Enterprise modeling and its applications in China

Prepared by Prof. Yuliu Chen,

Department of Automation

Tsinghua University

Richard Martin

Convenor, ISO TC184/SC5/WG1

Dr. Qing Li

Agenda

- Background ("informationization" in China)
- Correct understanding of CIM system architecture and its views
- The requirement for building an international standard of "Process model/view" was raised.
- Effects of applying enterprise modeling and system architecture in practice.
- How many ISO standards in this field have been translated into Chinese and applied in industries.
- "Economic view" as Annex B in the revised 15704 was raised from CIM implementations in China.

Historical Background ("informationization" in China)

- "Informationization," the term increasingly employed to describe this overall process, has in recent years become a linchpin of central and many local development strategies, turned the Chinese people into true denizens of the 21st century, and plugged China into the wider world.
- The wide use of this term started from 1995, but the work has been going on for many years.

Propagation of CIM concept and industrial implementation

In 1986, a strategical R&D program, 863 Program, was launched in China. One of the important themes was Computer Integrated Manufacturing Systems (CIMS).

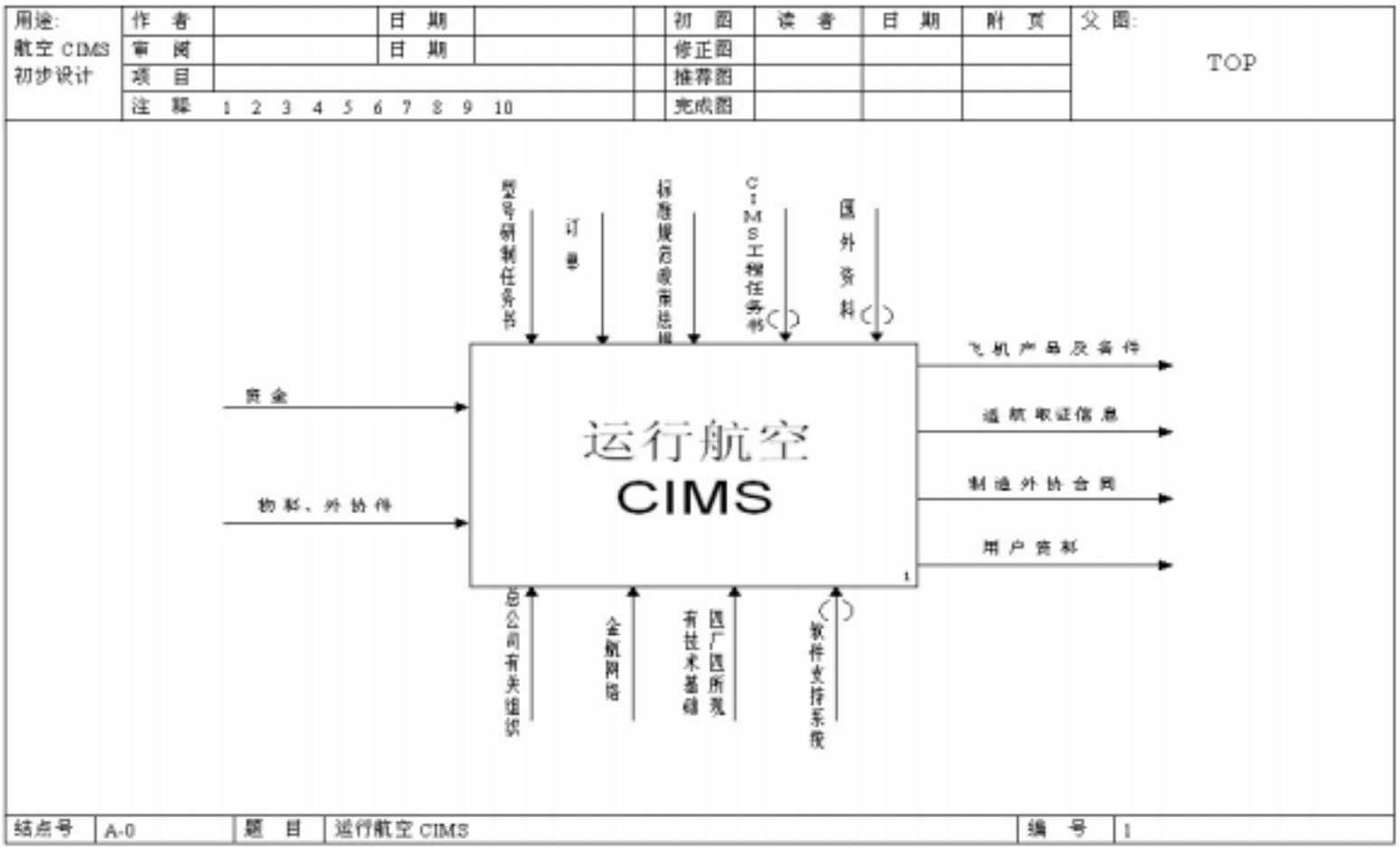
The basic idea was how to introduce computer technology, information technology, advanced manufacturing technique, advanced management mechanism to the industries for system integration----enterprise integration.

In practice, people recognized that the work should not become establishing a few automation islands. System integration was implemented. Thus the requirement of enterprise modeling was raised.

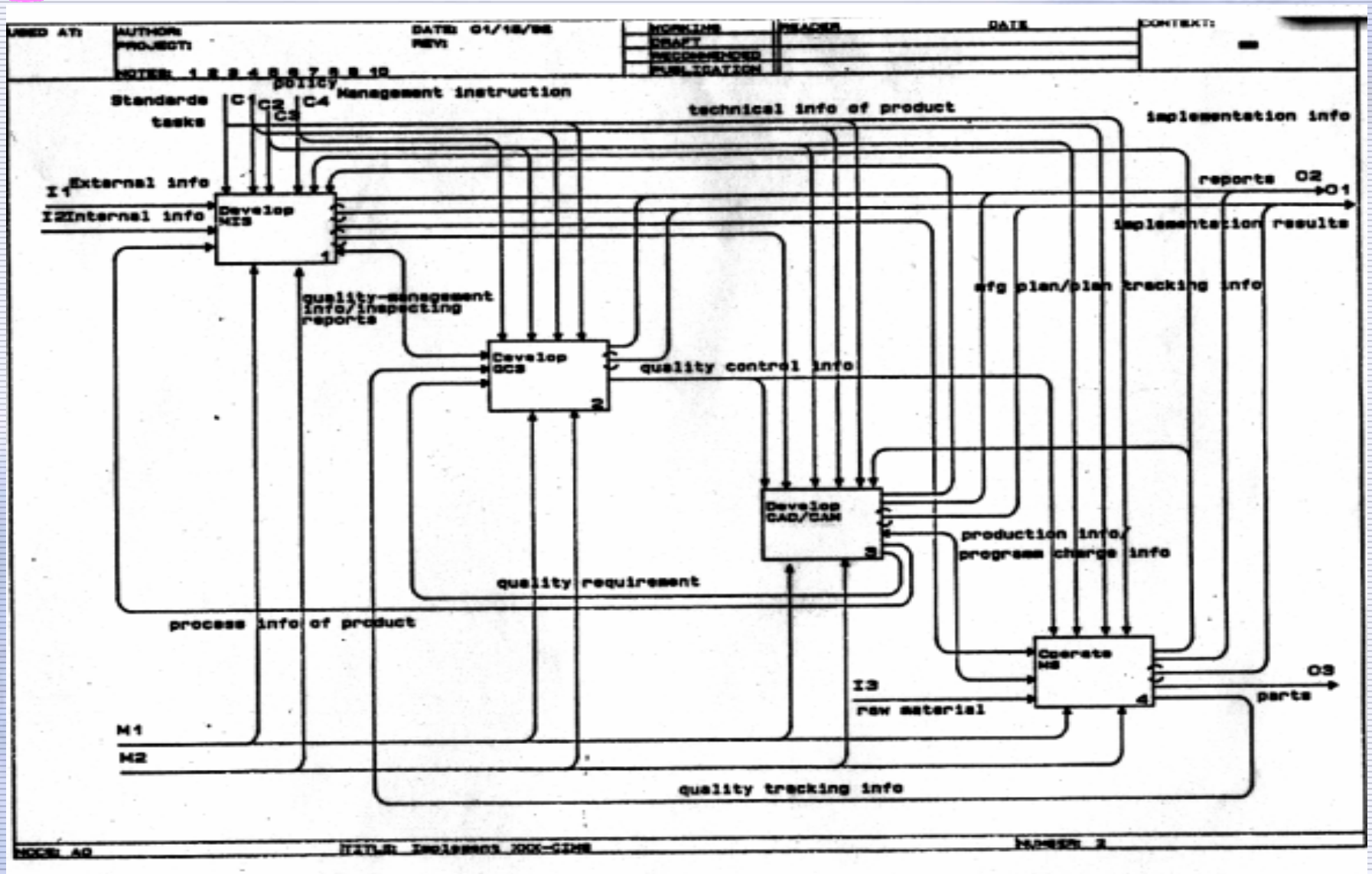
What means “Enterprise Model”?

- It is impossible to describe a complicated manufacturing company by using a single modeling format.
- A collection of different models with different purposes and different modeling methods is used to model and analyze the manufacturing plant.

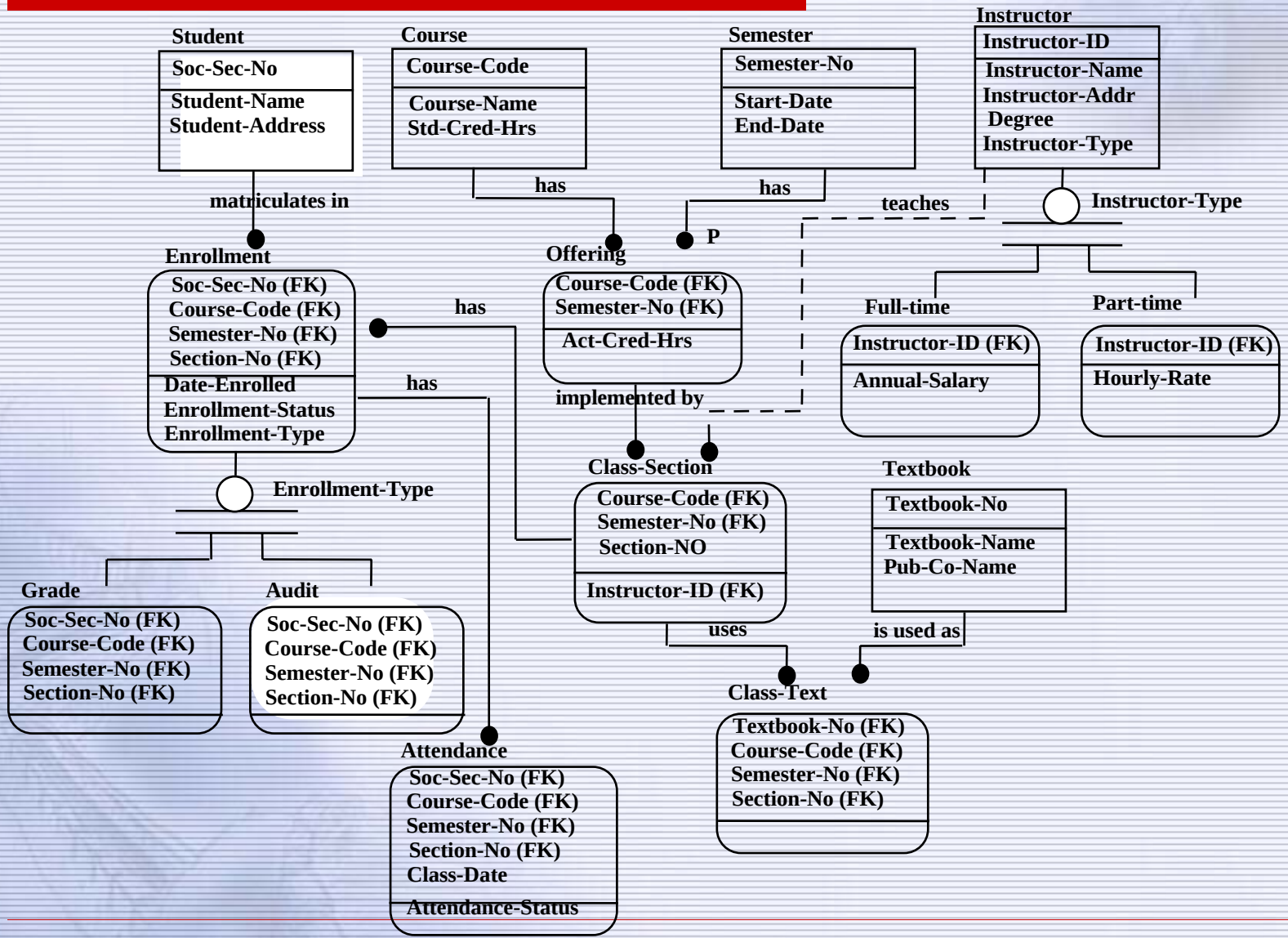
Function model in IDEF0 for Aviation Industry



