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# Designing a conceptual Inter-factory architecture for Higher adaptability of Manufacturing supply chain based on systems engineering

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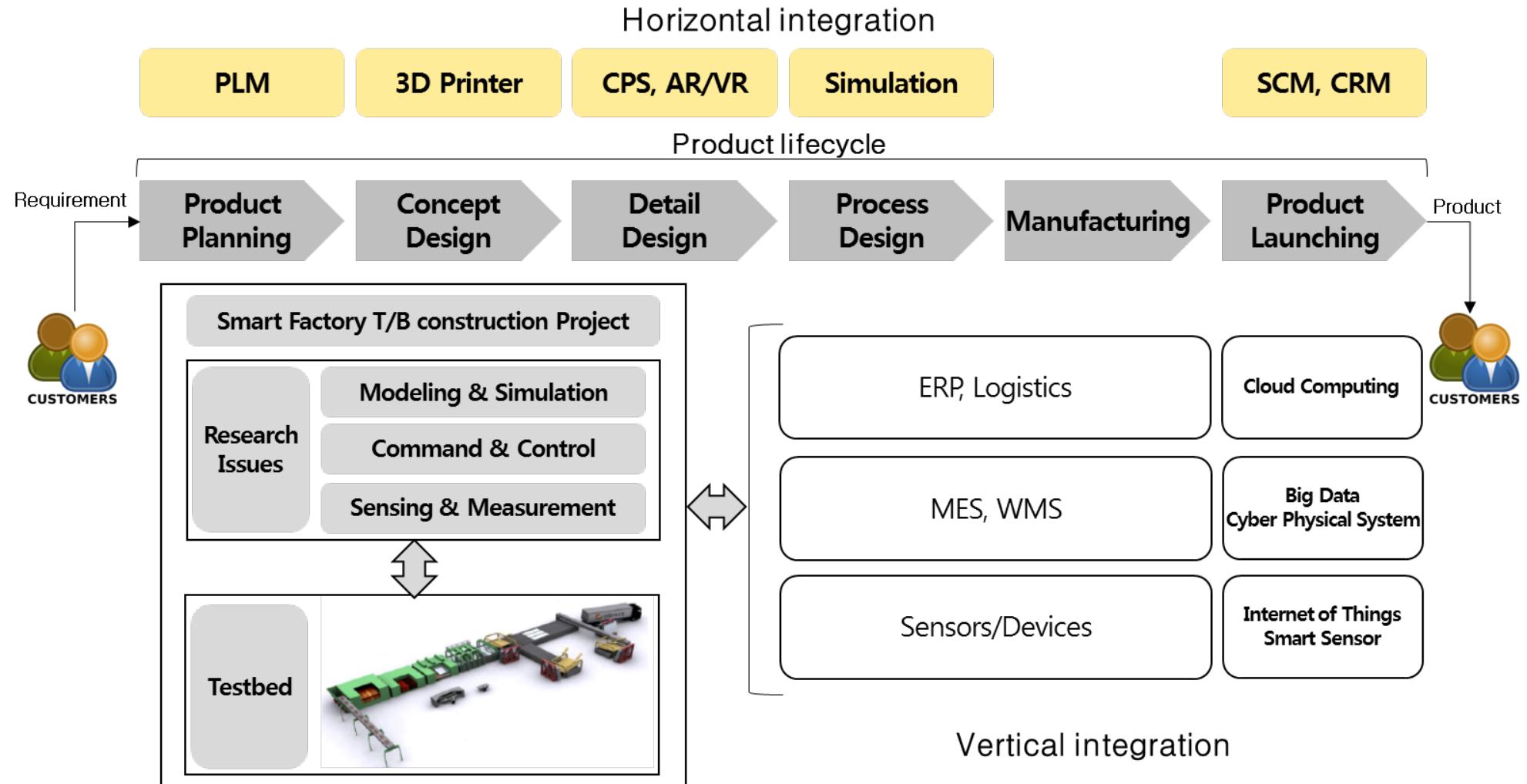
Smart Systems Engineering Lab.  
Graduate School of Engineering Mastership, POSTECH

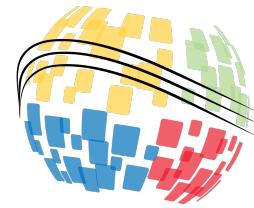
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- Introduction
- Research method
- Conceptual design of inter-factory architecture for higher adaptability of SCM
- Development of inter-factory prototype system
- Conclusion

