

for due date	purchasing a product to the lead-time when supply is available with time to spare
Rate of balancing purchase	whether the contents of purchase are balanced on the point of price or load when taking the bucket of month or week
Order size	rate of the average number of ordered products per one order to the suitable lot size for manufacturing
Plan open level	open level of the information that is required for supplier to forecast demand, such as plan information or inventory information (defined index)

✧ **Viewpoint of efficiently using resource**

The important items for manager are how efficiently production resources such as the present machinery or facilities of each enterprise are used, how efficiently profits are gotten from investment and the gathered talented persons, and how the talented persons are trained for the future. It is important to have the viewpoint of using efficiently management resources, like workers, things and money possessed by the enterprise in order to achieve a purpose and an ideal of each enterprise.

Rate of balancing load	rate of fluctuations in the load of bottleneck process in the totaled unit of day or week
Average number of days for inventory	For how many days the finished product inventory or the inventory of work in process are kept, averaging the amount of orders a day
Facility resource available ratio	ratio of the actual operation time to the operation available time in each machine or facility

Ratio of common parts	comparison between the ratio of the number of parts to the number of product items and the ratio of the average number of parts in one product
Rate of dead inventory	rate of the manufacturing costs of products, materials and works in process that are unsold for the fixed period and more and don't move
Multi-skilled labor rate	rate of the workers who have some skills and can operate various processes according to production change
Number of results in QC activity	number of QC activities that get the results at higher level than the fixed value
Motivation	Whether employees have a sense of purpose and develop their abilities through enterprise activities with reason for doing so (fixed index).
Manufacturing cost rate	rate of manufacturing cost (including the fixed cost) to sales price. The fixed cost is distributed by a cost driver.
Through-put	rate of the profit that is the sales price per the fixed term minus the direct cost (only material cost)
Cash Cycle	average number of days from paying cash for purchasing materials to collecting cash by sales

✧ **Viewpoint of information system**

Information system described here is the system synthesizing the flows of information and value in human work, not the closed world consisting of a computer and a network device only. In short, the

information system without using a computer exists. However the important problem in the present business environment is how the information system in the enterprise is advanced and how the system is replaced with the mechanism using a computer and network.

Planning cycle	cycle of creating a plan, including the case where the created plan is remade based on results.
Planning precision	rate of the case where the created plan is not corrected till the plan is actually executed.
Speed of planning correction	speed that a plan can be corrected for the unexpected situation, or a correction cycle
Rate of common terms	Whether the terms used for transmitting information in the enterprise or between the related enterprises are common by standardizing.
Rate of sharing information	Whether the information required for process link such as planning information between sections or enterprises is shared or not.
Rate of digitizing	How much various information in the production site is described on a computer, not on paper.
Master matching	Whether the master information for enterprise is integrated and managed, and whether there is a contradiction or mismatching with the reality (fixed index).
Rate of reusing knowledge	How much information and knowledge collected in each site are stored in the re-usable form and actually reused.

3. Constructional Elements of APS System

For concretely describing the grand design for manufacturing enterprises, the business models for individual enterprises must correspond to each other in the information system and must be detailed gradually. Thus it is important to design the mechanism of collaboration (collaborative decision-making) about how each functional element constructing the system behaves under the various circumstances and achieves the purpose for the whole.

This chapter first regards the collaboration mechanism based on APS concept as a concrete means of realizing the business model discussed in the former chapter and embodies the mechanism. The second layer "APS Collaboration Layer" in APS Engineering Architecture shown in "Guidance（PSLX-00）" is discussed from this chapter.

This chapter beforehand explains the outlines of constructional elements that appear in individual collaborations to be described in the next and later chapters. The constructional elements of collaboration are classified into two classes, agent and object.

3.1. Description of Agent

The agent described here is APS agent in "Guidance (PSLX-00)", and an active element making APS. In APS, the agents with individual special feature realize the various functions shown in the preceding chapter with active decision-making. At the same time, the agents always plan and execute the action with collaborating in the framework of "integrated decision-making," which handles individual functions by crossing them (moving from function to function.)

Because especially planning agent and scheduling agent have the important parts in APS among the below agents, the contents of them are explained more minutely in Part 2 "APS Agent Model" in this specification.

✧ **Policy planning agent（1）**

When executing production, first this policy planning agent decides a production policy. Production policy described here is decision-making about how the management resources are distributed from a standpoint of enterprise management. To put it concretely, it is the information about when, which, how many product families are made for market demand. Policy planning agent decides the production policy from the management viewpoint with considering the financial conditions of enterprise.

✧ **Planning agent（2）**

Planning agent creates various plans about production. The plan described here is what decides the information about which, how and how long an item is produced, or the information about the resource specification and the capacity for producing. Planning agent decides these data on the basis of any index with considering the entire balance of these data and integrating them

✧ **Scheduling agent（3）**

Scheduling agent follows the plan specified by planning agent, and adjusts the various necessary operations on the time axis with considering spending resources and materials required to put the plan into action actually. Scheduling agent searches the solution with considering the unique constraints in various production sites to bring scheduling result close to reality as much as possible.

✧ **Product design agent（4）**

Product design agent generates the detailed information about functions and configuration of product itself, and about how to use the product. Product information generated here is defined by being structured into parts of a product and so on. These structures of parts or specification options are the important information for deciding the way of manufacturing.

✧ **Process design agent（5）**

Process design agent designs the production process that is an equipment to transcribe the design data of various products into

concrete products. Besides the jobs of process design agent are newly building a factory itself and extending a production line. At the same time, process design agent defines various rules and constraints to make individual products when designing these production processes.

✧ **Purchase scheduling agent（6）**

Purchase scheduling agent follows the contents of production policy or production order planning, and supplies the required materials from the outside supplier. And outsourcing with supplies management such as process of outside supplier is also a target. This agent manages supplier to keep the losses to a minimum in regard to the production spreading over some enterprises.

✧ **Sales management agent（7）**

Sales management agent creates sales scheduling and manages the actual customer order for selling products in business section. This agent stands between a customer and a production site and follows the business section with processing the special express order, promising the due time and phasing individual specification.

✧ **Cost management agent（8）**

Cost management agent correctly grasps each manufacturing cost for the production individually executed by enterprise, and provides the basic information for deciding the most suitable way of producing from the viewpoint of cash flow. The master data required for cost calculation such as a management unit is managed and updated by this agent whenever necessary.

✧ **SC management agent（9）**

Supply chain management agent manages the information of the related enterprises on the supply chain such as the enterprises related with physical distribution or transportation, supplier, partner, not to mention customer. And this agent executes the action to keep a network most optimized for enterprise all times. To evaluate the related enterprises and to search a new constituent member are also very important jobs.

✧ **Transportation management agent（１０）**

Transportation management agent creates the plan for transportation between enterprises or in an enterprise, and manages executing the plan actually. When executing the production spreading over some sites, it is important to synchronize production process and transportation process by this transportation management agent.

✧ **Capacity adjustment agent（１１）**

Capacity adjustment agent adjusts the capacity to keep the required production capacity for realizing the production plan. The adjustable range of physical production capacity is limited for each factory. This agent selects the best way out of various choices, for instance extending a facility, prolonging operation time, or using outside production resources and so on.

✧ **Inventory adjustment agent（１２）**

It is necessary to efficiently use the inventory in order to assimilate the change in demand in the market and to realize the balanced production as much as possible. Inventory adjustment agent makes the decision about which position, which time and how many inventories should be possessed in the supply chain.

✧ **Manufacturing execution agent（１３）**

Manufacturing execution agent executes various managements when executing actually manufacturing under the created manufacturing indication. It is possible to say that the core function of MES（Manufacturing Execution System）is one form embodied by this agent. Manufacturing execution agent directly manages individual devices and workers, and defines the corresponding relation between production indication and results.

✧ **Facility maintenance agent（１４）**

Facility maintenance agent plans the various operations, like maintaining and so on, and manages the operations for a production system to be able to provide the expected capacity all time. Facility maintenance agent always monitors the condition of production

resources. Whenever finding the abnormal condition, this agent decides the measures and controls the situation.

✧ **BOM management agent（１５）**

BOM management agent manages the engineering information for Planning and Scheduling on production. The former BOM had mainly the information of parts lists, but this agent has also the information of process procedure and provides the basic information for simultaneously calculating resource load and material requirement, which is one special feature of APS. This agent also manages the items of BTO type products that the final product is decided by combining various specifications.

✧ **Specification decision agent（１６）**

Specification decision agent manages the order including the vagueness that all specifications of product are not decided beforehand. And this agent manages the term from the time to firstly receive the order to the time to lastly decide all of specifications. Specification decision agent provides the information of the decided part for starting to produce partially in this term, and at the same time, provides the information for asking for the specification decision of the undecided parts.

✧ **Allocation management agent（１７）**

Allocation management agent manages the correspondences between a customer order and a production order, or between a production order and individual manufacturing indications. In short, it corresponds to pegging management. This agent processes the various cases and requests that are from the simple pegging such as product number management, to the pegging with dividing or joining lots such as MRP.

✧ **Link management agent（１８）**

Link management agent supports the interactive communication when the unformatted information about production is exchanged between enterprises or organizations. Generally a great deal of person hour is needed to exchange the information over the wall of organizations because of difference of terms or data formats. But this agent

assimilates each local difference and enables the information exchange with high reliability.

3.2. Description of Object

The object described here is the passive data aggregate to be used for a definite purpose to some extent. These data have various business elements described in Chapter 2 or the original structure of APS required for executing integrated decision-making there. The following shows supplementary descriptions of objects as the minimum information to be required for explaining the collaborations by agents. The systematic structure of a object model or the concrete contents of object including the objects described here are explained in detail as "PSLX Domain Object" in Part 3 of this specification.

✧ **Financial statements object（1）**

Financial statements object is the object showing the financial conditions in enterprise.