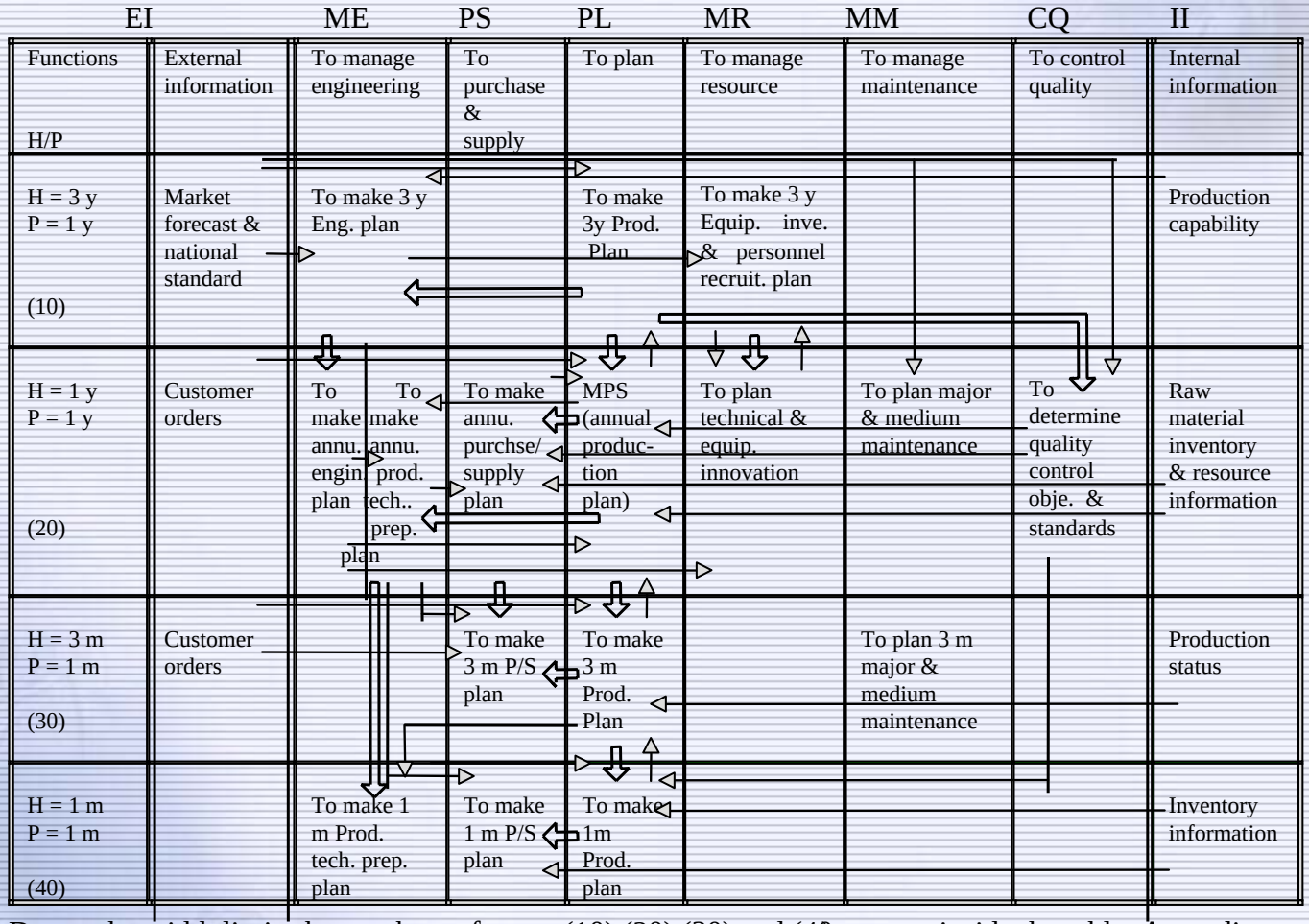
Function model in IDEF0 for an enterprise



Information model in IDEF1x for a university

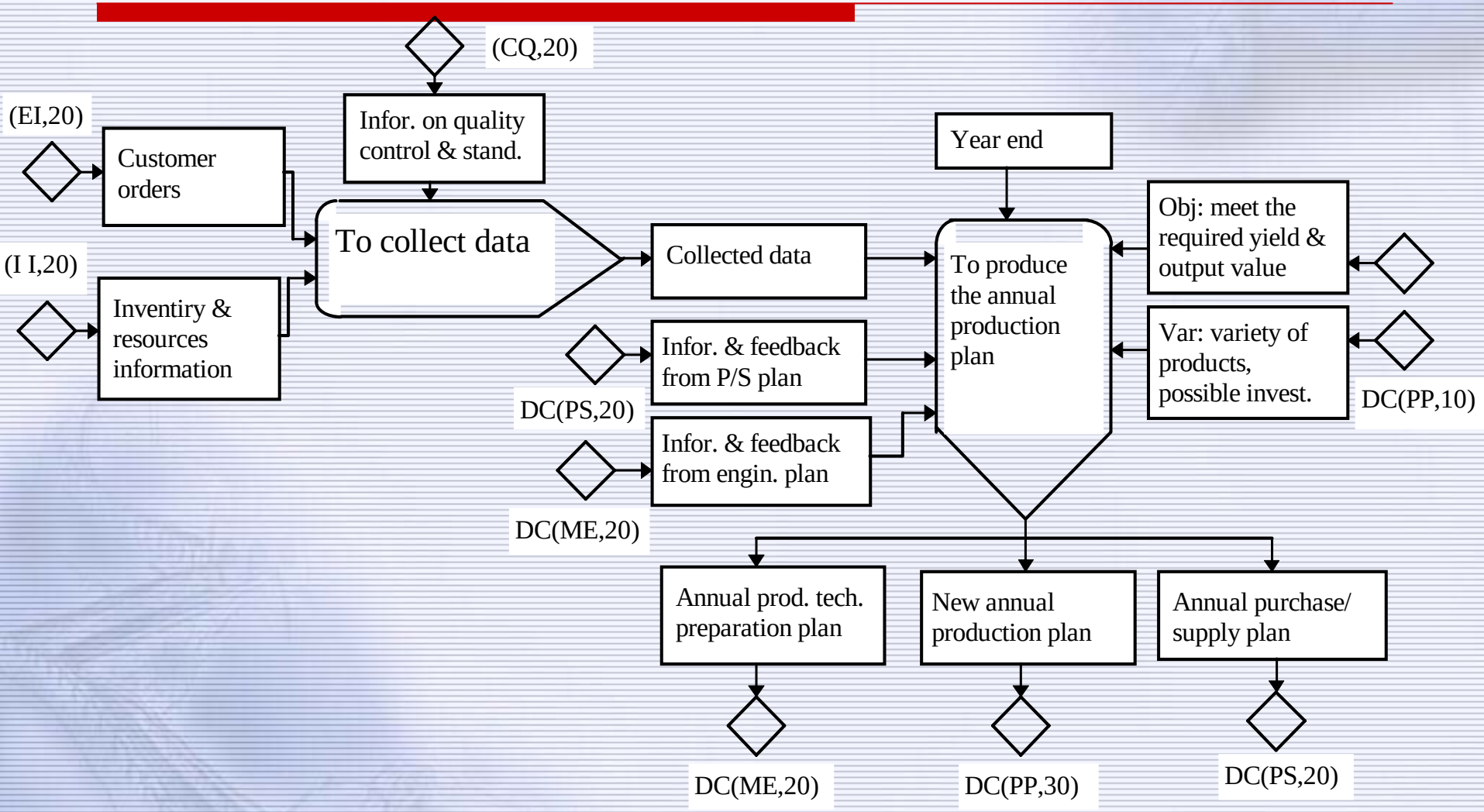


Decision model (Grai grid) for an enterprise

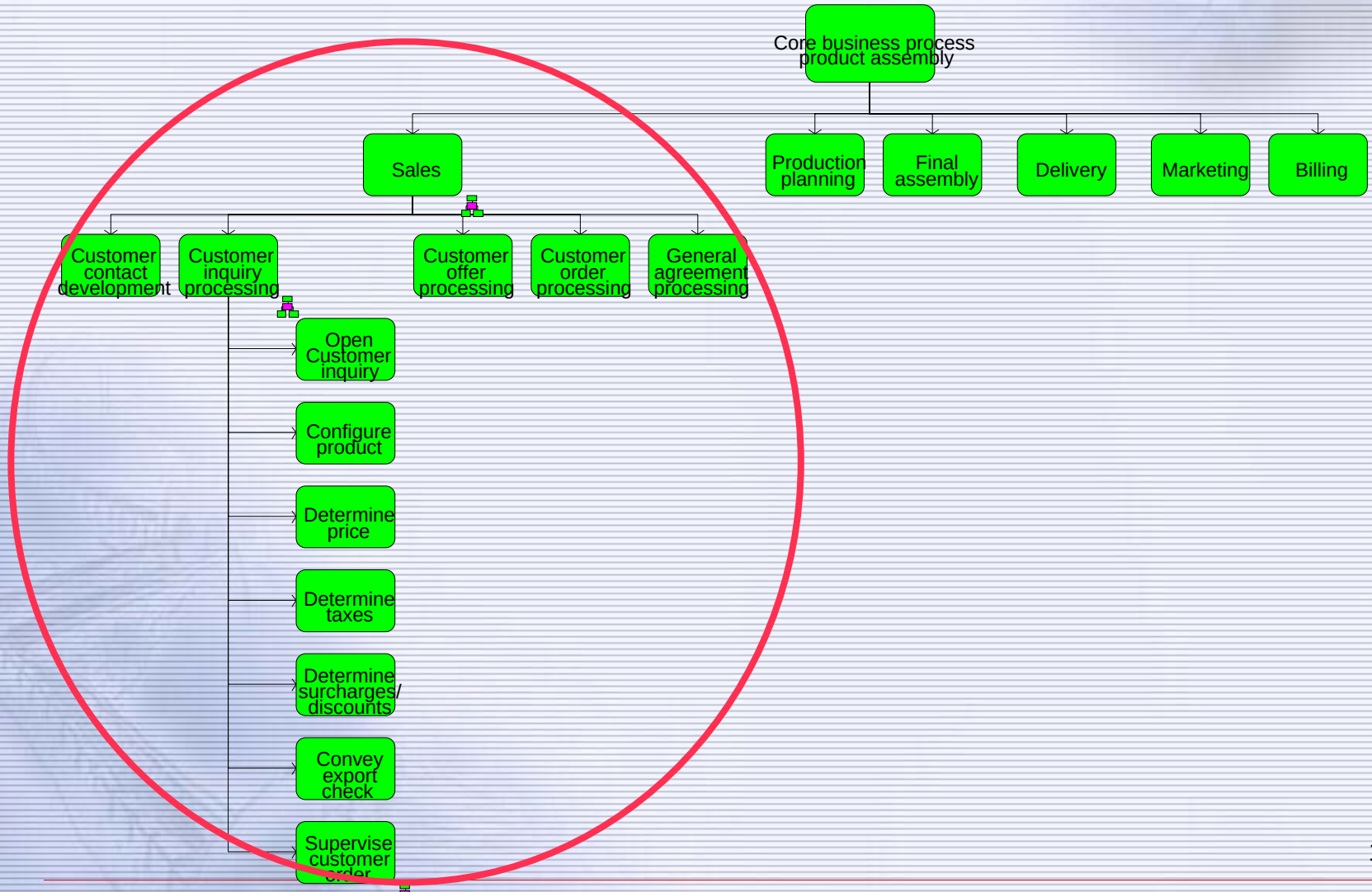


* Due to the width limit, the numbers of rows, (10) (20) (30) and (40), are put inside the table. According to the rule, they should be outside of the first column.