# Research Background – Smart Factory♪

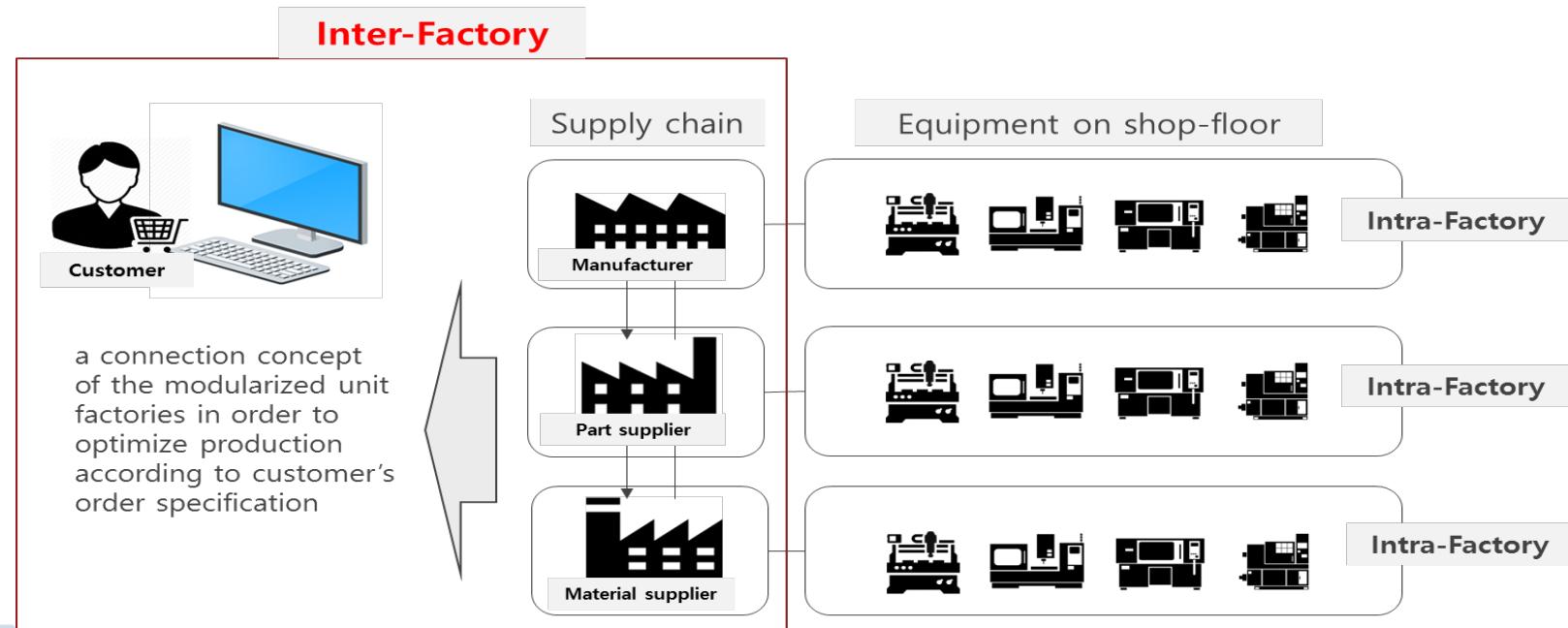




# Introduction♪

## □ Inter-factory system

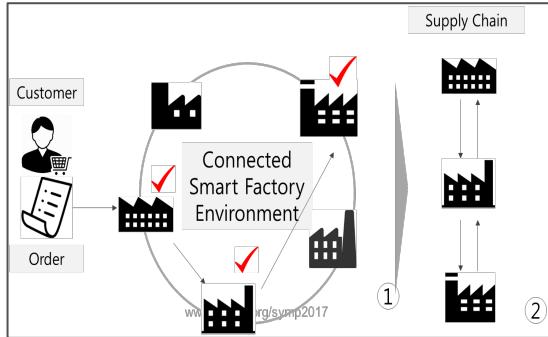
- The extension of on-going project called Modular factory or intra-factory
- To increase the speed of responsiveness of manufacturing systems to unpredicted events, such as sudden market demand changes or unexpected machine failure of suppliers
- To provide exactly the functionality and production capacity needed, and can be economically adjusted when needed



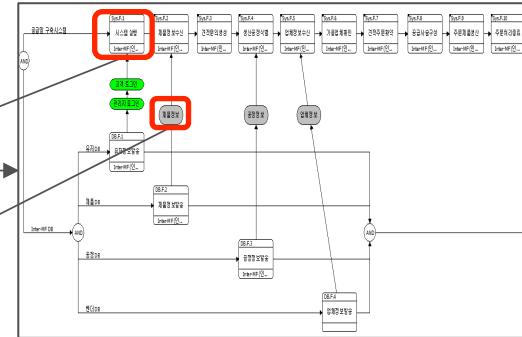
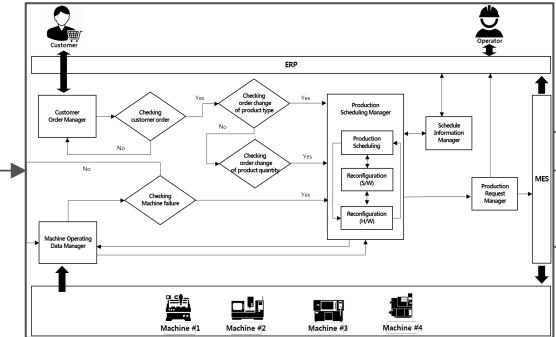
# Research Method♪