✧ **Market demand object（2）**

Market demand object is the object indicating the potential needs of market, forecasting information about customer order and unofficial information.

✧ **Production policy object（3）**

Production policy object is the object that represents the basic policy on production such as when, what, how many products are produced.

✧ **Production order object（4）**

Production order object indicates the information about what, how many and how long products must be made as an order in a unit of the final product. This is the request to the production section.

✧ **Customer order object（5）**

Customer order object is the object that directly indicates the request from a customer and corresponds to production order finally.

✧ **Purchase order object（6）**

Purchase order object shows the purchase order sent to a supplier for keeping the required materials for production order.

✧ **Manufacturing indication object（7）**

Manufacturing indication object shows the information about the operation to actually produce for individual production resources. It includes the information corresponding to the operation indication such as start time or end time to operate.

✧ **Sales scheduling object（8）**

Sales scheduling object indicates the forecasting value or the target value of the number of products to be sold to customers in the future. The value provided by sales scheduling object is used as forecasting information for planning a production order.

✧ **Inventory planning object（9）**

Inventory planning object expresses the expected inventory level in the future generated by inventory adjustment agent.

✧ **Transportation scheduling object（10）**

Transportation scheduling object indicates the future planning or scheduling about transportation operation in an enterprise or between enterprises specified by transportation management agent.

✧ **Maintenance scheduling object（11）**

Maintenance scheduling object expresses the information about maintenance scheduling.

✧ **Related enterprise object（12）**

Related enterprise object expresses the concrete information about each enterprise used by supply chain management agent.

✧ **Transportation capacity object（13）**

Transportation capacity object expresses the resource capacity of transportation facilities etc. required for transporting.

✧ **Production capacity object（１４）**

Production capacity object expresses the resource capacity required to produce such as production facilities or machines. And also it includes the information about the usable time of each resource.

✧ **Manufacturing results object（１５）**

Manufacturing results object expresses the manufacturing results of how many products have actually been made under manufacturing indication and the operation results of how many production resources have been used.

✧ **Production rule object（１６）**

Production rule object expresses the constraints or the rules to be considered when actually producing. In production scheduling, the realistic scheduling is generated under this rule.

✧ **Product inventory object（１７）**

Product inventory object has the time series information about where and how many goods are stocked for every product. It includes the inventory information about the stock outside of enterprise such as distributor's stock.

✧ **Material inventory object（１８）**

Material inventory object expresses the inventory information of the materials not to be a product yet or works in process.

4. Basic Collaboration Form

This chapter shows the most basic examples for various collaborations required for realizing APS. Chapter 2 describes that it is necessary to make the integrated decision to control the operation functions to be considered by APS. This is the basic information for constructing the mechanism for executing concretely integrated decision-making.

Thirteen typical collaborations are described dividing into three groups: about production item, about production resources, and about supply chain.

4.1. Decision-making on Production Item

At first, the examples of collaborations making decision about items to be produced are given here.

✧ Policy planning collaboration（1）

This collaboration creates the production plan including the index about persons or funds by standing on the managing viewpoint such as business development or product development for what, when and how many products are made. This becomes the medium- and long-term plan comparatively.

Name	Policy planning collaboration
Agent	Policy planning agent, Planning agent, SC management agent
Object	Market demand object, Produce capacity object, Financial statements object, Production policy object

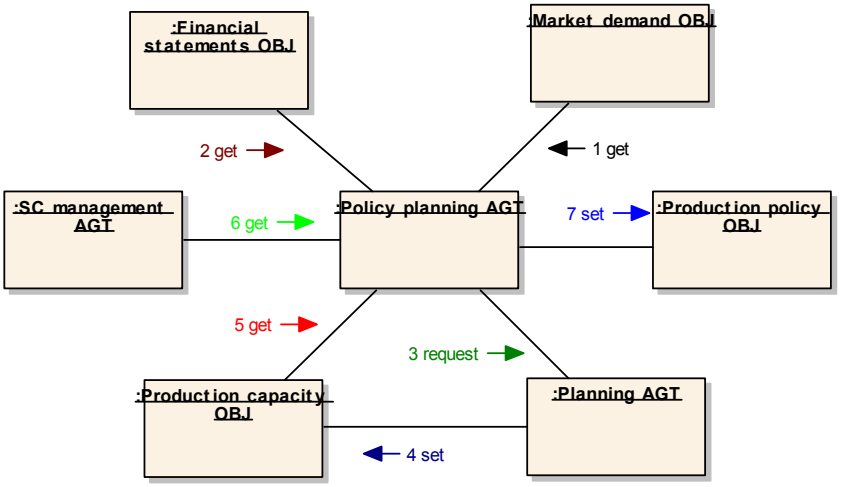

Figure 1-6　Policy Planning Collaboration

✧ Production order planning collaboration（2）

This collaboration decides the required amount of production for preparing materials needing prior arrangements, or for adjusting the production capacity in every finished product for production order planning. However the amount obtained here may be altered with time. In production order planning, planning agent and scheduling agent exchange information closely and the plan guaranteeing that the scheduling is executable to some degree is given.

Name	Production order planning collaboration
Agent	Planning agent, Scheduling agent, Capacity adjustment agent, Sales management agent
Object	Production policy object, Market demand object, Production order object, Product inventory object, Inventory planning object

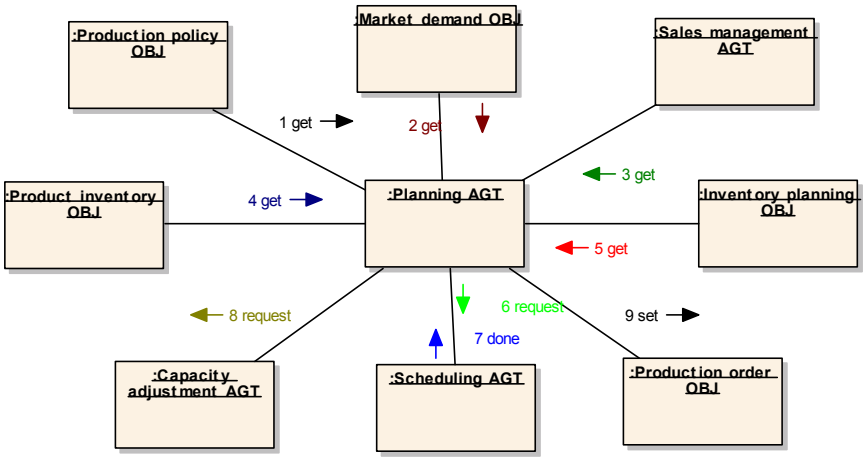

Figure 1-7　Production Order Planning Collaboration

✧ **Manufacturing indication planning collaboration（3）**

This collaboration creates the plan in an operation unit for every process actually executing manufacturing.　This plan becomes finally an indication to the manufacturing process.

Name	Manufacturing indication planning collaboration
Agent	Scheduling agent
Object	Production order object, Production capacity object, Material inventory object, Production rule object, Manufacturing results object, Manufacturing indication object, Maintenance scheduling object

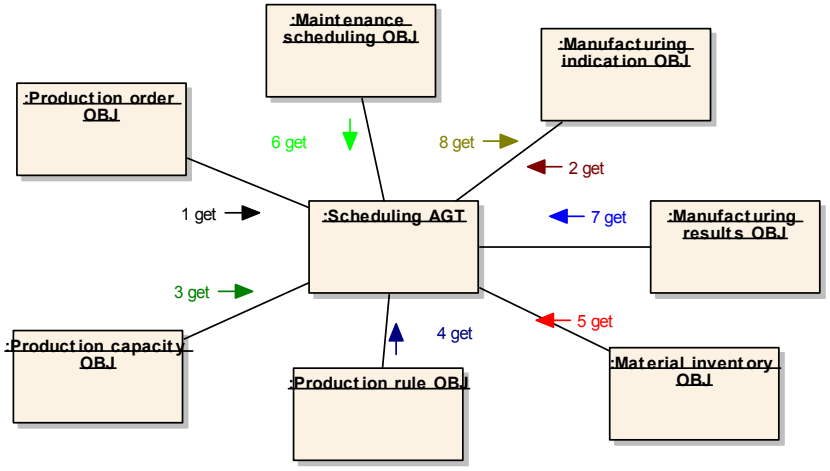

Figure 1-9　Manufacturing Indication Planning Collaboration

✧ Due date estimation collaboration （4）

When any new operations are necessary for the order from customer, this collaboration answers the due date by scheduling those operations temporarily.

Name	Due date estimation collaboration
Agent	Allocation management agent, Scheduling agent, Sales management agent
Object	Production order object, Product inventory object, Manufacturing indication object, Manufacturing results object, Production capacity object, Material inventory object, Production rule object

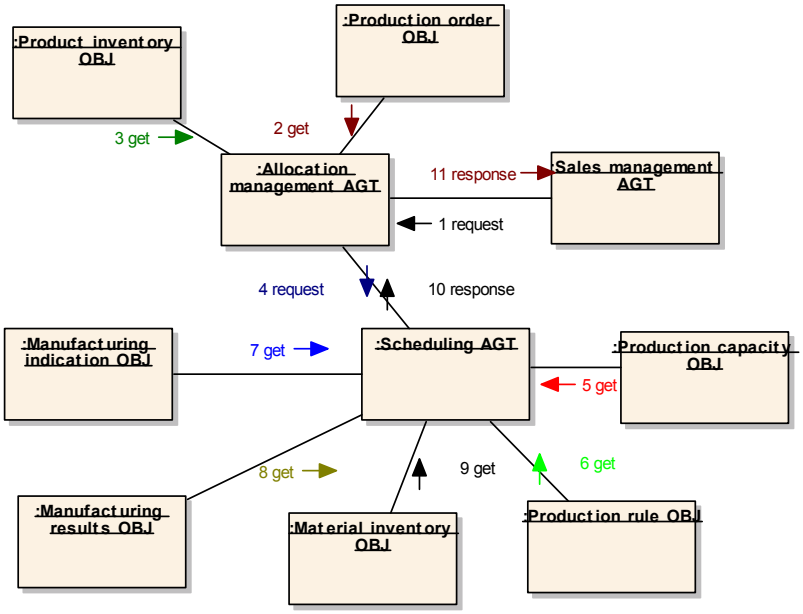

Figure 1-8　Due Date Estimation Collaboration

✧ Manufacturing execution collaboration（5）

This collaboration follows the manufacturing indication and actually executes manufacturing with issuing the manufacturing indication information to every facility or every machine.　After executing manufacturing, this collaboration gathers manufacturing results and operation results and these results are reflected to the later plan and indication.