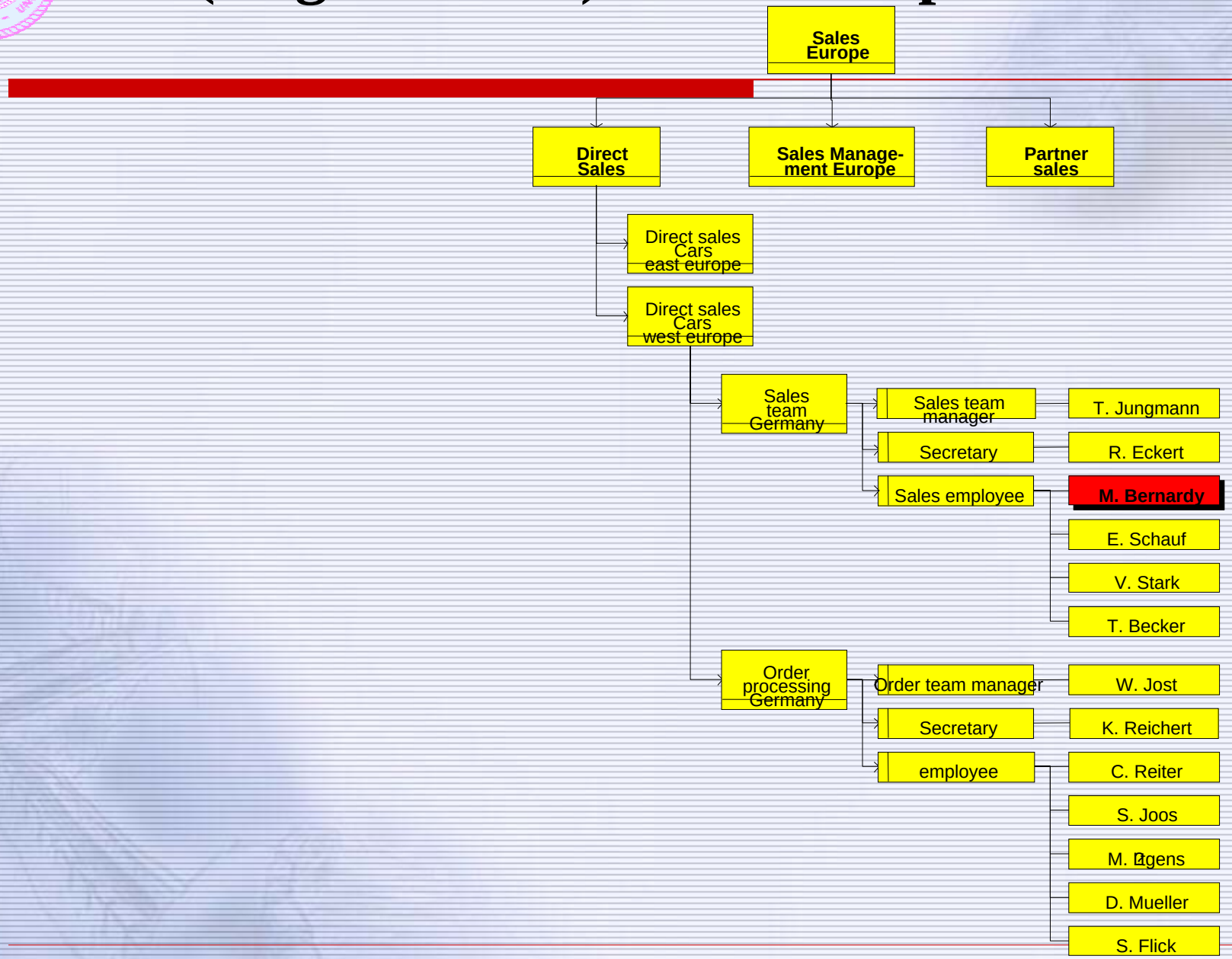
Decision model (Grai net) for an enterprise



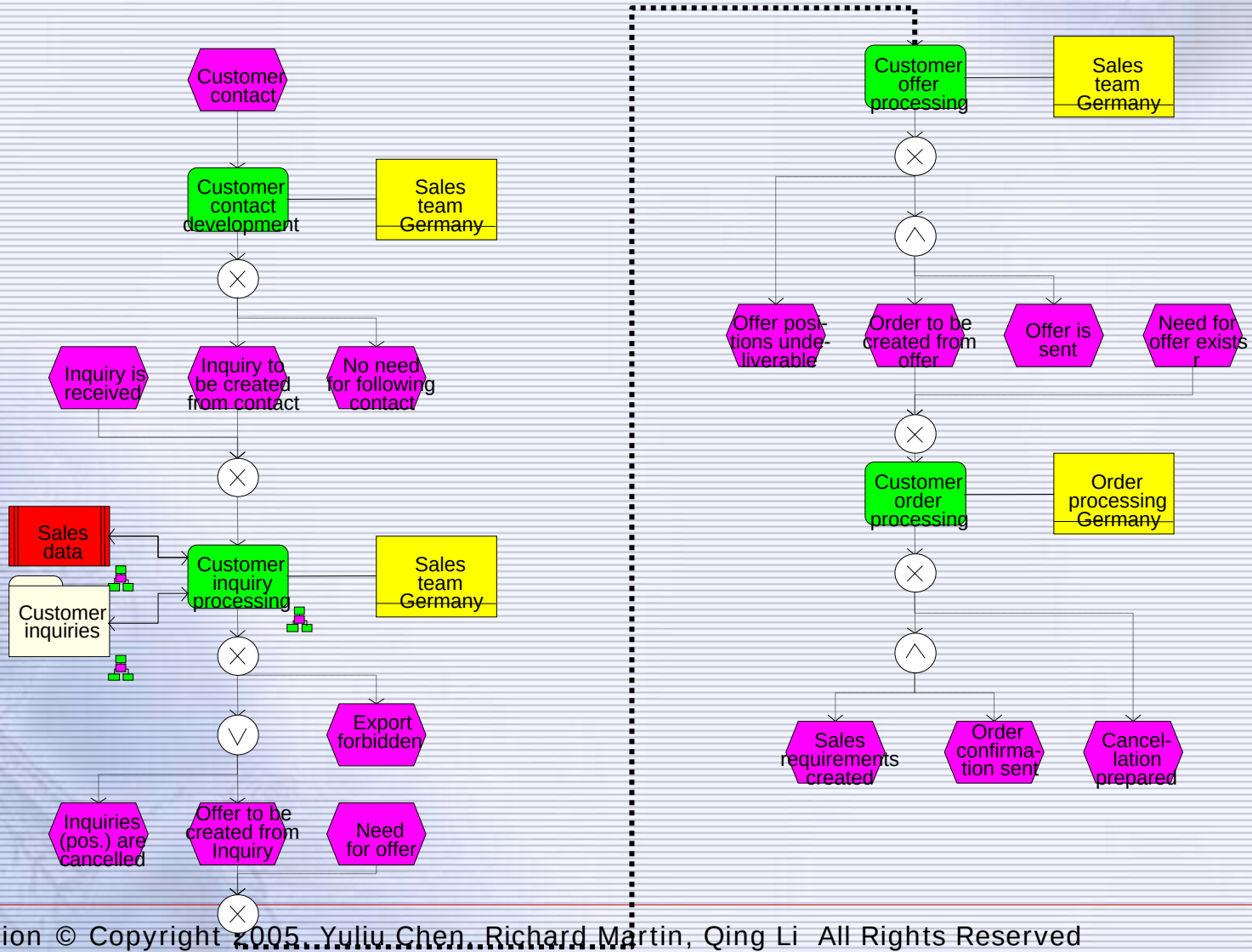
Sales functions of an enterprise in ARIS



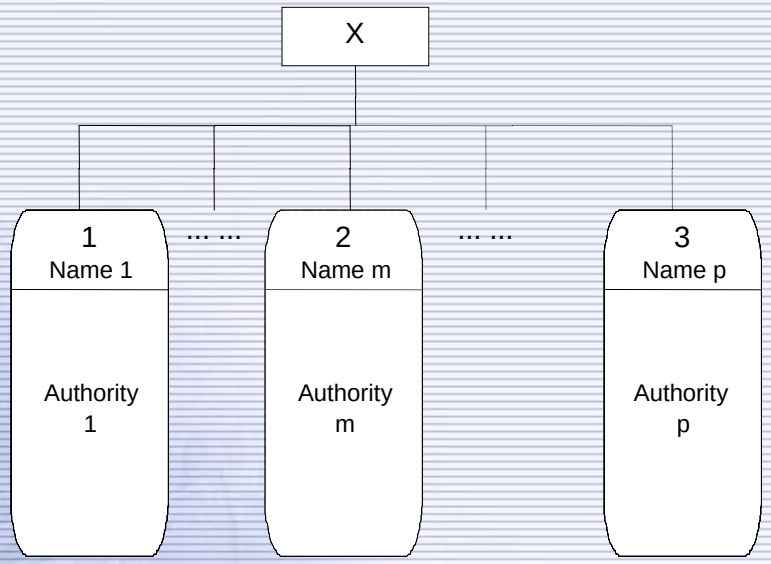
Sales (Organisation) of an enterprise in ARIS