- To conduct a research on the inter-factory system for flexible manufacturing environment



Stakeholder Requirements			
No.	Name	Description	Func.
SR.1	Estimating customer's order	Inte-MF application should receive customer's order information.	0
SR.2	Recognizing manufacturing process	Inte-MF application should recognize overall manufacturing process for the product which the customer ordered.	0
SR.3	Checking available suppliers	Inte-MF application should identify available suppliers to build supply chain.	0
SR.4	Confirming customer's order	Inte-MF application should have a commitment based on customer's estimate.	0
SR.5	Building supply chain	Inte-MF application should build manufacturing supply chain using confirmed customer's order.	0
SR.6	Manufacturing products	Inte-MF application should manufacture the product which the customer ordered with the manufacturing supply chain.	0
SR.7	Closing order	Inte-MF application should close the customer's order after delivering the product to the customer.	0
SR.8	Receiving product specification	Inte-MF application should have product specifications which the customer ordered.	0
...	...	...	...



Concept modeling

Requirement Analysis

Operation Scenarios

Dynamic Modeling

Inter-factory Architecture

Logical

Func. No.	Func. Description	Input Refs.	Output Refs.
F1.1	Customer Order	-	-
F1.2	Supply Chain	-	-
F1.3	Machine	-	-
F1.4	Product	-	-
F1.5	Customer Order	-	-
F1.6	Supply Chain	-	-
F1.7	Machine	-	-
F1.8	Product	-	-



Info. ID	Info.	Data	From	To
I1.1	Customer Order	-	ERP	MBS
I1.2	Supply Chain	-	ERP	MBS
I1.3	Machine	-	ERP	MBS

Functional List

Data Structure

Algorithm

Design Document

Physical



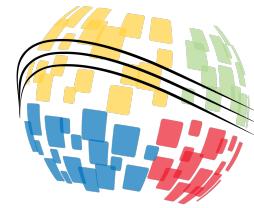
Web Server

제품 선택 & PCT 계산 요청	Basic Product	Option (Color)
Option (Product Type)	Option (Engraving)	Option (Quantity)
Option (Cutting)	Quantity	0
PCT 계산 요청( ) 취소( )		