Name	Manufacturing execution collaboration
Agent	Scheduling agent, Manufacturing execution agent
Object	Manufacturing indication object, Production capacity object, Production rule object, Material inventory object, Manufacturing results object

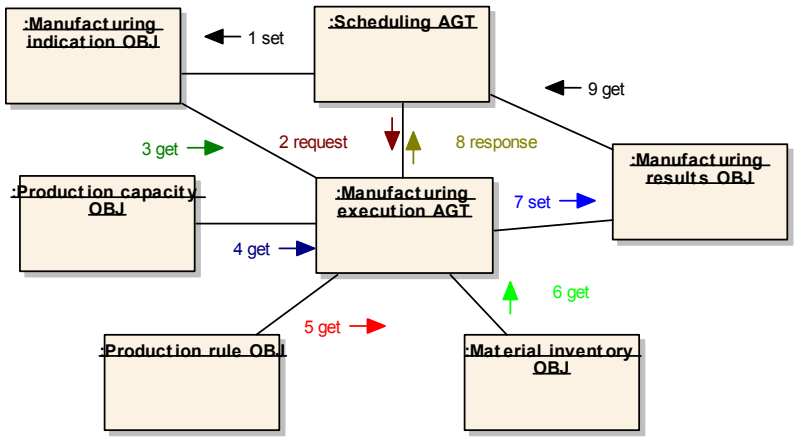

Figure 1-10　Manufacturing Execution Collaboration

4.2. Decision-making on Production Resources

When seeing from the viewpoint of production resource that is the producing side, the following collaborations concerned with the capacity or the tolerance value of resource, maintenance and management of those resources are necessary.

✧ **Factory planning collaboration（6）**

This collaboration forms the plan to increase a line and to establish or to abolish the factory following a new market tendency.

Name	Factory planning collaboration
Agent	Planning agent, Process design agent
Object	Financial statements object, Market demand object, Production policy object, Related enterprise object, Production capacity object, Transportation capacity object, Production rule object

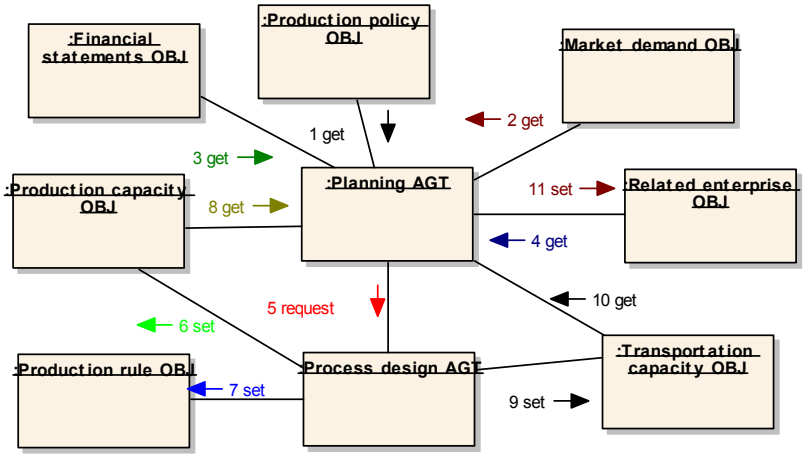

Figure 1-11　Factory Planning Collaboration

✧ **Capacity planning collaboration（7）**

The capacity of production resources such as facility or worker is adjusted according to production order. To put it concretely, this collaboration changes the ability of worker or the capacity of facility. The ability and the capacity are adjusted by setting up the operation calendar in every resource.

Name	Capacity planning collaboration
Agent	Planning agent, Scheduling agent, Capacity adjustment agent, SC management agent
Object	Production order object, Production capacity object, Manufacturing indication object

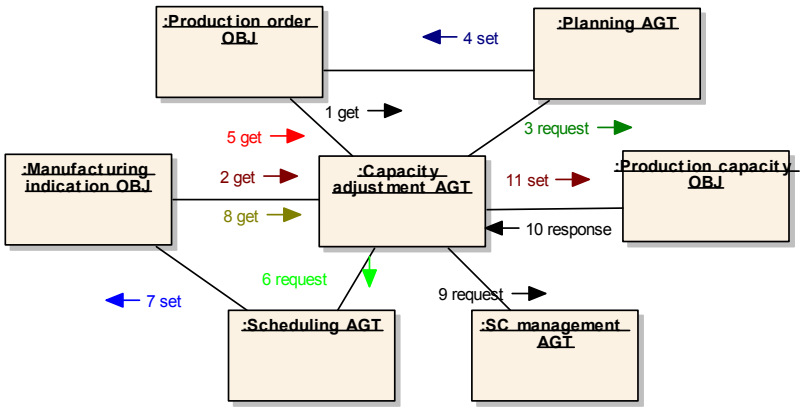

Figure 1-12　Capacity Planning Collaboration

✧ **Facility maintenance collaboration（8）**

This collaboration sets up a plan for facility maintenance. Facility maintenance work is necessary irregularly and executed by cutting into the production scheduling. Facility maintenance monitors the operation conditions of various facilities and sets up the plan if necessary.

Name	Facility maintenance collaboration
Agent	Facility maintenance agent, Scheduling agent
Object	Production order object, Manufacturing indication object, Production capacity object, Maintenance scheduling object, Production rule object, Production policy object

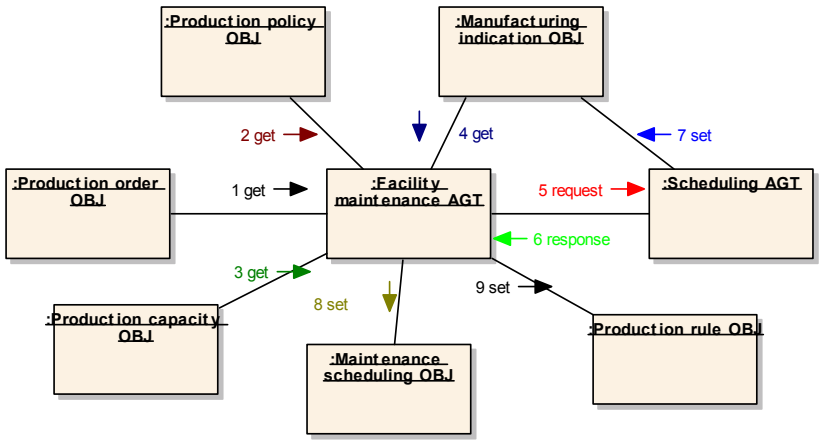

Figure 1-13　Facility Maintenance Collaboration

4.3.　Decision-making on Supply Chain

From the viewpoint of the entire supply chain, it is important that how the relation with customer and the relation with outside enterprise such as supplier are constructed.　These are concretely handled as the following collaborations about sales activity for product or material supply.

✧ **Sales scheduling collaboration（9）**

Sales section creates sales scheduling based on the original forecasting. The plan created here is the sales target for the creator.　This information is used for production order scheduling.

Name	Sales scheduling collaboration
Agent	Sales management agent, Planning agent
Object	Production order object, Production policy object, Customer order object, Market demand object, Sales scheduling object, Product inventory object

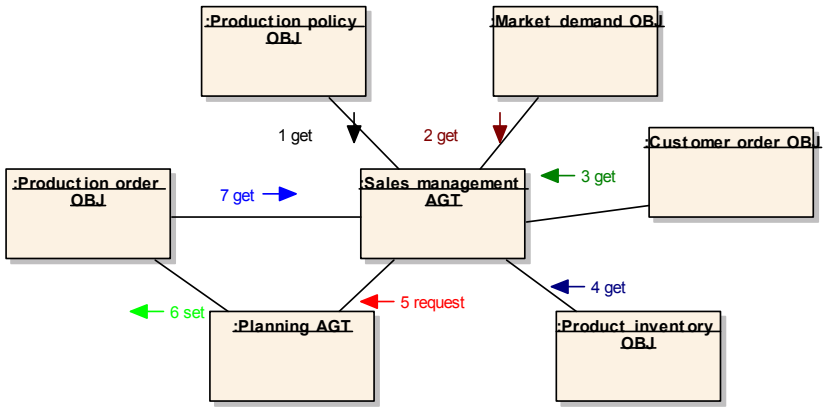

Figure 1-14　Sales Scheduling Collaboration

✧ **Inventory planning collaboration（１０）**

This collaboration controls the proper level to keep the fixed amount of the finished product stock for providing for the future demand.　In this collaboration, not only the finished product inventory in a factory but also the finished product inventory in the distribution process is considered.