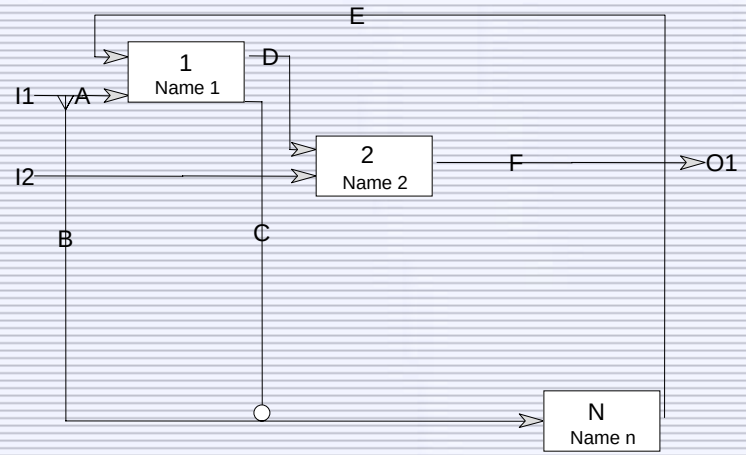


Sales processing (eEPC) of an enterprise in ARIS



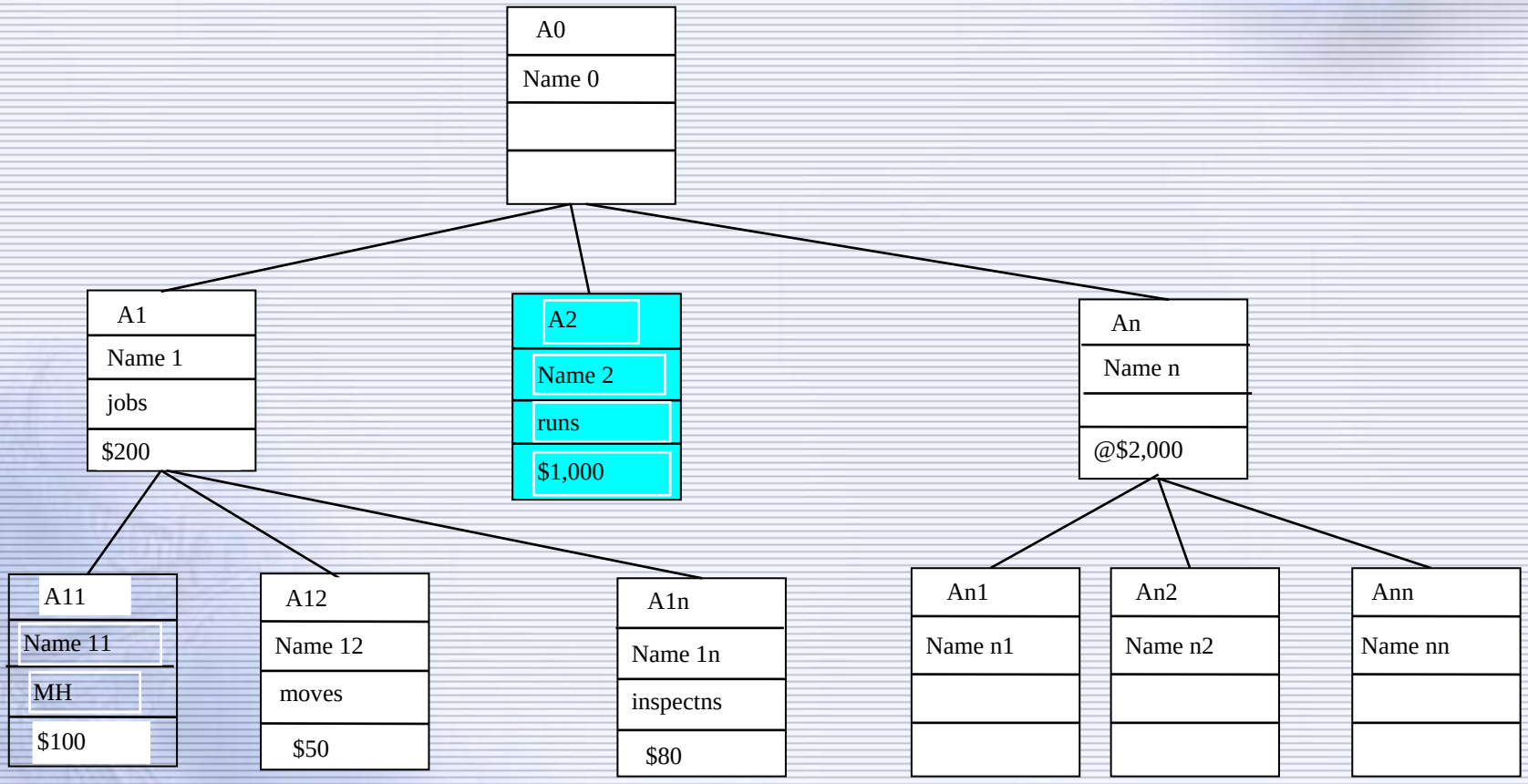
Example of Tree/Link (T/L) Method*





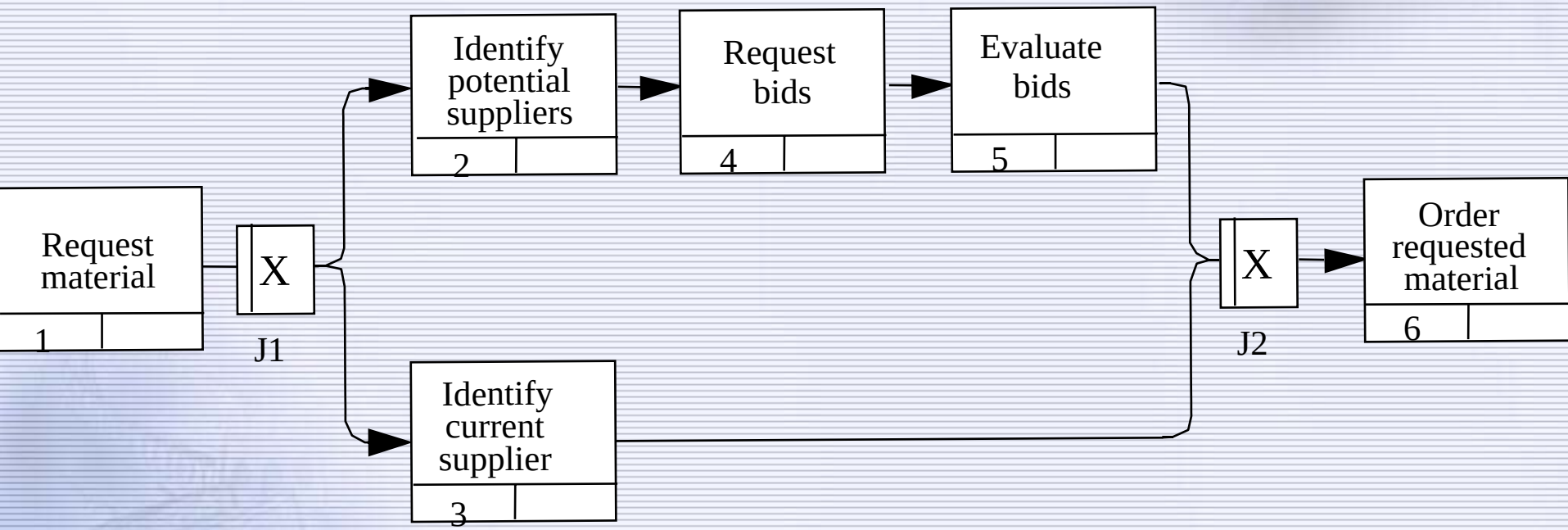
*(Huang, Q., Chen Y. and Xie, B., 1996)

Example of hierarchy for economic model by using ABC (Activity Based Costing) method

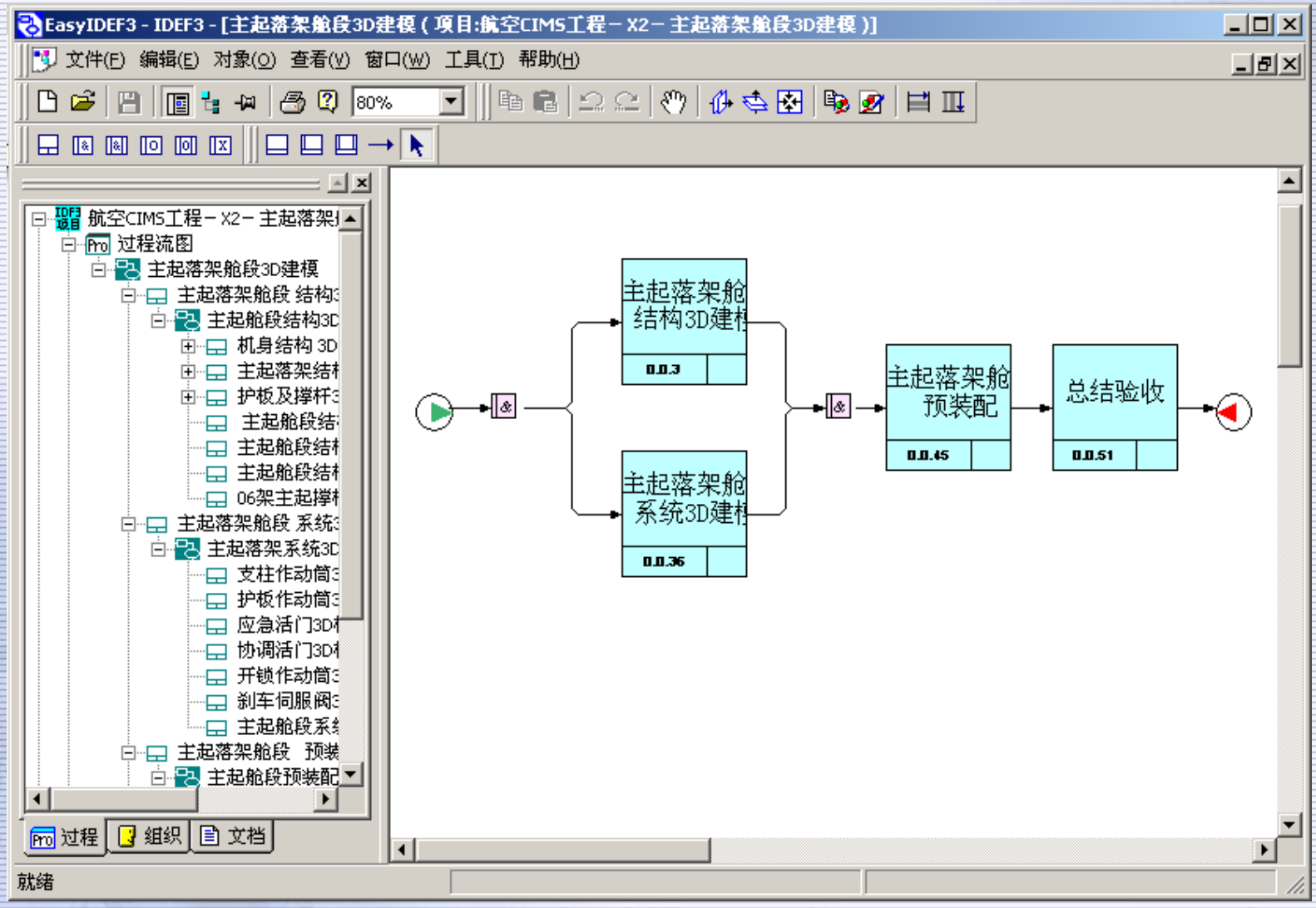


For intangible factors, AHP (Analytical Hierarchy Process) is used.