User Interface



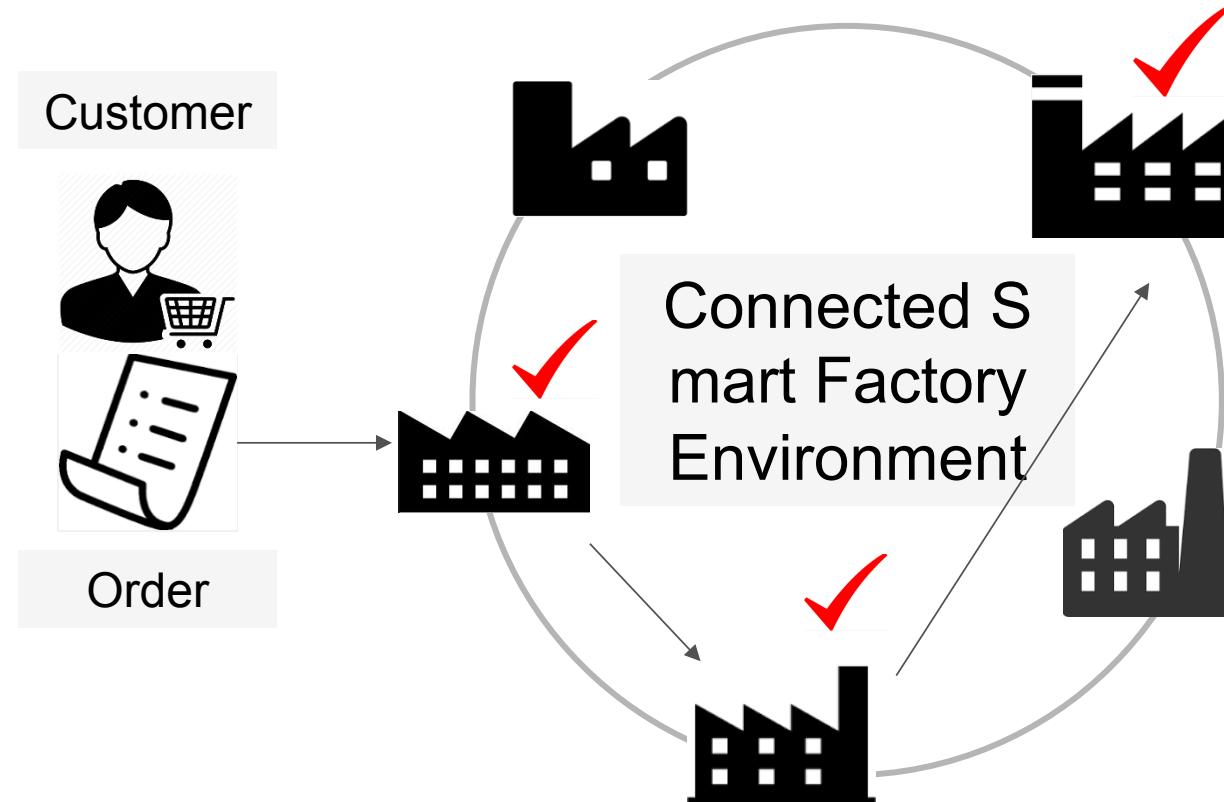
Application



# Conceptual modeling of inter-factory architecture♪

## □ To meet customers' needs in a connected Smart Factory environment

- Function to make dynamic supply chain meeting delivery date and product specification(1)
- Function to share information among partners in a supply chain (2)

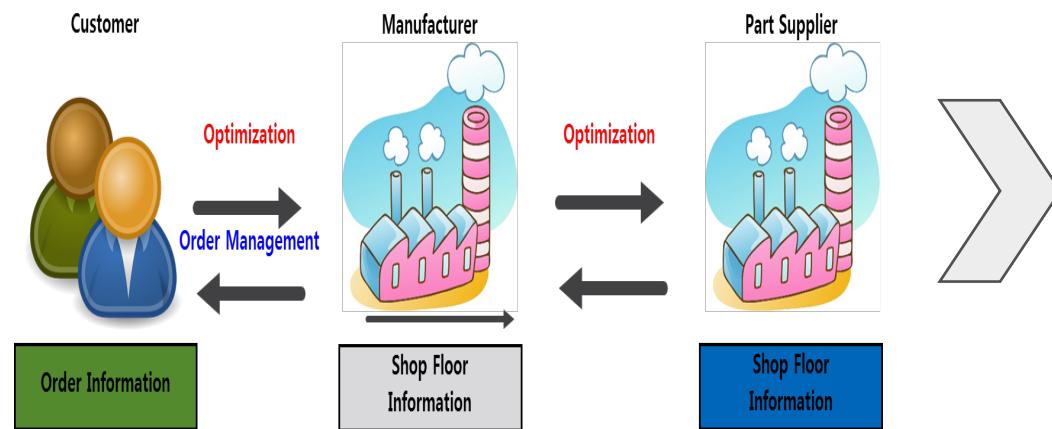




# Requirement analysis of inter-factory architecture♪

## □ Identifying stakeholders and extracting stakeholder requirements

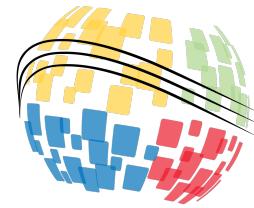
- To catch stakeholder requirements which are affected direct and indirect regarding developing inter-factory management system
- Totally 36 stakeholders requirements



Identifying major stakeholders

Stakeholder Requirements			
No.	Name	Description	Func.
StR.1	Estimating customer's order	Inter-MF application should receive customer's order information.	0
StR.2	Recognizing manufacturing process	Inter-MF application should recognize overall manufacturing process for the product which the customer ordered.	0
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...	...	...	...