Name	Inventory planning collaboration
Agent	Inventory adjustment agent, SC management agent, Planning agent
Object	Inventory planning object, Product inventory object, Sales scheduling object, Production order object, Transportation scheduling object

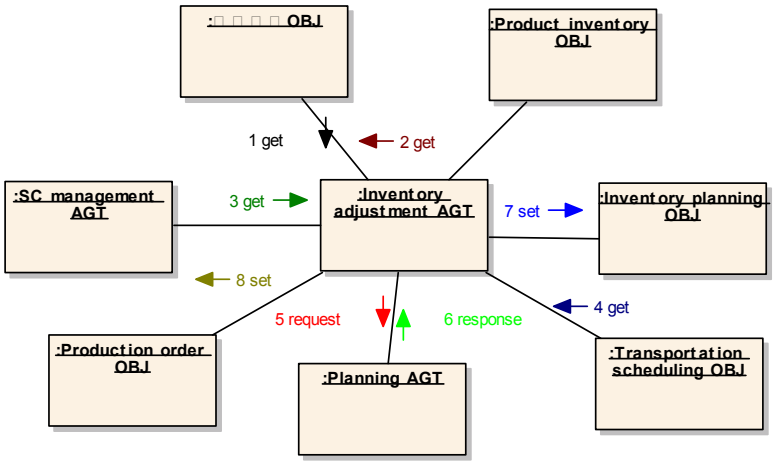

Figure 1-15　Inventory Planning Collaboration

✧ **Supplier selection collaboration（１１）**

This collaboration selects a supplier and decides the contents of contract to efficiently supply the necessary material with a profitable condition.　It includes the case where the specific process other than material is outsourced.

Name	Supplier selection collaboration
Agent	SC management agent, Planning agent, BOM management agent
Object	Production policy object, Production order object, Related enterprise object, Production capacity object

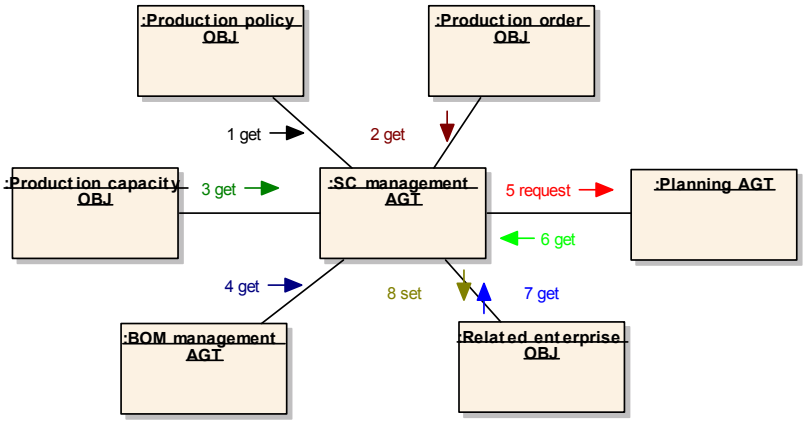

Figure 1-16　Supplier Selection Collaboration

✧ **Purchase scheduling collaboration（1 2）**

Purchase scheduling is made in advance for the purpose that the materials required for production can be supplied at all times.

Name	Purchase scheduling collaboration
Agent	Purchase scheduling agent
Object	Manufacturing indication object, Purchase order object, Material inventory object, Production order object, Related enterprise object

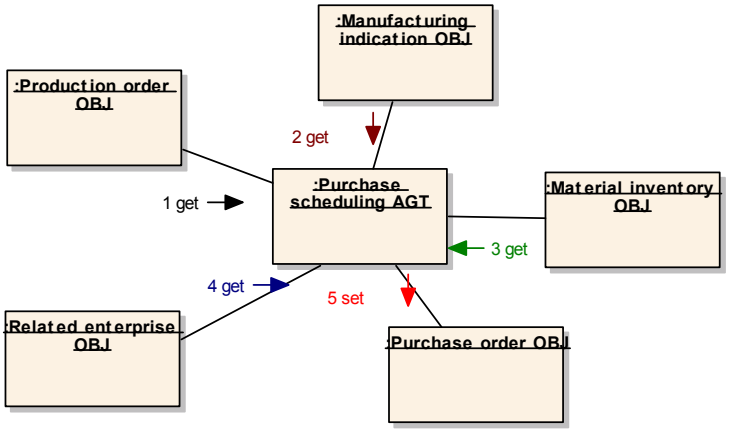

Figure 1-17　Purchase Scheduling Collaboration

✧ Transportation scheduling collaboration（1 3）

Synchronizing with production scheduling sets up transportation scheduling. This collaboration sets up scheduling such as conveyance between the processes in two separated places or transportation between bases. And also it selects the desirable transportation route.

Name	Transportation scheduling collaboration
Agent	Transportation management agent, SC management agent, Planning agent, Scheduling agent
Object	Transportation scheduling object, Transportation capacity object, Related enterprise object, Production order object

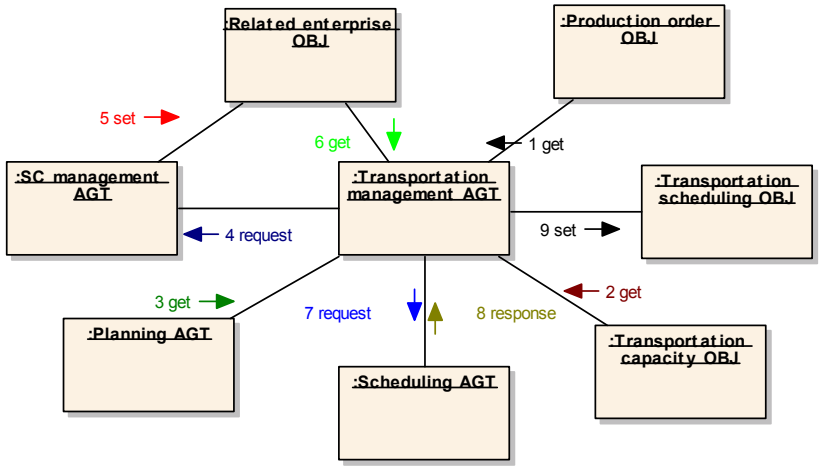

Figure 1-18 Transportation Scheduling Collaboration

5. APS Expansion Collaboration Model

As seeing the basic configuration of collaboration shown in Chapter 4, each collaboration in APS is not independent and relates with each other. Because the agents and the objects constructing collaboration are common and they influence each other in the process of collaboration.

It is possible to design APS's own mechanism with considering this point and combining the basic collaborations shown in Chapter 4. This chapter introduces a new system integrating some collaborations as an example of the specific mechanism in APS. These become sketches to realize concretely the integration and the link of Planning and Scheduling that are the basic concepts of APS.

5.1. Booking-type Production System

Booking-type production system is the mechanism for adjusting the demand and supply with collaborating a sales section and a manufacture section. Production limit information called production seat list is used as a medium of information transmission between sales section and manufacturing section. So the sales section can answer and promise the due time and the manufacturing section can execute the balanced production. When a person in charge of sales sets up the reservation for the reliable expected order information in the production seat list, the extremely precise forecasting is available.

Booking-type production system mainly consists of three collaborations: "Seat generation," "Booking," "Seat correction."

✧ Seat generation collaboration（1 4）

Booking-type production system generates a seat at first. Production seat is generated in the form corresponding to the production order created by a planning agent under sales scheduling or production policy.

Name	Seat generation collaboration
Agent	Planning agent, Scheduling agent
Object	Sales scheduling object, Production policy object, Production order object, Manufacturing indication object, Production rule object, Production capacity object, Material inventory object

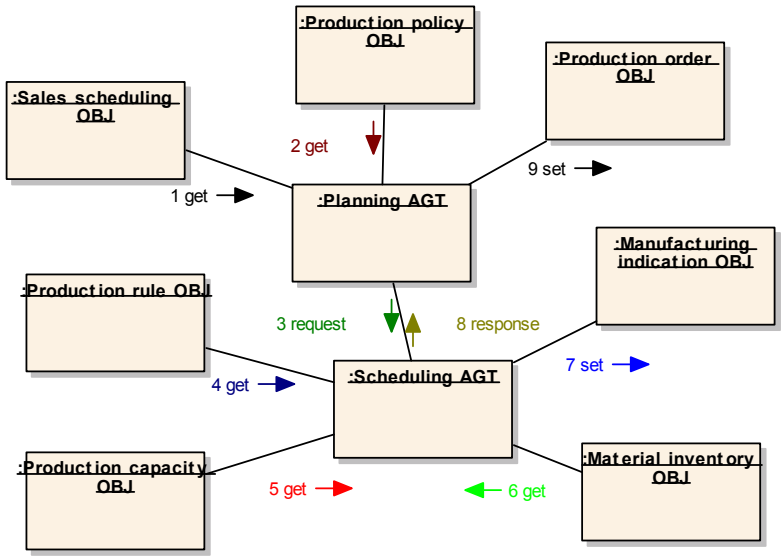

Figure 1-19　Seat Generation Collaboration

✧ **Booking-type production collaboration（１５）**

Customer's request is corresponded to the seat list that was set up as a production seat beforehand.　When the applicable seat exists, the seat is reserved as a customer order.　The customer order gotten there is transmitted to a production site as a manufacturing indication with guaranteeing the due time.

Name	Booking-type production collaboration
Agent	Sales management agent, Scheduling agent

Object	Market demand object, Production order object, Manufacturing indication object, Customer order object

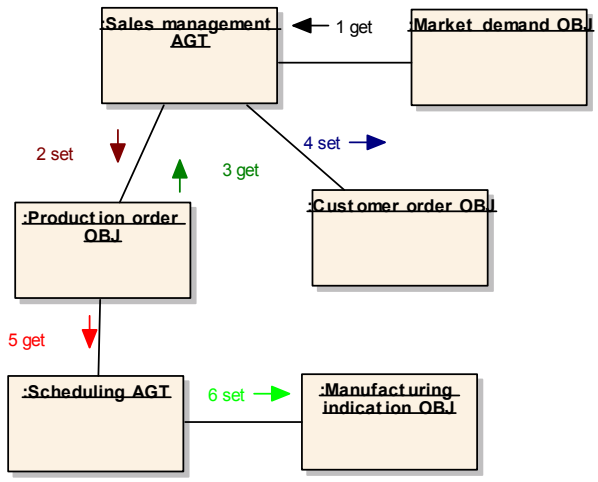

Figure 1-20　Booking-type Collaboration

✧ **Seat correction collaboration（1 6）**

When there is no production seat corresponding to a customer request, a new seat is recreated to apply to the request if necessary.　In such a case, rescheduling is executed with a prerequisite that the due time and the amount of products are sure to be satisfied for the already reserved production seat.