Process model of an enterprise in IDEF3



EasyIDEF3 Model Transfer



Transfer to eIDML

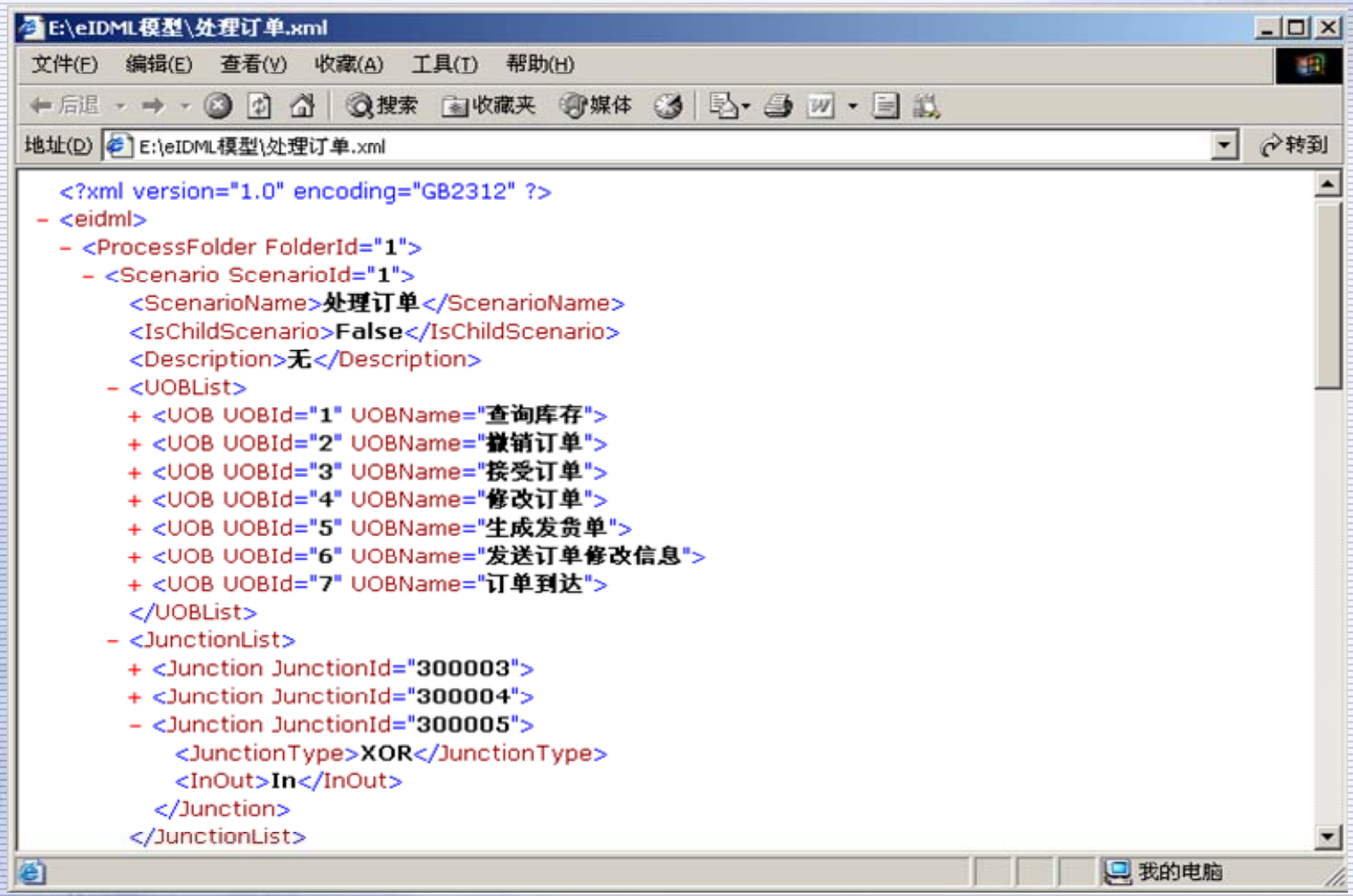


图5.11 由EasyIDEF3模型导出的eIDML文件

Transfer to XPDL

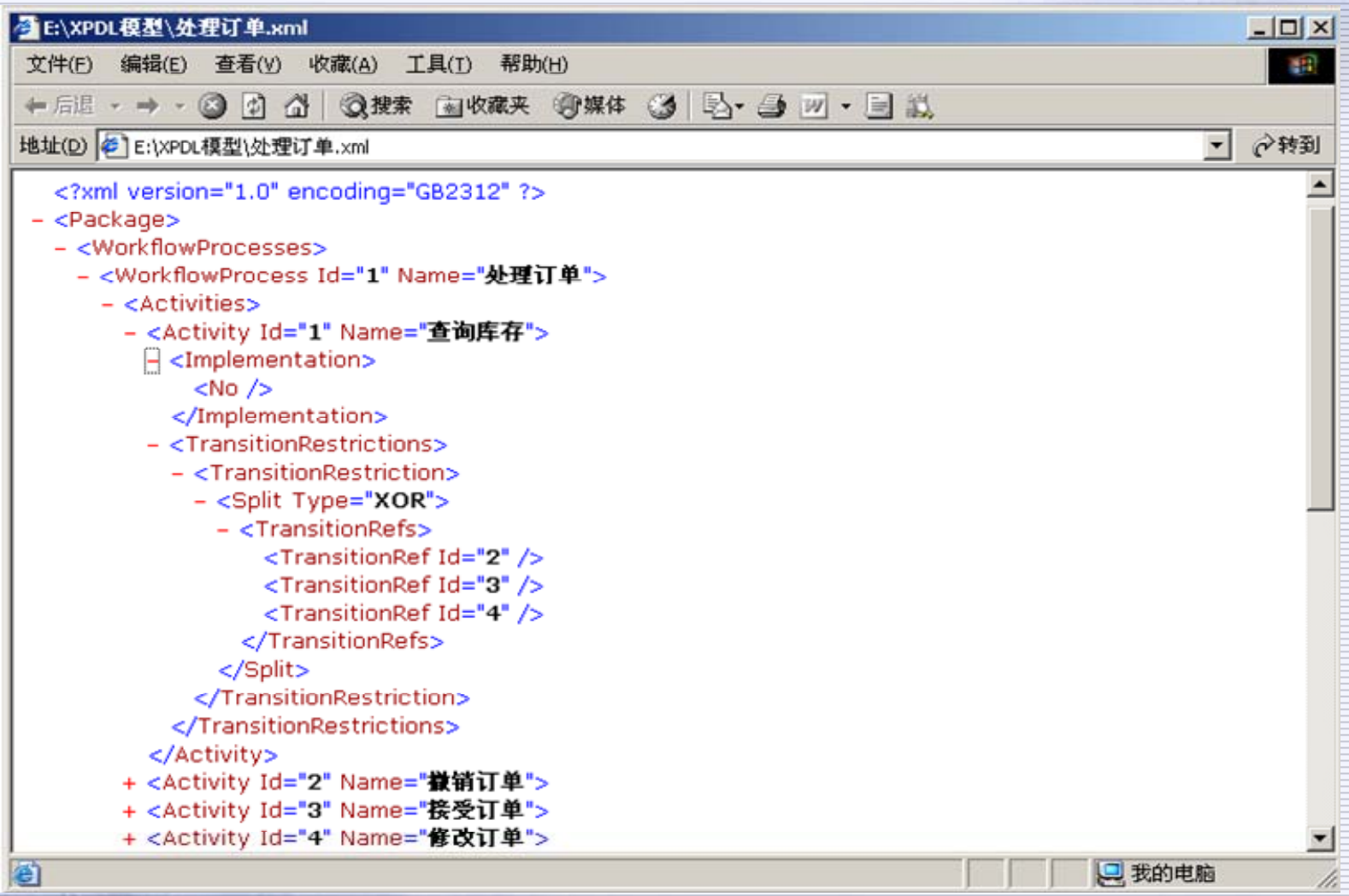
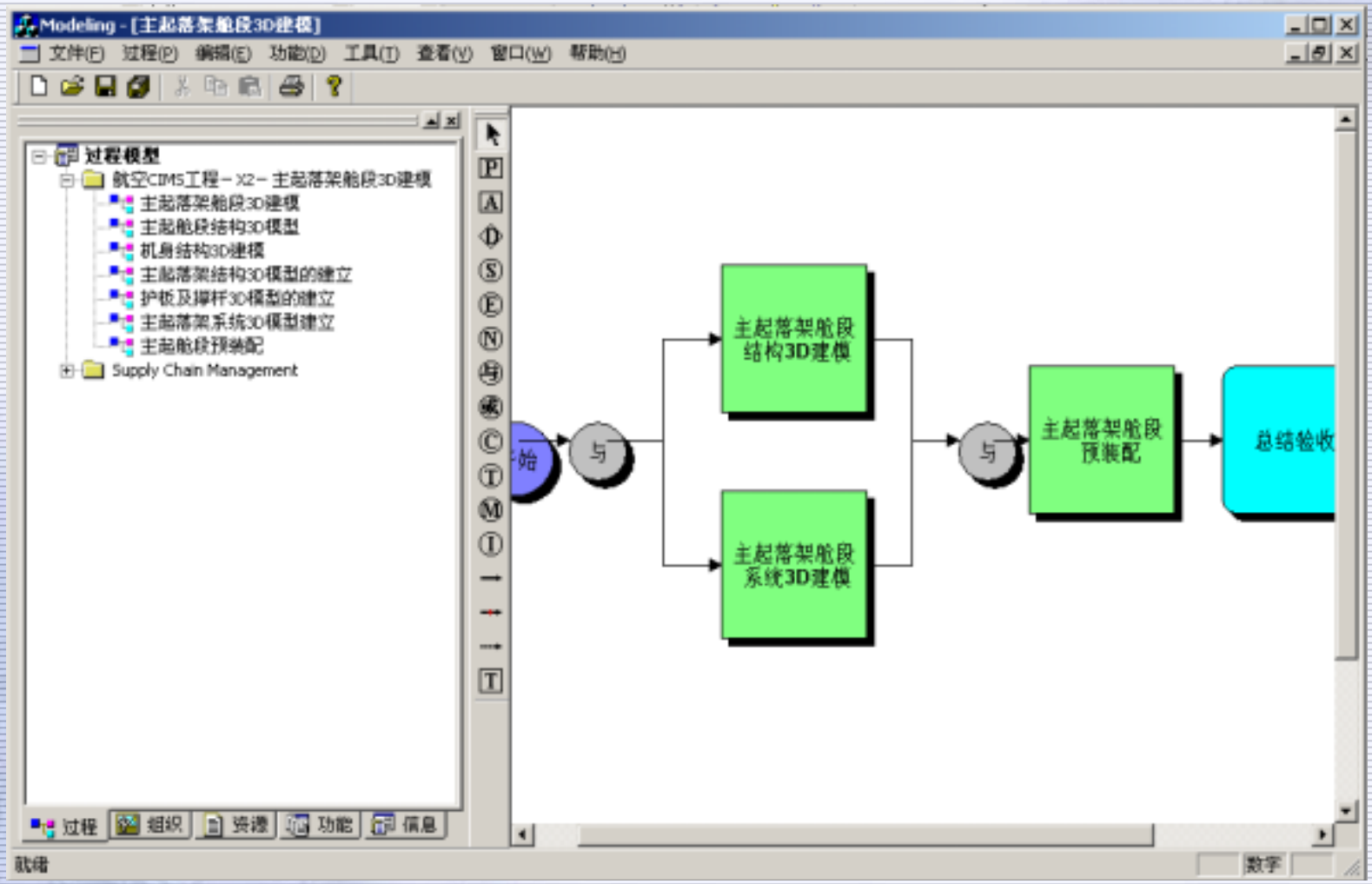


图5.12 由eIDML模型导出的XPDL模型

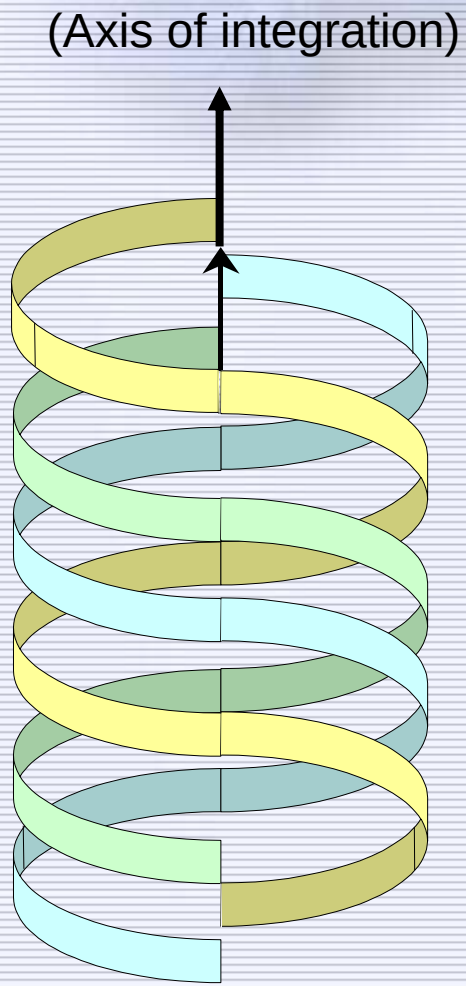
Transfer to Workflow



Three Layers for System Integration

- **Information integration**
- **Process integration**
- **Enterprise Integration**

- ***Computer Integrated Manufacturing System has been extended to "Contemporary Integrated Manufacturing System" in China.***



Layer No.1 (Information Integration)

Definition: **Information integration means to guarantee to provide the right information to the right person at the right time and right place in the right way.** (or, the right person can receive the right information).