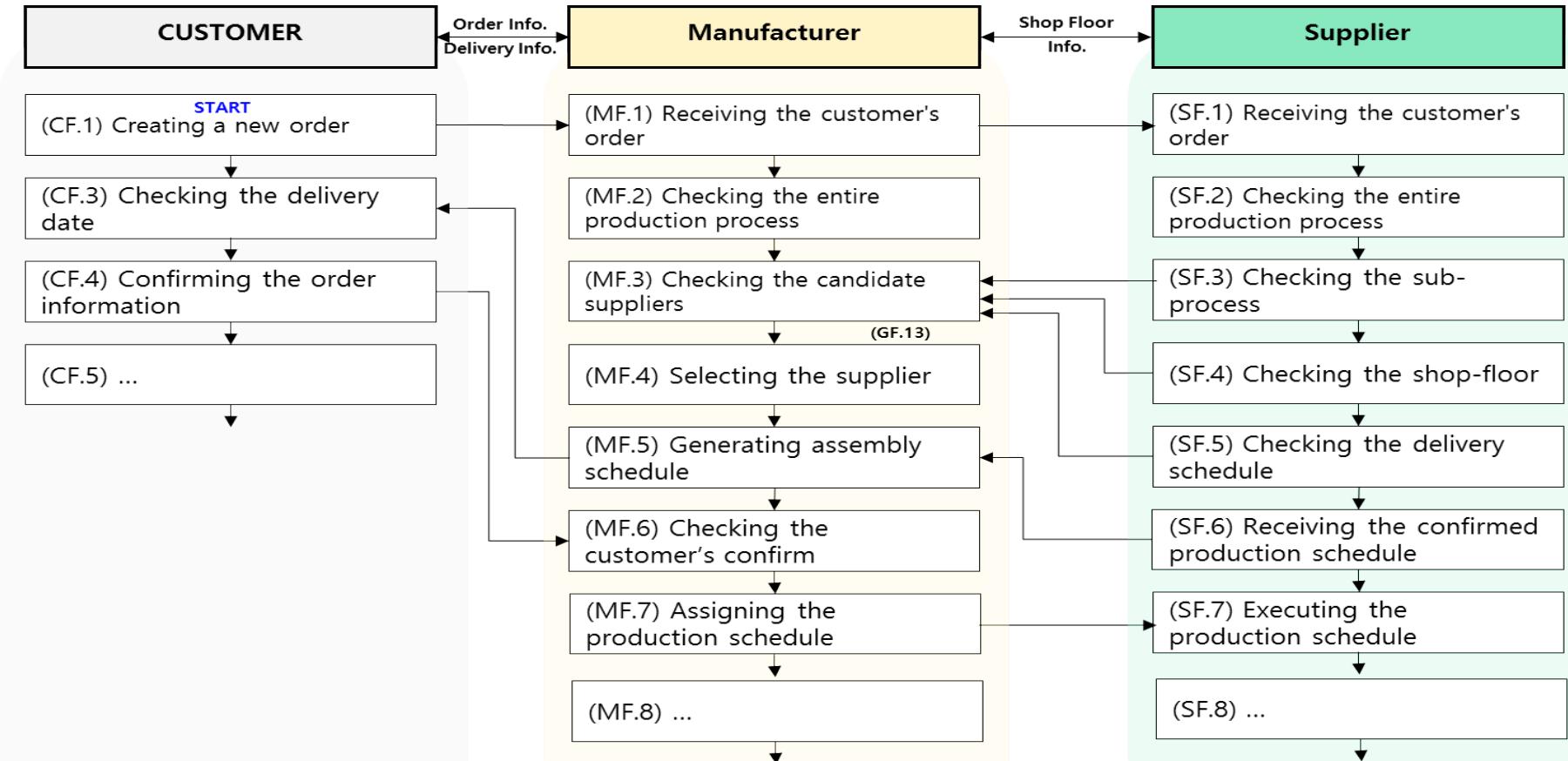
Stakeholder requirements



# Operation Scenario of inter-factory architecture♪

## □ Basic Operational Scenario

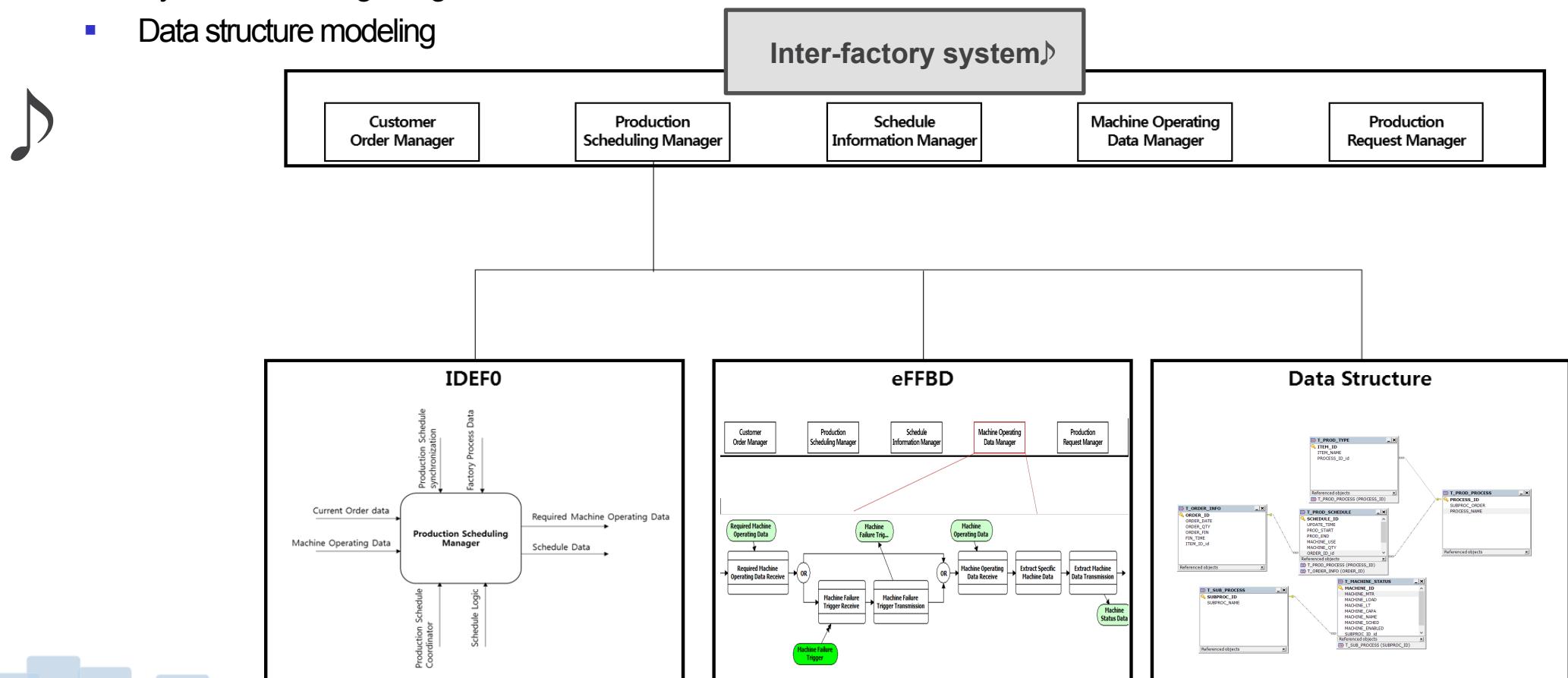
- Developing operational scenario modeling based on identified stakeholder requirements