Name	Seat correction collaboration
Agent	Sales management agent, Scheduling agent, Planning agent
Object	Market demand object, Production order object, Manufacturing indication object, Production rule object, Production capacity object, Material inventory object

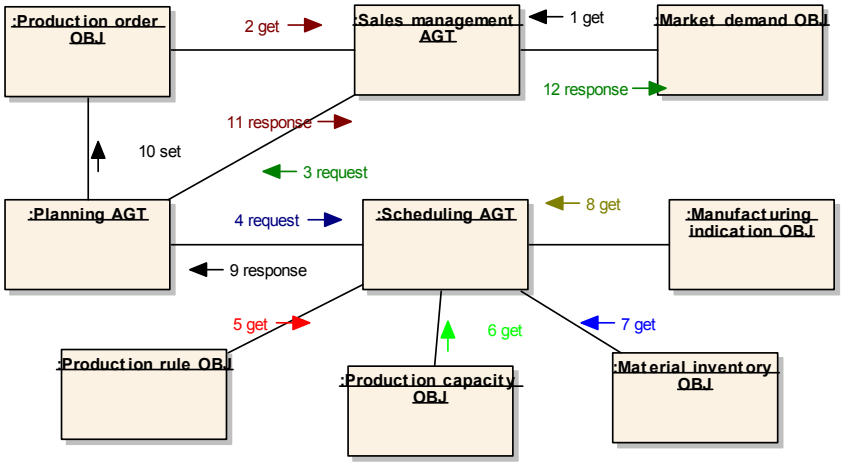

Figure 1-21　Seat Correction Collaboration

5.2.　Mixed Production Allocation System

Mixed production allocation system doesn't tell the present forecast order production from sales order production and manages all items after the mixed method of combining forecast order production and sales order production. If the order isn't received to the end, the production is close to forecast order production. If the order is received immediately after planning, the production is close to sales order production. In short, this system is the system in which the management method seems to change dynamically for every item according to the condition of sales order. Forecast order production lot and sales order production lot are mixed and flow in individual processes. This system has a special feature that is able to execute lead-time shortening and inventory reduction at the same time.

Mixed production allocation system mainly consists of three collaborations: "Plan generation," "Plan allocation," "Results management."

✧ Plan generation collaboration（1 7）

In the mixed production method, production order is set up beforehand as a plan order according to forecasting. Production order is immediately developed by the manufacturing indications in each process. And materials are arranged if necessary.

Name	Plan generation collaboration
Agent	Planning agent, Scheduling agent
Object	Market demand object, Production policy object, Sales scheduling object, Production capacity object, Production order object, Manufacturing indication object, Production rule object, Material inventory object

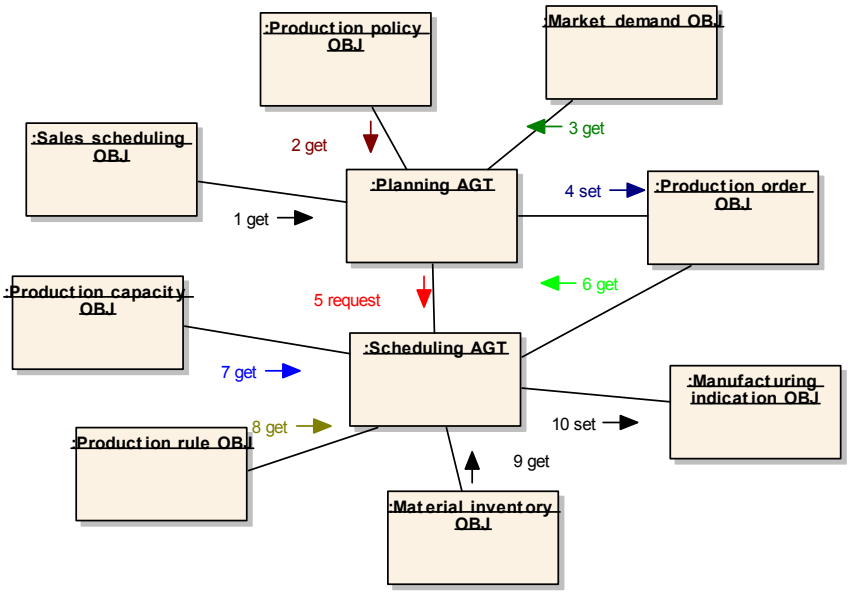

Figure 1-22　Plan Generation Collaboration

✧ **Plan allocation collaboration（１８）**

When receiving the actual customer order, this collaboration allocates the applicable production order and the detailed manufacturing indication to the order. Even if producing is completed and the products are in stock, this collaboration allocates them for the completed plan information. This allocation considers fractions and the difference of lot sizes.

Name	Plan allocation collaboration
Agent	Planning agent, Allocation management agent
Object	Customer order object, Production order object,

	Manufacturing results object, Manufacturing indication object

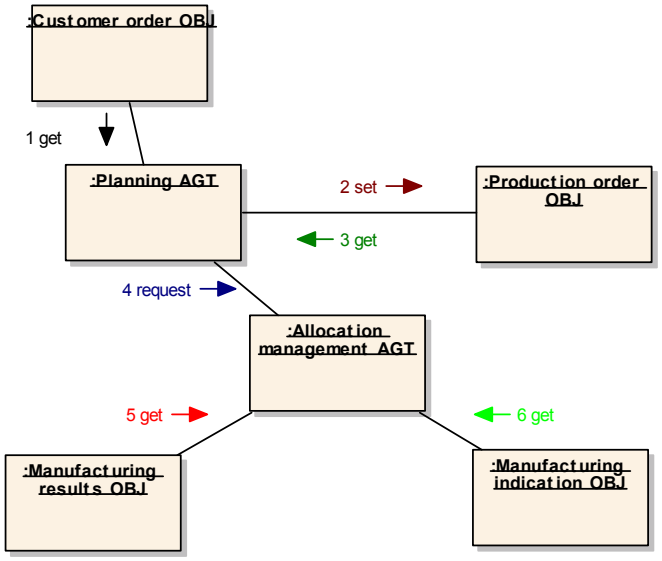

Figure 1-23　Plan Allocation Collaboration

✧ **Results management collaboration（１９）**

Whenever individual manufacturing indications are executed under the daily production progress, results management collaboration grasps the progress information and reflects it on the production order information finally.

Name	Results management collaboration
Agent	Allocation management agent, Manufacturing execution agent, BOM management agent
Object	Production order object, Manufacturing indication object, Material inventory object, Manufacturing results object, Product inventory object

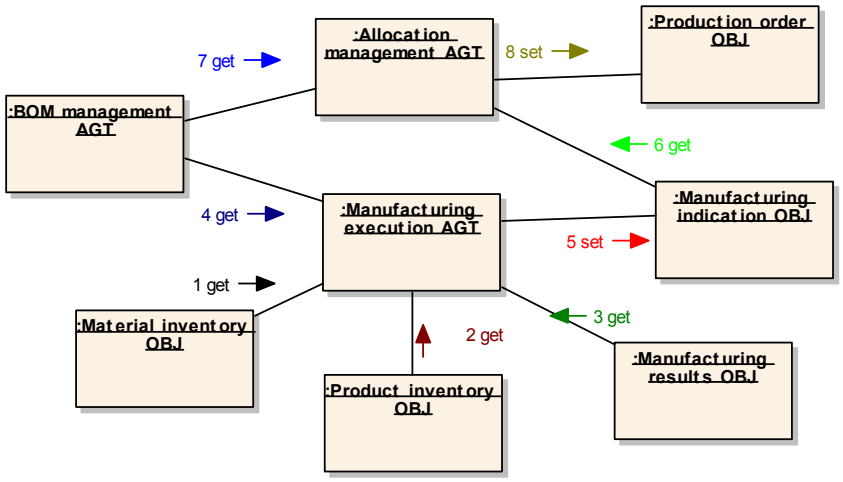

Figure 1-24 Results Management Collaboration

5.3. Collaborative Specification Decision System

Collaborative specification decision system is the mechanism for starting to make the parts of which the specification is defined when starting to produce before the specification is decided completely for individual sales order production. And at the same time, the system manages the schedule where the business section must decide the specification with a customer till the last due date. It is possible to produce the product suited to individual customer's specification in the shorter lead-time.

Collaborative specification decision system consists of three collaborations: "Order setup," "Specification asking," "Specification decision."

✧ Order setup collaboration（２０）

Order setup collaboration accepts the customer order of which specification isn't settled yet, and processes it as a regular order. This collaboration notifies the unsettled specification to the specification decision agent.

Name	Order setup collaboration
Agent	Sales management agent, BOM management agent,

	Allocation management agent, Specification decision agent
Object	Customer order object, Manufacturing indication object

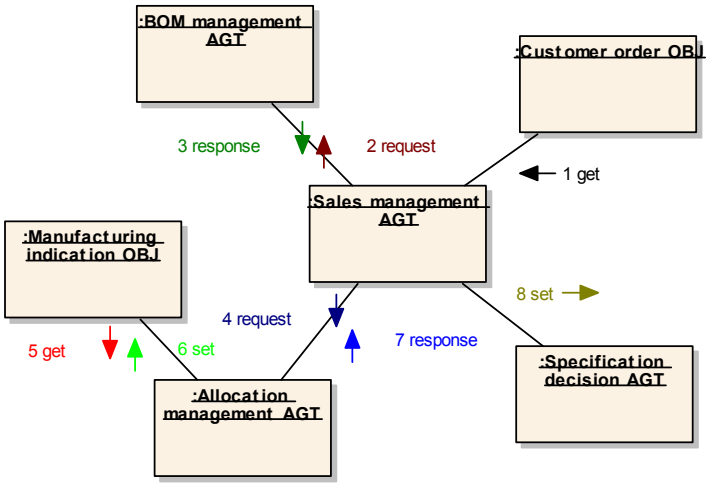

Figure 1-25 Order Setup Collaboration

✧ **Specification asking collaboration（２１）**

Specification asking collaboration provides the information about the time when the unsettled specification must be decided at the latest in order to keep the due date required by a customer and asks the customer to decide the specification.