- **The Experimental Engineering for CIMS**
  - **The design methodology, design standards and design tools have been adopted by Chinese CIMS area.**
  - **In 2000, the integration methods and techniques have been applied to more than 200 enterprises (directly supported by MOST) for heterogeneous systems (hardware and software) and devices.**
- **Integrated Platform for CIMS Application Development**
  - **Integrating Chinese software for CIMS with commercial software.**
  - **The integrated platform for Information integration and application integration has been developed, to reduce the duration of CIM implementation and to ensure quality.**

Layer No.2 (Process Integration)

After the completion of information integration and coordination among processes, **"process integration" refers to ensuring that all redundant and non-value adding sub-processes (or activities) and those obstacles related to human factors and resource constraints, which produce negative influences on process efficiency, are eliminated, so that the overall process can work synergistically and achieve overall optimization.**

- **Concurrent Engineering**
  - **Mainly in the middle of 1990s**
  - **Product development process management**
  - **Integrating CAD/CAPP/CAM based on PDM and STEP**
  - **Distributed CAD/CAPP/CAM through INTERNET**
- **Applications**

  Aircraft, motor cycle, etc.

Layer No.2 (continue)

- **Process integration connects and combines people, processes (including activities), systems, and technologies to ensure that:**
  - **the right processes have the right information and the right resources at the right time,**
  - **most obstacles that affect the inter-processes or intra-process efficiency are overcome,**
  - **the redundancy and non-value added parts are eliminated,**
  - **the overall process and sub-processes work synergistically.**

Layer No.3 (Enterprises Integration)

"CIM is the joint application of human and business knowledge and capabilities with information and manufacturing technology to increase the productivity and responsiveness of manufacturing enterprises, whereby all human, functional, information and organizational aspects of an enterprise are part of an integrated whole." (ISO TC184/SC5/WG1, 1993) Anyway, the integration of people, technology and business is emphasized.

- **Research on Next Generation Manufacturing**
- **Agile Manufacturing (CPC,ASP)**
  - **CIMSNET has been created, covered all of main research organizations, more than 100 enterprises**
  - **Research on Enabling Technology**
  - **Research on Internet/Intranet/Extranet**
  - **Virtual enterprise modeling**
  - **Agile Supply chain modeling and management**
- **Applications**

  Aeronautics and astronautics, Shipbuilding, Textile, Oil refining, Machinery engineering, Consuming electronics, Automobile, Motor cycle, etc.

Structured Approach for Implementing CIM

Life Cycle of CIM Development

- Requirements Definition
- Feasibility Study
- Primary System Design
- Detailed System Design
- Engineering Implementation
- System Operation and Maintenance
- Decommission

All these considerations and experiences converged into this very term----CIM system architecture.

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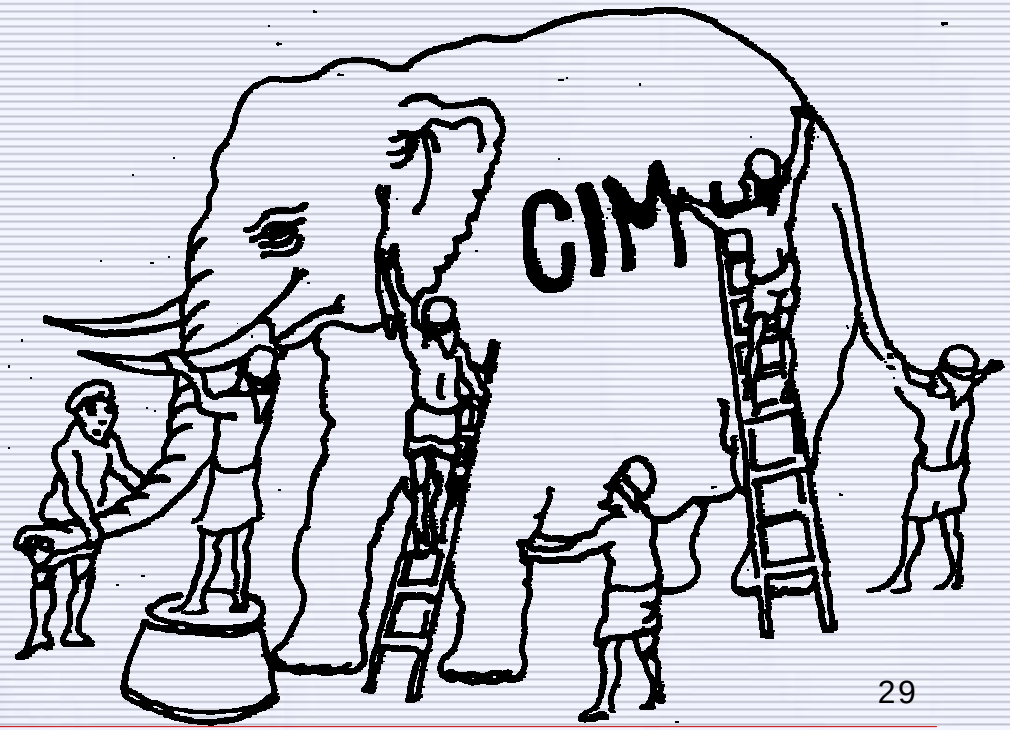
Correct understanding of CIM system architecture and its views

- **Definition: CIM system architecture is a collection of models representing multi-levels and multi-views of the entire system.**



What is model?

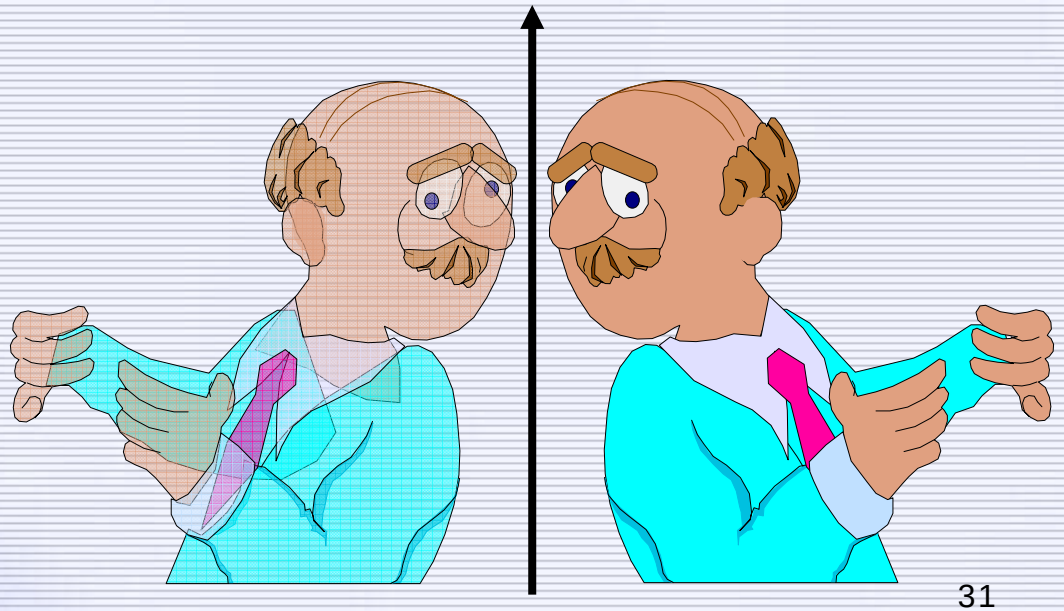
A model is a representation of a set of components of a system or subject area. The model is developed for understanding, analysis, improvement or replacement of the system.

Systems are composed of interfacing or interdependent parts that work together to perform a useful function. System parts can be any combination of things, including people, information, software, processes, equipment, products, or raw materials.

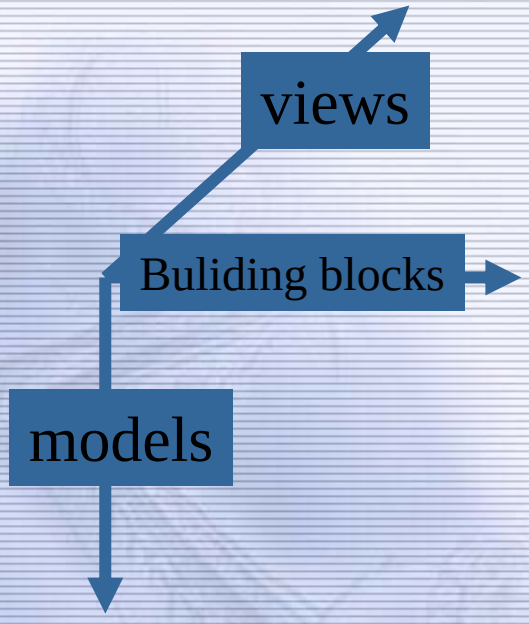
The model may describe what a system does, what controls it, what things it works on, what means it uses to perform its functions, and what it produces.

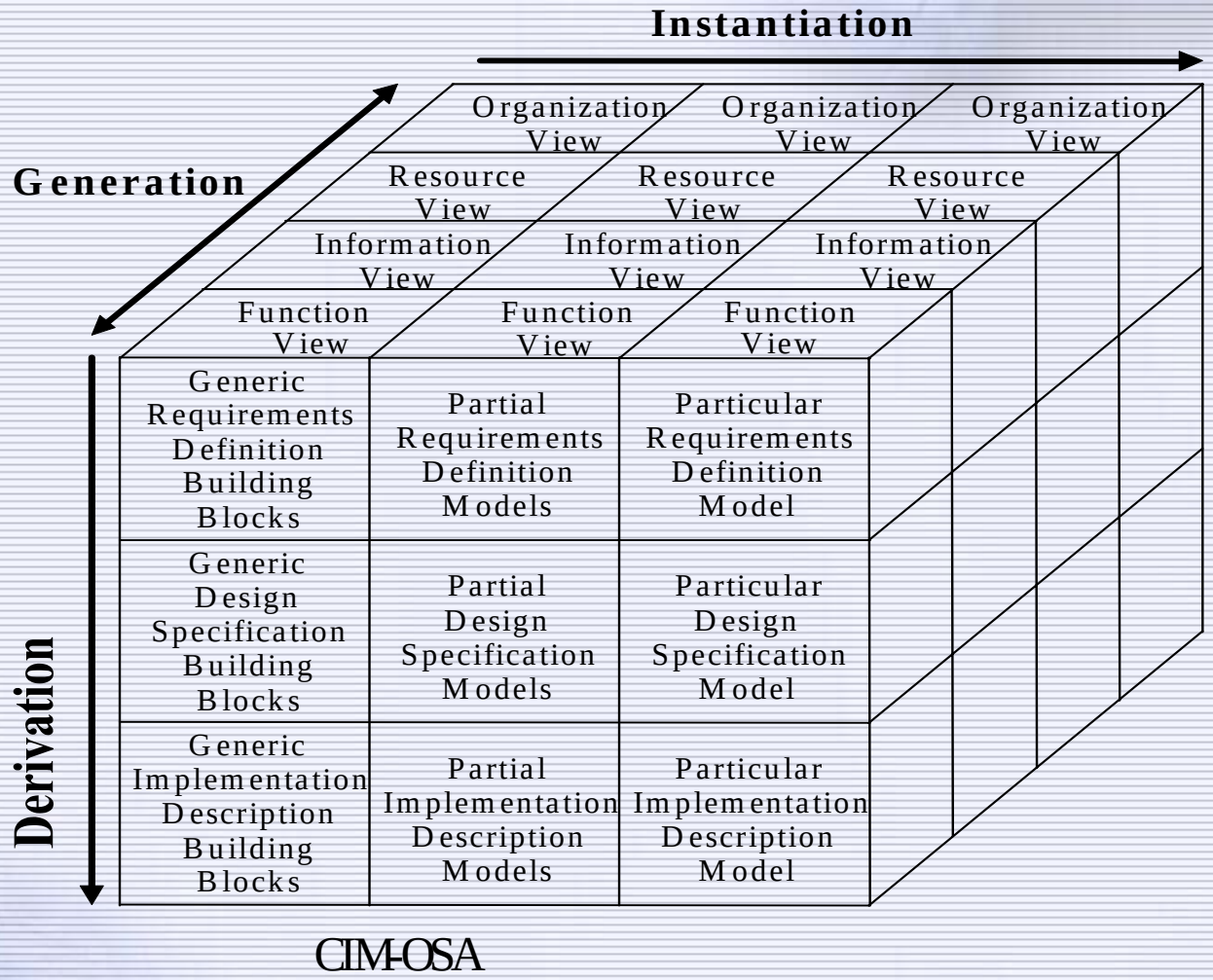
The definition of Model

M models A if M answers questions about A.