# Designing logical architecture of inter-factory system♪

## □ Performing detail design based on five components

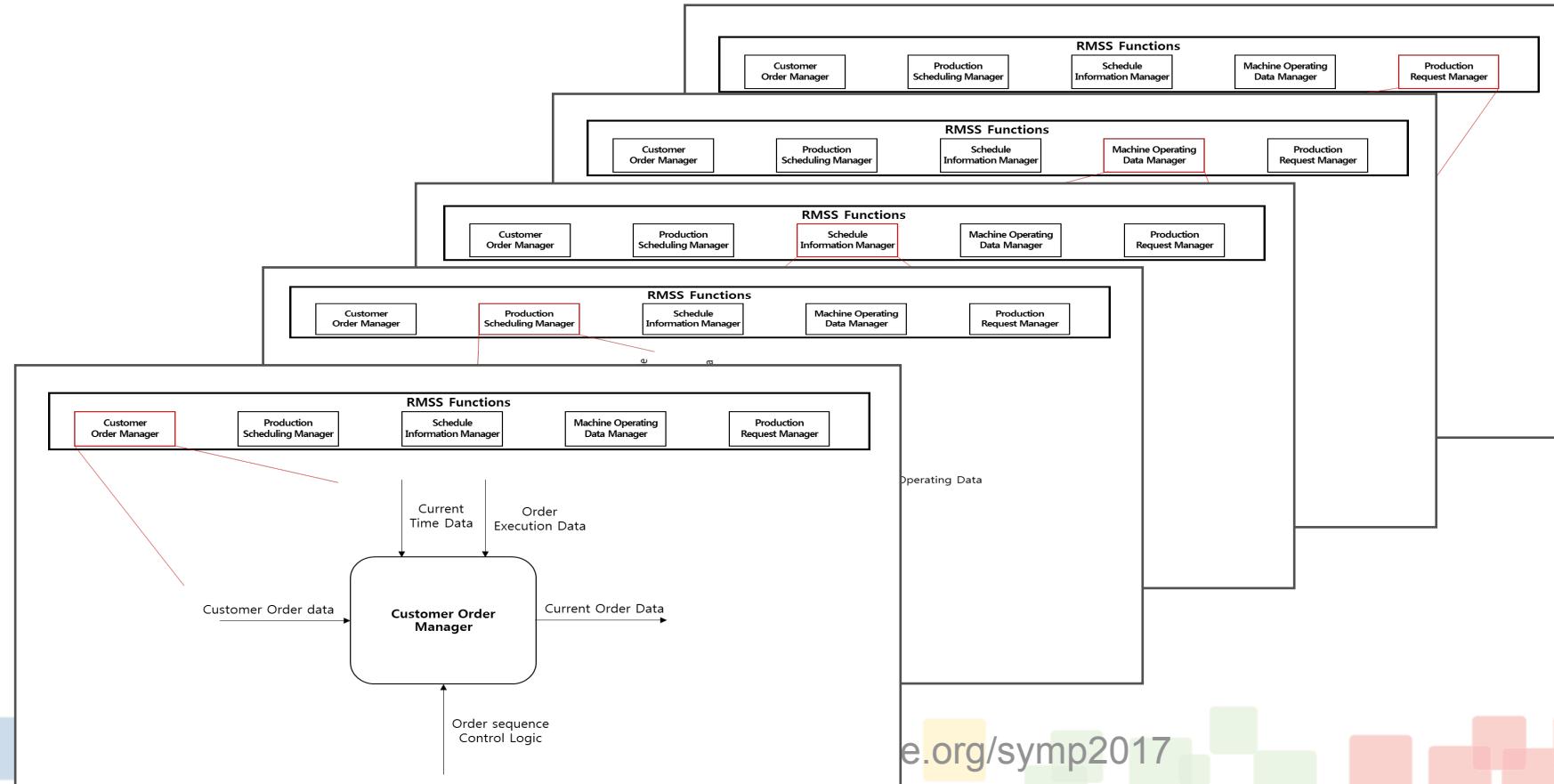
- Function modeling using IDEF0
- Dynamic modeling using eFFBD
- Data structure modeling