Name	Specification asking collaboration
Agent	Specification decision agent, BOM management agent, Scheduling agent, Sales management agent
Object	Customer order object, Production capacity object, Manufacturing results object, Manufacturing indication object, Material inventory object

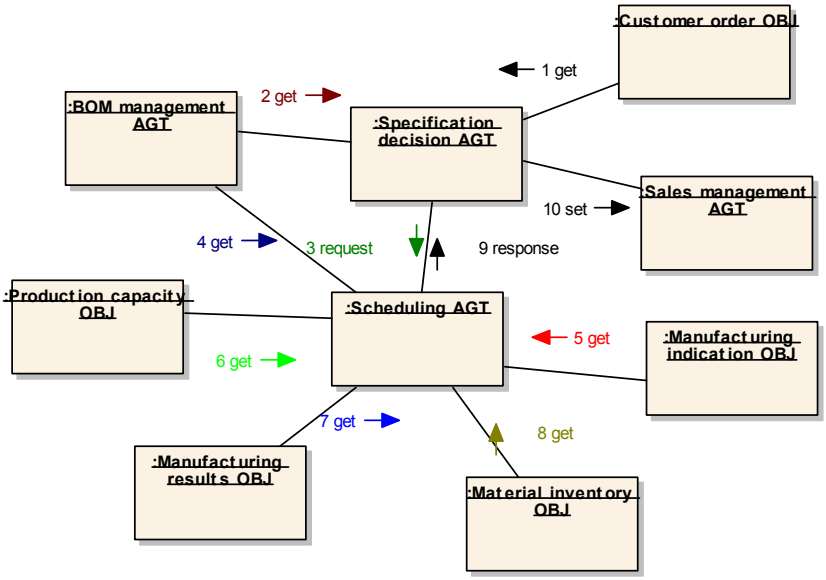

Figure 1-26　Specification Asking Collaboration

✧ **Specification decision collaboration（2 2）**

When the customer's specification is decided additionally, specification decision collaboration reflects the information to sales BOM and generates and sends the necessary indication information to the production site at the same time.

Name	Specification decision collaboration
Agent	Specification decision agent, Sales management agent, BOM management agent, Allocation management agent
Object	Manufacturing indication object, Customer order object

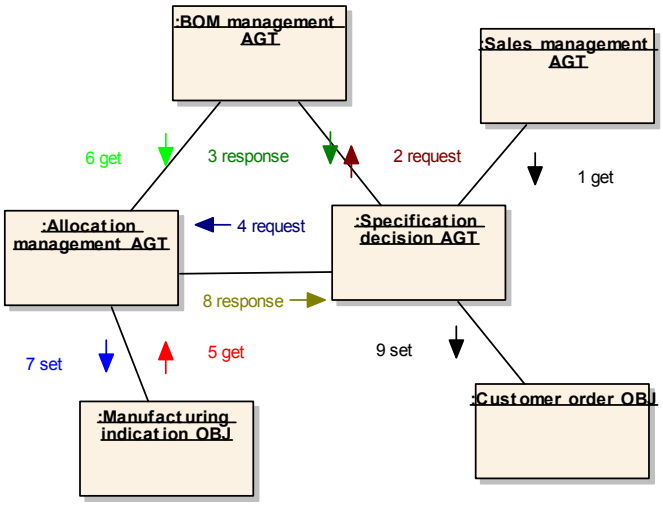

Figure 1-27　Specification Decision Collaboration

5.4. Project-type Quantified Production

The former project-type production was the typical one-item production including design development process. Project-type quantified production is the method that the fixed amount of products are produced repeatedly for the fixed period and the production is stopped by itself according to the product lifecycle. This production anticipates the change of customer's desire and has the effect to maximize the cash flow.

Project-type quantified production consists of three collaborations: "Profits planning," "Switch decision," "Product switching."

✧ Profits planning collaboration（2 3）

Profits planning collaboration regards a new product development as one project, and plans the profits of the entire enterprise with grasping the cost rightly. In this collaboration, product design, process design and sales section decide the basic plans under the index such as profitableness.

Name	Profits planning collaboration
Agent	Planning agent, Cost management agent, Product

	design agent, Process design agent, Policy planning agent
Object	Financial statements object, Production policy object, Sales scheduling object, Production order object

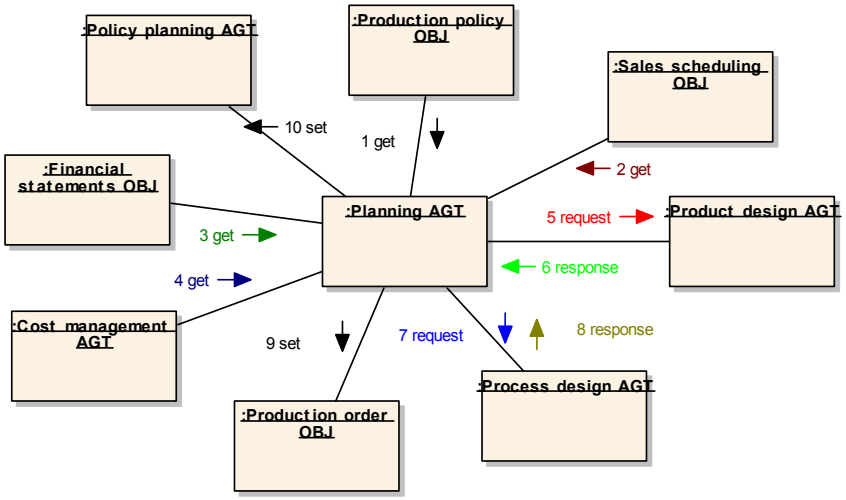

Figure 1-28　Profits Planning Collaboration

✧ Switch decision collaboration（２４）

Once mass production starts and the product shipping starts, it is important to make the decision on how long the product will continue being produced.　Switch decision collaboration decides the timing to close production and to switch to a new product manufacturing.

Name	Switch decision collaboration
Agent	Scheduling agent, Cost management agent, Allocation management agent
Object	Sales scheduling object, Customer order object, Production order object, Manufacturing indication object, Purchase order object, Material inventory object, Manufacturing results object, Inventory planning object, Product inventory object

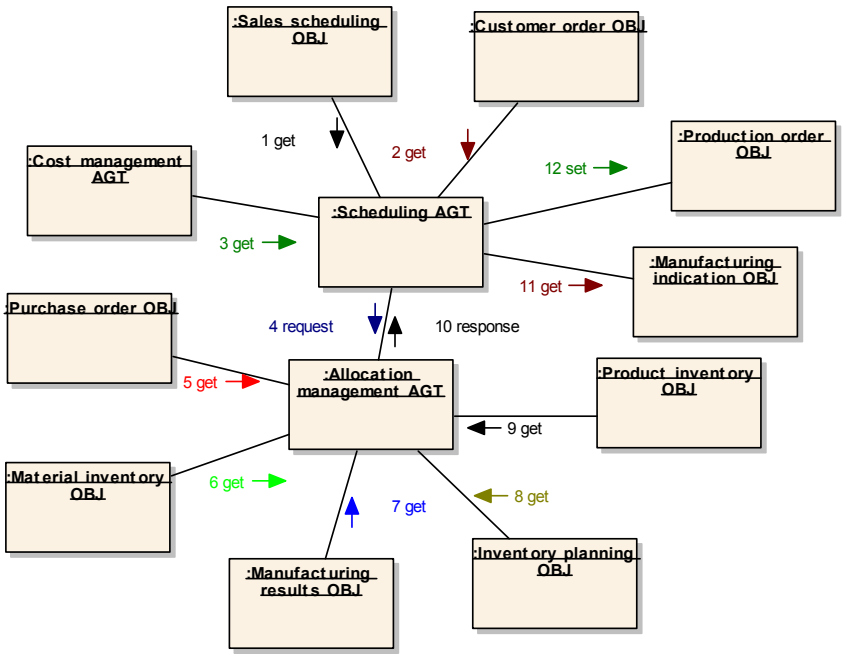

Figure 1-29 Switch Decision Collaboration

✧ Product switching collaboration（２５）

When changing a model of product, this collaboration manages the timing to switch the present model production to the new model production in every process and changes the model at the timing with the least waste.

Name	Product switching collaboration
Agent	Scheduling agent, BOM management agent, Allocation management agent, Process design agent
Object	Production order object, Manufacturing results object, Manufacturing indication object

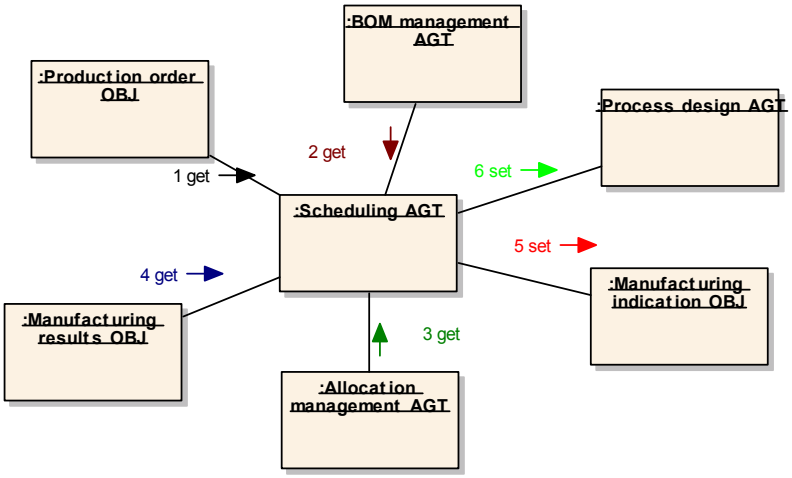

Figure 1-30　Product Switching Collaboration

6. Multi-site Plan link by APS

Multi-site plan link is the mechanism that schedulers in each site indicate the planning information each other and the plan is with matching data as a whole. This link enables inventory reduction and lead-time shortening by linking with the related client factory or linking transportation process with production process.