CIM-Open System Architecture

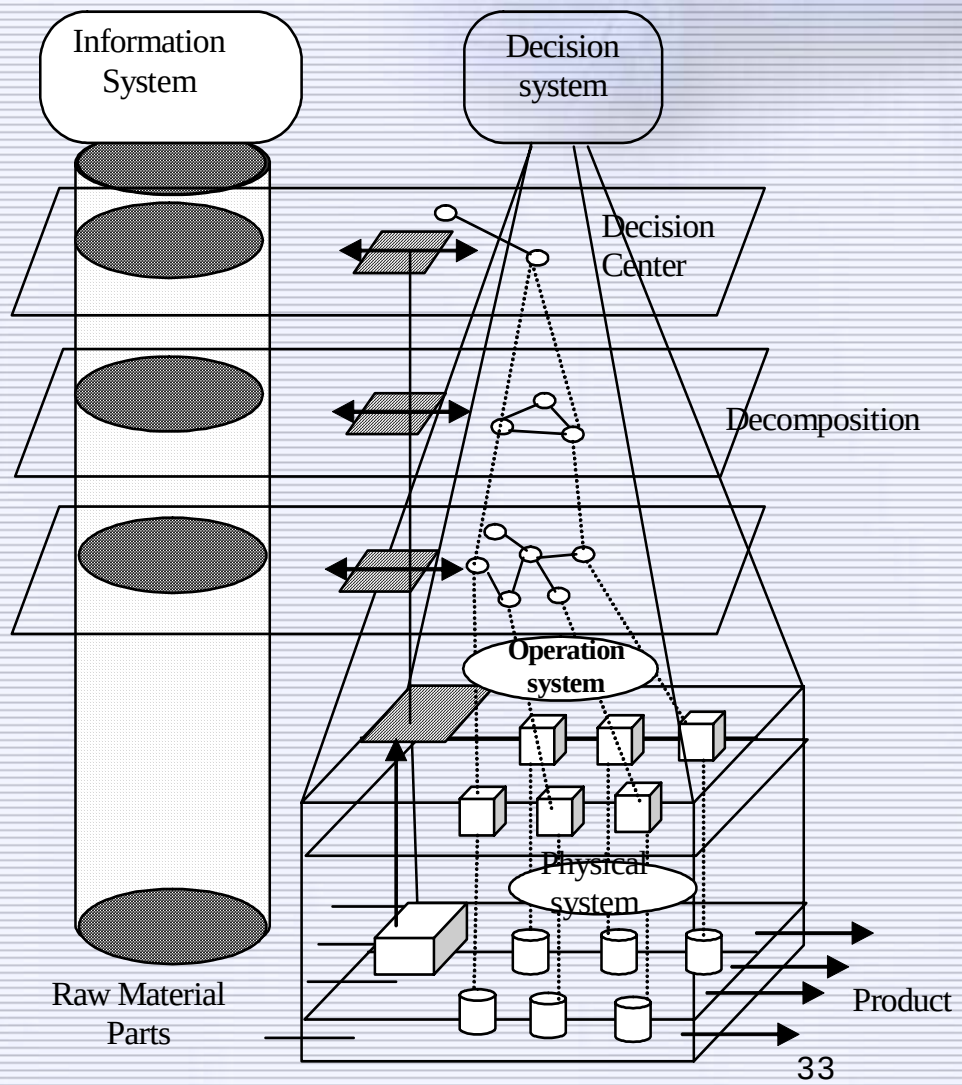




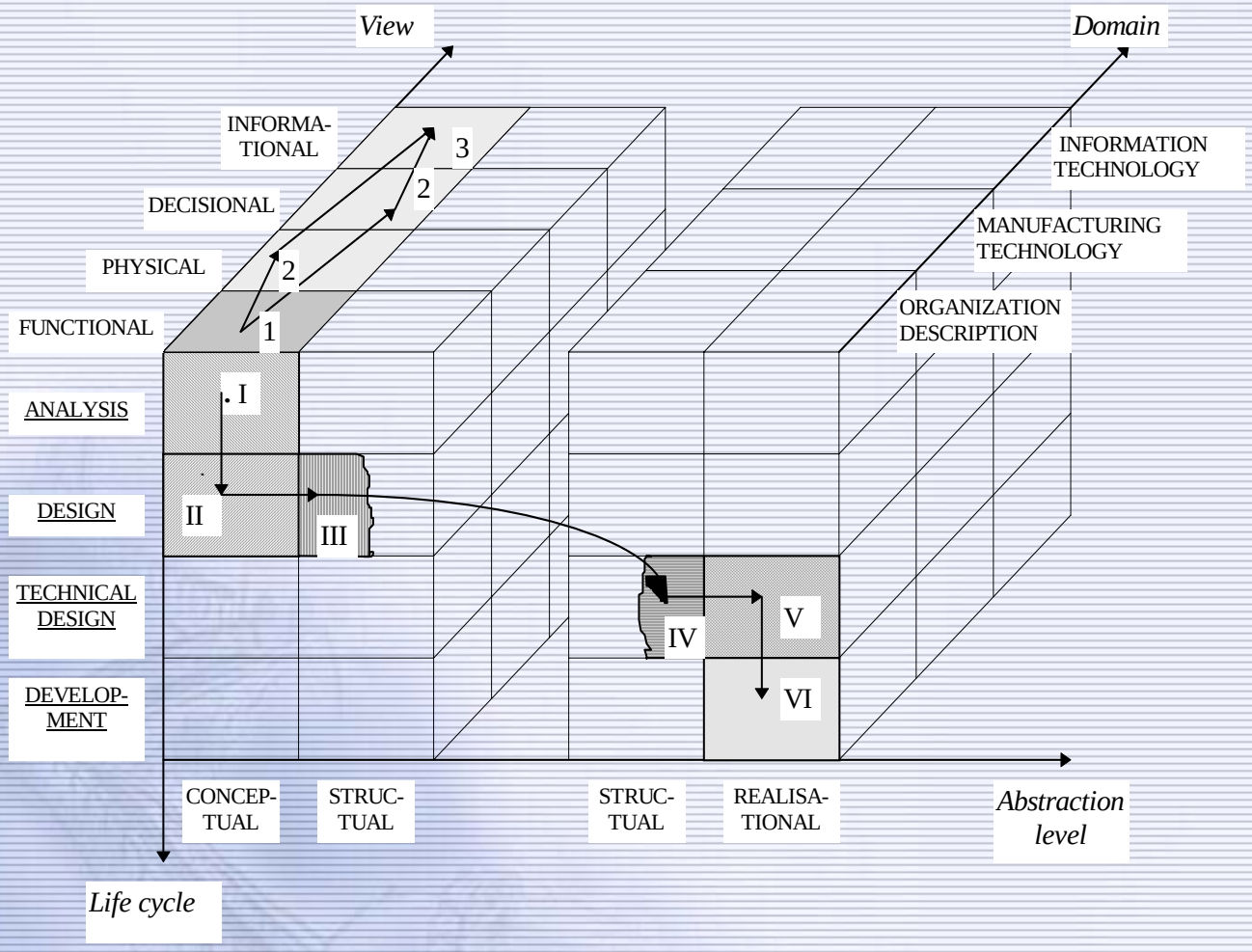
Basic concept of GIM

An enterprise includes Decision System, Physical System and Information System.

Now it can present decision, function and information modeling methods.