# Function modeling of inter-factory architecture♪

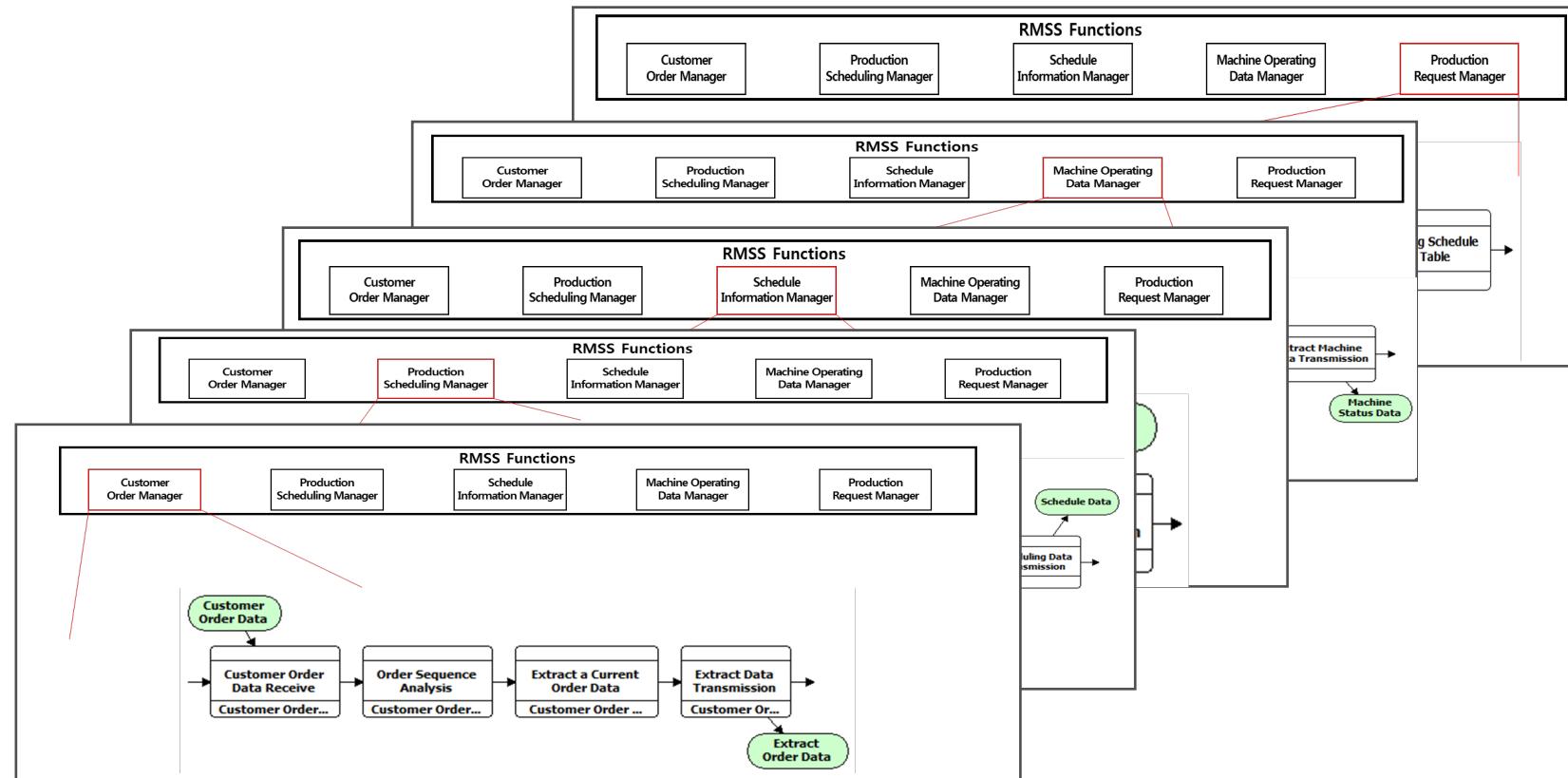
- Major five functions modeling using IDEF0
- ‘Customer Order Manager’, ‘Production Scheduling Manager’, ‘Schedule Information Manager’, ‘Machine Operating Data Manager’, ‘Production Request Manager’