6.1. Sharing Production Capacity And Inventory Information

The information about inventory information and production capacity is shared between partnered enterprises. Thus materials can be ordered or one part of process can be outsourced with considering the partner's conditions. At the same time, supply lead-time becomes more exact.

✧ **Inventory information sharing collaboration（２６）**

Name	Inventory information sharing collaboration
Agent	Scheduling agent, Purchase scheduling agent, Link management agent, Sales management agent
Object	Purchase order object, Production capacity object, Product inventory object, Customer order object

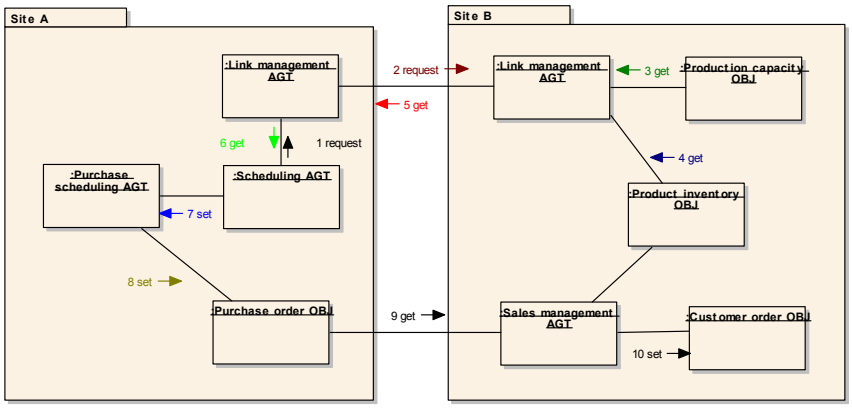

Figure 1-31 Inventory Information Sharing Collaboration

6.2. Sharing Production Plan And Forecasting information

The basic information of each enterprise for production plan such as forecasting or sales forecasting is shared. Thus the production plan with the higher precision can be created between supply chains. This may be the realization of CPFR（Collaborative Planning, Forecasting and Replenishment）by APS.

✧ Forecasting information sharing collaboration（２７）

Name	Forecasting information sharing collaboration
Agent	Planning agent, Link management agent
Object	Market demand object, Sales scheduling object, Inventory planning object, Production order object

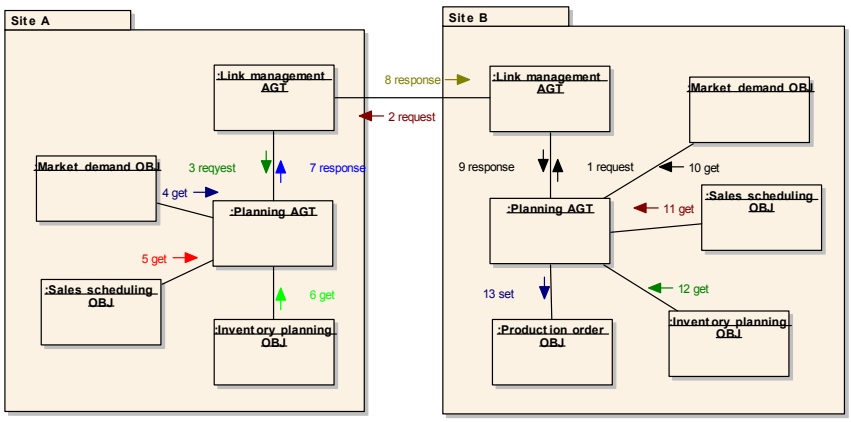

Figure 1-32 Forecasting Information Sharing Collaboration

6.3. Sharing And Linking Production Order Plan Information

The information is sharing on the level of production order plan between enterprises. Therefore the plans link between different enterprises as if they belonged to the same enterprise.

✧ **Planning information sharing collaboration（２８）**

Name	Planning information sharing collaboration
Agent	Planning agent, Scheduling agent, Link management agent
Object	Product inventory object, Production order object

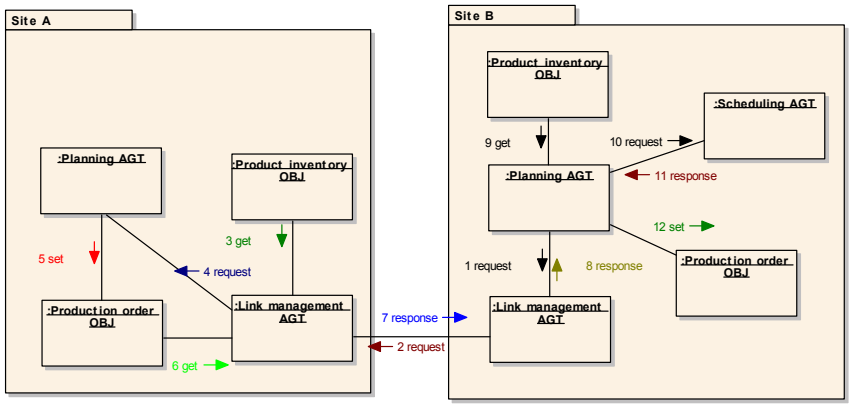

Figure 1-33　Planning Information Sharing Collaboration

6.4.　Synchronous Production on Operation Indication Level

The actions for each production synchronize on the level of operation indication such as a manufacturing indication.　The closer link between enterprises can be realized.　It is possible to synchronize not only two production processes but also with transportation process by linking with 3PL enterprise or the distribution enterprise.

✧ **Operation indication sharing collaboration（２９）**

Name	Operation indication sharing collaboration
Agent	Scheduling agent, Link management agent
Object	Transportation scheduling object, Material inventory object, Production capacity object, Manufacturing indication object, Manufacturing results object, Production order object, Production rule object

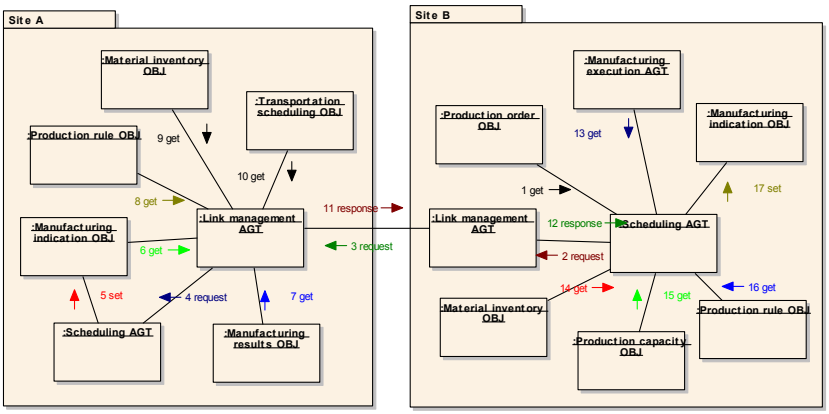

Figure 1-34　Operation Indication Sharing Collaboration

Appendix A Business Environment of Manufacturing Enterprise

In 1980s, Japanese manufacturing industry was at the height of its prosperity, in 1990s it lost its power and nowadays in 21 century it seems to miss the direction to go. What Japanese manufacturing industry should do first is to start rightly recognizing the business environment where manufacturing enterprises are currently placed. The specific changes in the business environment in recent years are classified into the external factors and the internal factors as below.

A.1 Change in External Environment

✧ **Over-supply by deflation**

Today is the time when deflation economy continues for a long time and goods are not easy to be sold. The price of goods tends to fall with the time. It is very high risk for a product to be in stock and so it is the important point for profits that products are sold as soon as the products are made or the products are made without losing an opportunity for selling them.

✧ **Shortening product lifecycle**

The cycle of developing a new product becomes short rapidly. Customers aren't satisfied with the minimum function. It is necessary that how rapid a product should answer the change in customer's request, or conversely how a product should stimulate the potential desire of customer. So it is necessary and essential to continue providing a new product repeatedly for the market for creating a new demand.

✧ **Uncertainty of forecasting increases**

In an information-oriented society, a hit goods is sold explosively all of a sudden and is not sold in an instant. The more customer's segment are limited by answering various needs, the more uncertainty of each

product demand increases. The enterprises that can execute the stable production according to forecasting are decreasing.

✧ **Speedup of technological innovation**

The technology is innovated at a very high speed in the high-technology industries such as the industry related with IT. If product development doesn't keep up with the speed of technological innovation, the inferior stocks will be piled up high soon. When a new technology or standards are created, the products made with the former technology or standards will be valueless very rapidly.

✧ **Competition with the low-price product of Chinese enterprise**

Japanese industrial goods were once a synonym for high quality and low-price. But nowadays China and other Asian countries gain power and get able to produce the mass-produced goods whose quality is same as Japanese goods and the price is lower than them. It is clear that Japanese manufacturing enterprises have already no chance of winning in the competition for producing goods at low price. Unless Japanese manufacturing enterprises change the field for competition, they will have a tough game.

✧ **Weight of maintenance and collection service increases**

The role of manufacturing enterprise is not only selling products. If anything, maintenance service after sales or collection service for recycling begin to be the important activities for manufacturing enterprise. Manufacturing enterprise must be concerned in the whole product lifecycle.

✧ **Understanding of environment and safety deepens.**

The measures against environment and safety are taken very seriously as an index of evaluating a manufacturing enterprise. Manufacturing enterprises are evaluated with not only the quality of product to be provided for market but also the quality of enterprise itself severely. The enterprise that doesn't consider safety, like the food industry, will get social sanctions from consumers.

A.2 Change in Internal Environment

✧ Progress of supplier selection

Supply chain management has the usual business relations more effectively and moreover expands into supplier selection. Many manufacturing enterprises begin to change their principles from the viewpoint of live-and-let-live to the law of the survival of the fittest. In such a principle, the usual indexes, like quality, cost, due date and besides the rate of progressing IT in a company are regarded as important.

✧ Direct hit of demand change by integrating vertically

In the case of consumer products, generally the products shipped from factory pass through the various distribution routes to a final customer. The first wholesale dealer and the secondary wholesale dealer, who have shouldered the complex Japanese distributive machinery, are gradually disappearing because major volume sales stores and manufacturing retail stores appear. But the adjustment function for supply and demand balance taken by the usual distribution machinery disappears at the same time. So manufacturing enterprises get directly suffered the hardship of fluctuation in demand.

✧ Making a little lot and high frequency

Manufacturing enterprises can't mass-produce as before because of answering the various needs of customer and the unforeseeable change in demand. The idea of just in time, which makes the required amount, the required number of products at the required time, spreads through all sorts of industries. Therefore not only manufacture lot size but also the contents of order between enterprises are made in the more little lot and more frequently.

✧ Dividing functions and getting fabless

Manufacturing enterprises begin to divide organizations into every function so as to avoid being a big and stiff enterprise. If the enterprise specializes its core competence and displays the engineering ability as one functional element in a virtual corporation, it is the great

advantage to answer the needs more quickly. The case where an enterprise without a manufacturing factory such as a fabless enterprise makes a profit is increasing.

✧ **Supply and production in the best suited place**

Global production is advanced and so all areas in the world become manufacturing fields. The global enterprises are always very sensitive to the best-suited supply: which area is selected for a supplier, in which area the products are made, and in which area the sales activities are done for consumers. There are many cases where a Japanese parts-maker or a subcontract factory closes down or moves the factory into overseas countries because a business-related enterprise manufactures in the local factory.

✧ **Decrease of skilled workers**

Manufacturing engineering cannot be expressed as logically as a manual. A lot of engineering is difficult to pass down, for instance the technique of an expert. Manufacturing skill of a skilled worker, which was Japanese advantage in manufacturing, is disappearing rapidly because the young persons who will take over the skill run short and the production is mechanized.

✧ **Decline in the will to work by restructuring**

Under the present economic conditions, many managers carry out restructuring with a personnel cut, which has been under taboo up to the present. The lifetime employment system breaks down in reality by betraying employees' allegiance to their companies. The work force of Japanese manufacturing industry of which special feature was diligence has the possibility to greatly change the quality in future.

✧ **Increase of distrust and uneasiness toward IT**

Up to this time, manufacturing enterprises mainly cut down expenses and tended to dismiss the excess personnel with automatizing a production line for the investment in the information system. Most of cases where the usual information system investment is mainly in package don't get the expected results because the project isn't

managed successfully. Manufacturing industry is tied down by worrying about falling behind the information-oriented society and distrust of IT.

Appendix B　How to Decide on Grand Design

This specification aims at providing a guideline or a reference model for manufacturing enterprises to settle on a new grand design by themselves. However the information shown in this specification is just one part of the whole information. So each enterprise must complete the grand design by originally adding information.

There is not the predefined method as the procedure for making a grand design. When a manufacturing enterprise decides on a grand design, this section individually argues about the point that each enterprise is related with in common. Refer to the arguments for making the grand design decided by each enterprise more effective.

✧ Recognizing environment and enabler of change

Appendix A of this specification shows the specific environments of manufacturing enterprise. It is the first step for drawing the grand design to decide how to recognize the present or future business environment.

At the same time, it is necessary to watch the trend of engineering as seeds. While forecasting exactly the impact on business by spreading high-speed Internet from now on, it is necessary to correctly understand APS as an enabler (a thing which enables to realize) of change and to have the knowledge about the potential and the limits of APS.

The present environment and the meaning of new technology ought to be different altogether for each enterprise. The recognition shared and argued here will serve as a big ground to the last, when drawing the grand design.

✧ How to deal with a business model change

When drawing the grand design, it is important to decide clearly a business model of the enterprise. However, because of a rapid change in the business environment of these days, the form of a competitively

superior business model is also changing. The business model of the enterprise that has been successful until now doesn't necessarily guarantee to be superior in the future.

Therefore business models of each enterprise must continue changing with the times. It is necessary to look for a point of agreement between needs and seeds, and to judge calmly the model which uses the current management resources possessed by each enterprise to the maximum and the period when the resources are valid on a mid- and long-term time axis.

✧ **Constructing stakeholder and index**

When a business model is actually operated, it is necessary to prove stakeholders beforehand and to analyze that who has what influence in them and what influence is expected.

After considering the external factors in such a business model, individually tuning in the argument about structuring the related evaluation is needed in order to make the performance of an enterprise into the maximum. Concrete behavior, such as each action of the enterprise, changes a lot by designing exactly the priority and the subordination of index beforehand.

✧ **Selection of business architecture**

As the text describes, businesses of each enterprise can't be done with ignoring the existence of business architecture where each enterprise belongs. Each enterprise can make a decision only within the limits permitted by the business architecture where each enterprise belongs whether the enterprise likes or not.

However fortunately the enterprise can select the business architecture suited to it out of some business architectures. There are many cases where the innovative business model conversion brings a changeover of business architecture.

It is very important to be conscious of the existence of business architecture positively in order to rightly recognize the parameter that the enterprise can control with its own intention.

✧ PSLX as the information system architecture

Information system architecture is the pattern for constructing an information system. As “Guidance” shows, the pattern for constructing the information system proposed by PSLX including the contents of this specification has a lot of different points from the usual pattern.

Information system architecture is the method of modeling the data and making permanence of each data that is also the fount of the knowledge for an enterprise, the design thought that regards each application as an active agent and thinks a great deal of the link between those agents to the maximum, and the mechanism that can evolve according to the business process change by regarding an information system as one side of a business model.

As a different construction makes a different building, the more flexible and stubborn information system, which differs from the usual system, are made when advancing the development following the information system architecture proposed by PSLX. For deciding on the grand design, consider this point and carry out the way of thinking that is not bound by the frame of the fixed concept of the former system development.

✧ Designing a business reform program

Even if the direction where enterprise should go or the final goal is in sight, the present condition should never change to such an ideal form in one night. Also it is not guaranteed that an object can be attained by spending money and time. In fact, there are many cases where the process for attaining the object is more important than the goal to be reached.

Therefore, the scenario of business reform is required for the grand design for manufacturing enterprises. The scenario must concretely show the route in the time series when an enterprise goes toward the future from the present. Note that a map showing only the goal point is meaningless.

For example, when introducing APS, fully make preparations, like creating basic data, consciousness reform in the site and training new talented persons and so on. Moreover, it is desired to probe the points to be reformed for filling the gap between the present condition and an ideal form and to create and execute the reform programming for applying to each point.

Always reconsider the goal that was already set up and modify the grand design itself if needed. Thus it can be said that it is the only one way to a success to repeat the grand design decision, execution and reconsideration of the reform programming in the continuous activities of the enterprise.

Appendix C　Cross Reference

The following lists the passages where the agents and the objects appear in the various collaborations shown in from Chapter 4 to Chapter 6. In the below list, the number in the corresponding collaboration line is the collaboration number shown when explaining each collaboration.

Table 1A-1　Agent list

No.	Name	Corresponding collaboration
1	Policy planning agent	1,23
2	Planning agent	1,2,6,7,9,10,11,13, 14,16,17,18,23,27,28
3	Scheduling agent	2,3,4,5,7,8,13,14,15, 16,17,21,24,25,26,28,29
4	Product design agent	23
5	Process design agent	6,23,25
6	Purchase scheduling agent	12,26,
7	Sales management agent	2,4,9,15,16,20,21,22,26,
8	Cost management agent	23,24
9	SC management agent	1,7,10,11,13
10	Transportation management agent	13
11	Capacity adjustment agent	2,7
12	Inventory adjustment agent	10,
13	Manufacturing execution agent	5,19,
14	Facility maintenance agent	8
15	BOM management agent	11,19,20,21,22,25
16	Specification decision agent	20,21,22
17	Allocation management agent	4,18,19,20,22,24,25
18	Link management agent	26,27,28,29

Table 1A-2　Object list

No.	Name	Corresponding collaboration
1	Financial statements object	1,6,23
2	Market demand object	1,2,6,9,15,16,17,27
3	Production policy object	1,2,6,8,9,11,14,17,23
4	Production order object	2,3,4,7,8,9,10,11,12,13,14,15,16,17,18,19,23,24,25,27,28,29
5	Customer order object	9,15,18,20,21,22,24,26,
6	Purchase order object	12,24,26,
7	Manufacturing indication object	3,4,5,7,8,12,14,15,16,17,18,19,20,21,22,24,25,29
8	Sales scheduling object	9,10,14,17,23,24,27,
9	Inventory planning object	2,10,24,27,
10	Transportation scheduling object	10,13,29
11	Maintenance scheduling object	3,8
12	Related enterprise object	6,11,12,13
13	Transportation capacity object	6,13
14	Production capacity object	1,3,4,5,6,7,8,11,14,16,17,21,26,29
15	Production results object	3,4,5,18,19,21,24,25,29
16	Production rule object	3,4,5,6,8,14,16,17,29
17	Product inventory object	2,4,9,10,19,24,26,28
18	Material inventory object	3,4,5,12,14,16,17,19,21,24,29