# Dynamic modeling of inter-factory architecture♪

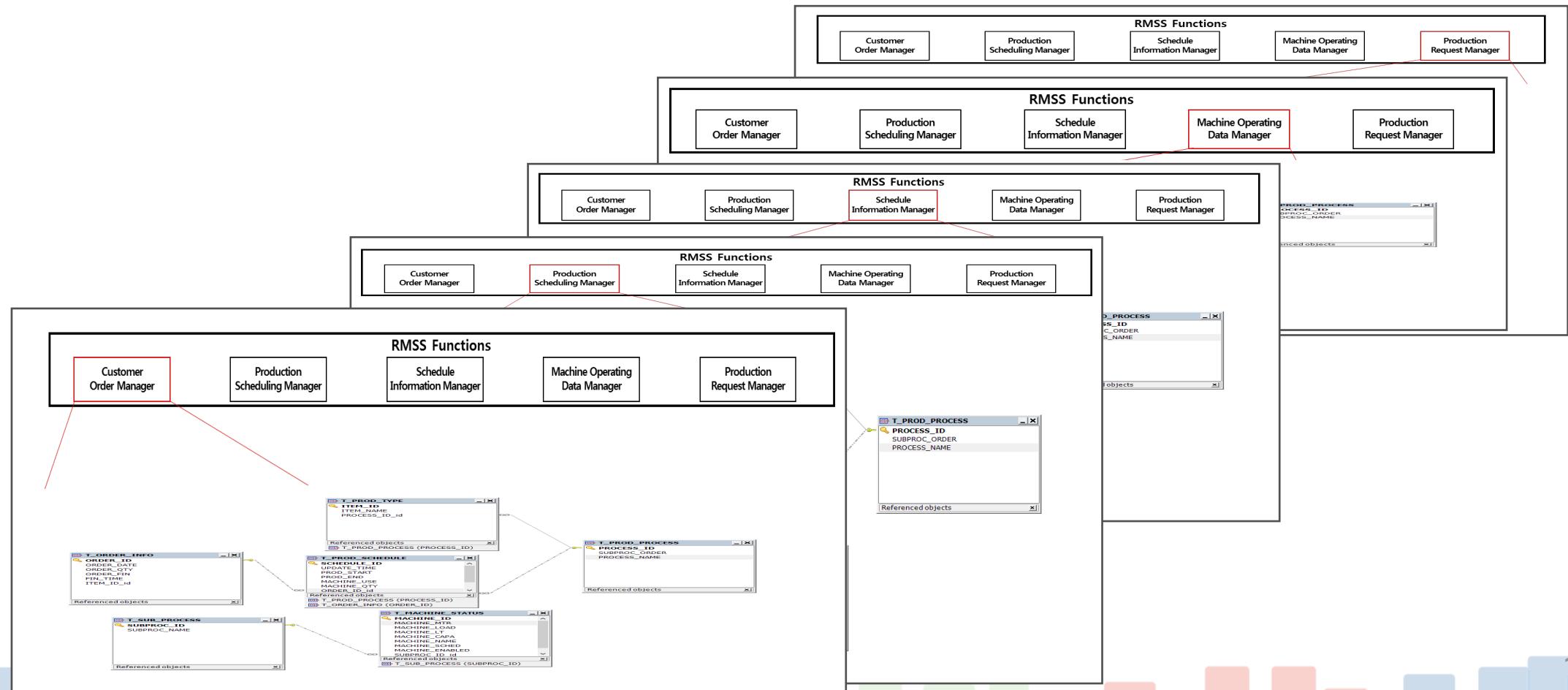
- Major five functions modeling using eFFBD(Extended Functional Flow Block Diagram)



# Data structure modeling of inter-factory architecture



- Designing the detail structure of data
- Consisting of Table, column name, column ID, and Data type





# Development of inter-factory prototype system♪

- A web based inter-factory prototype system for supporting dynamic supply chain



MySQL®

The screenshot shows a web-based application interface for generating purchase orders. On the left, a sidebar titled '운영 시나리오' (Operating Scenario) lists five items: (CF.1 주문 이슈 # 생성), (CF.2 주문 목록), (CF.3 납품 일자 확인), (CF.4 주문 품목 수령), and (CF.5 이슈 # 종료). The main panel is titled '이슈 생성 UI' (Issue Generation UI). It contains three input fields: '주문 등록' (Order Registration) with a dropdown menu showing '전동 모터 A', '주문 수량' (Order Quantity) with a text input '0' and unit 'ea', and '요청 납품일' (Requested Delivery Date) with a date input set to '2016 5 12'. A large '이슈 생성' (Issue Generation) button is located at the bottom right of the main panel.



# Conclusion♪

## ❑ Research summary

- Inter-factory system, a connection concept of the modularized unit factories in order to optimize production according to customer's order specification
- Suggesting a conceptual model of the inter-factory system to optimize manufacturing supply chain according to the customer's needs in real time
- Making the operation concept of inter-factory, defining key components, and designing system architecture based on systems engineering approach
- Developing a prototype system with key features of inter-factory application in order to validate effectiveness of this study

## ❑ Further research

- Focusing on dynamic supply chain based on discrete manufacturing process, not continuous manufacturing process
- The scope of following research♪



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