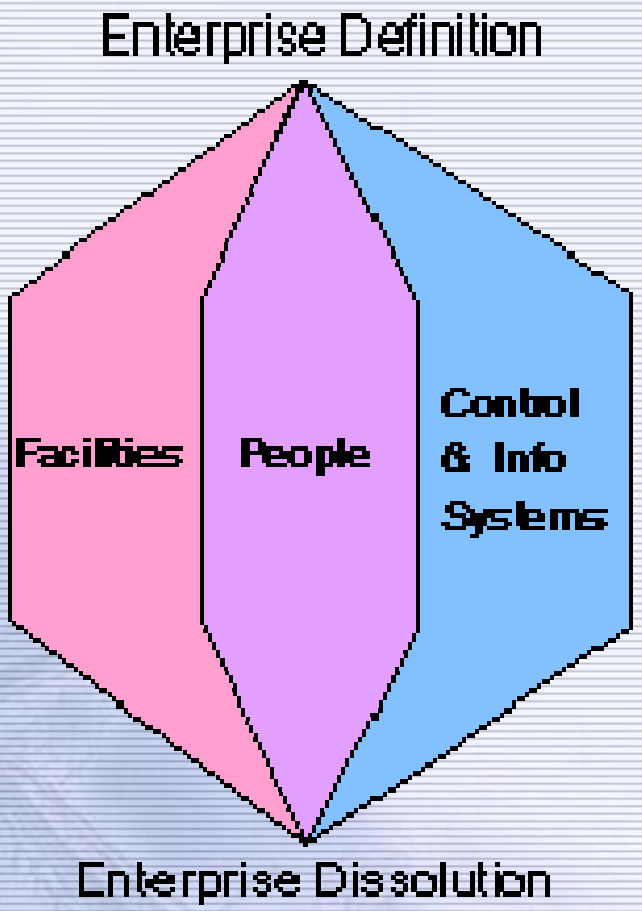


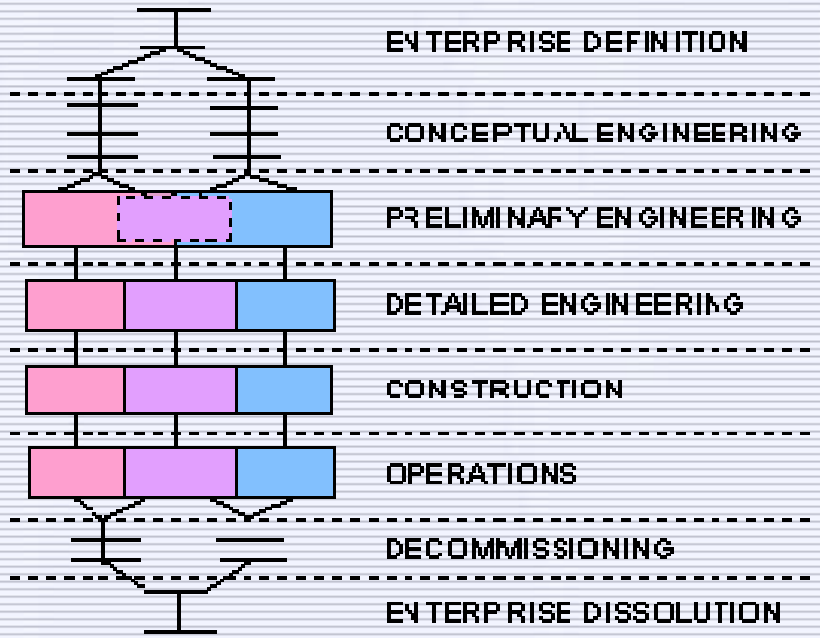
Basic concept of IMPACS



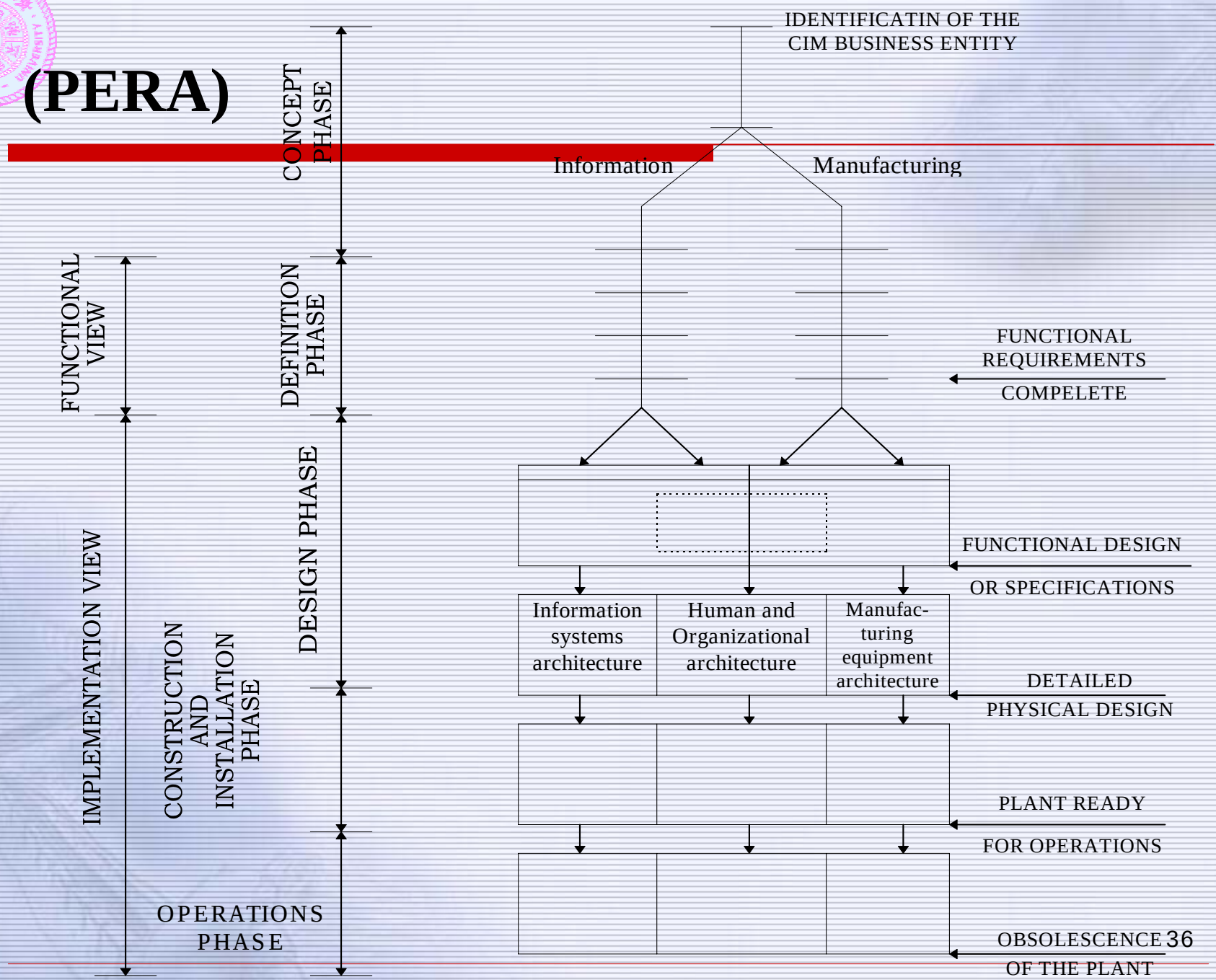
This Architecture has the same views with GIM. It emphasizes the relationship among subsystems.

Basic concept of PERA

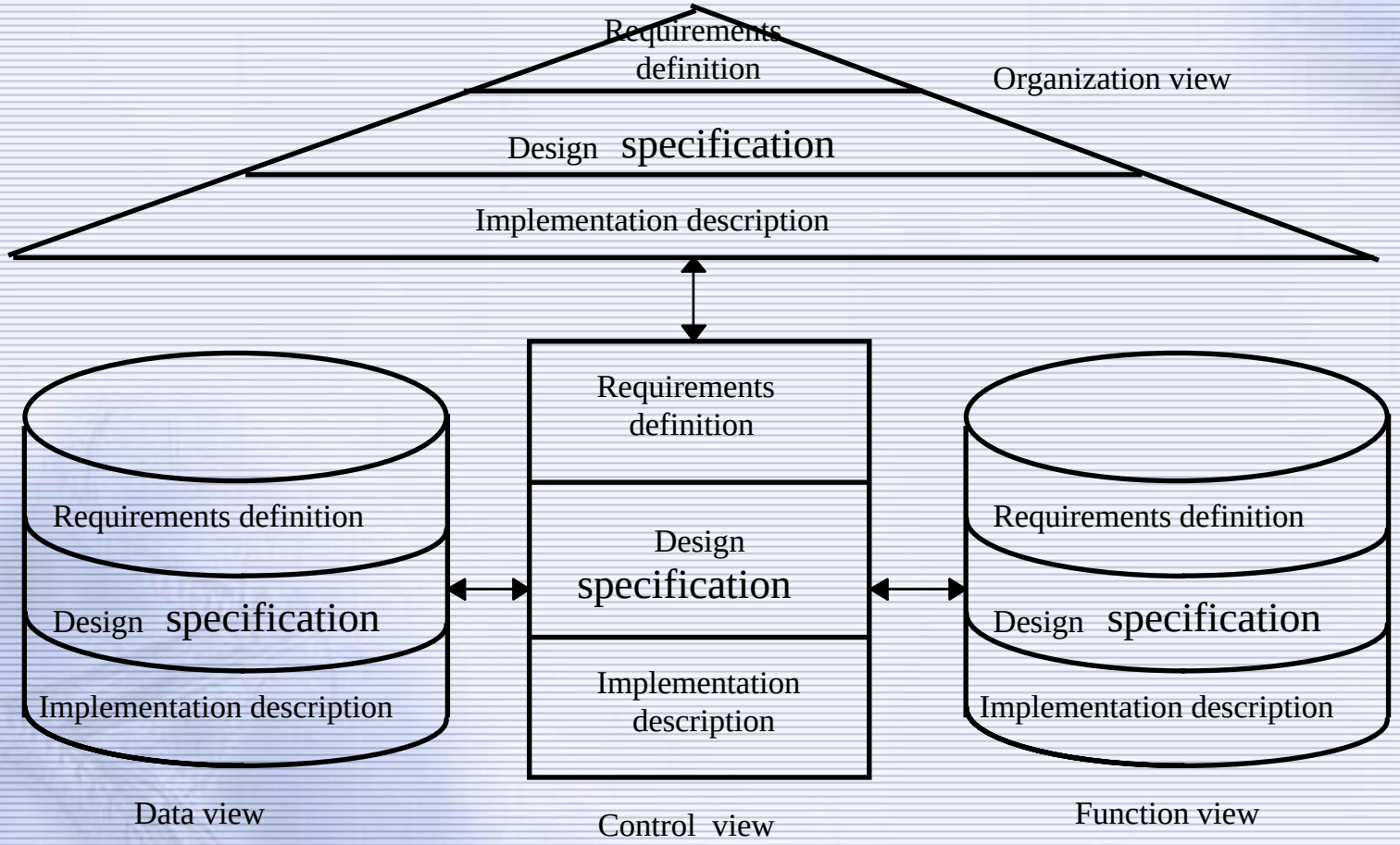




(PERA)

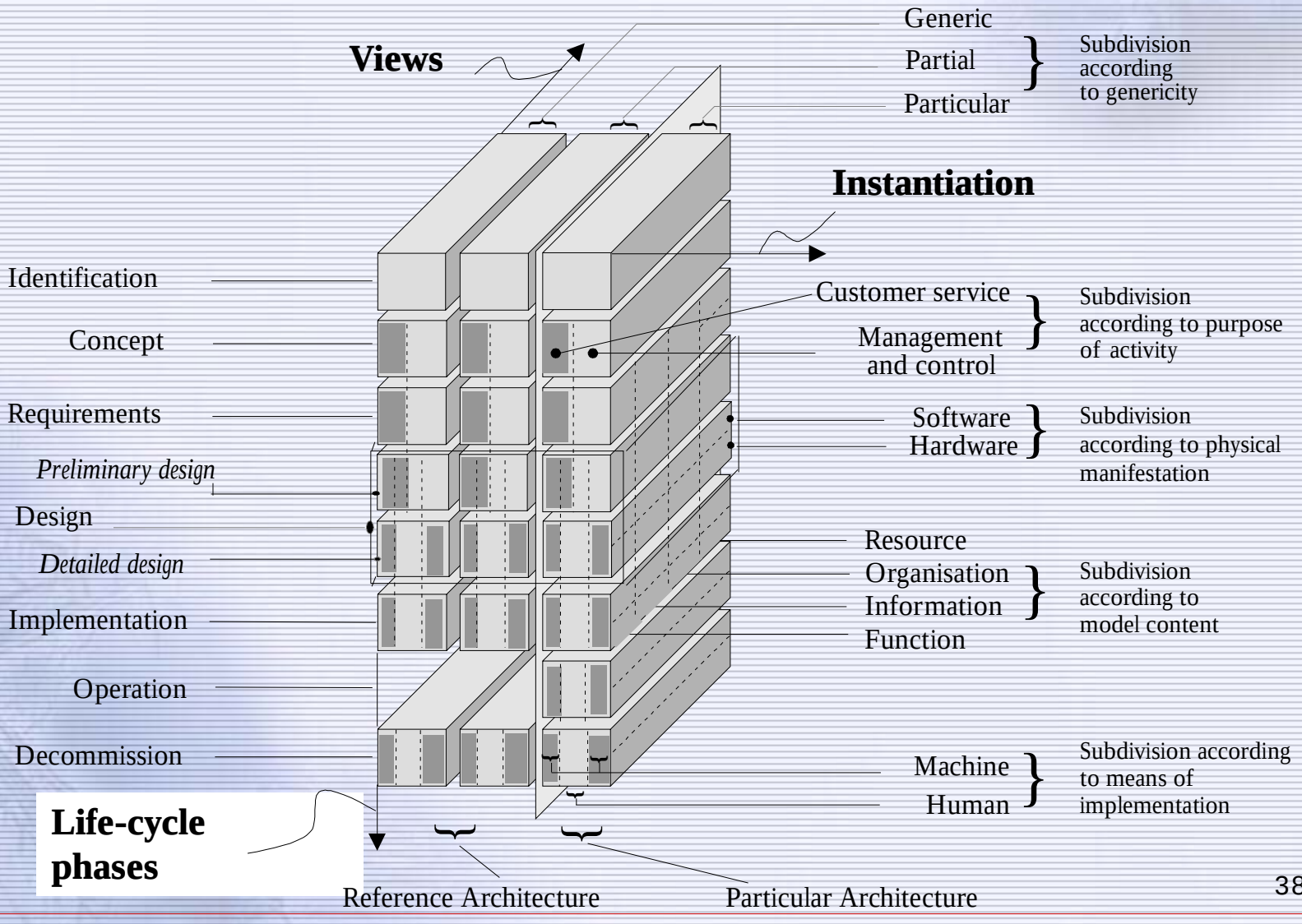


Information System Architecture (ARIS)

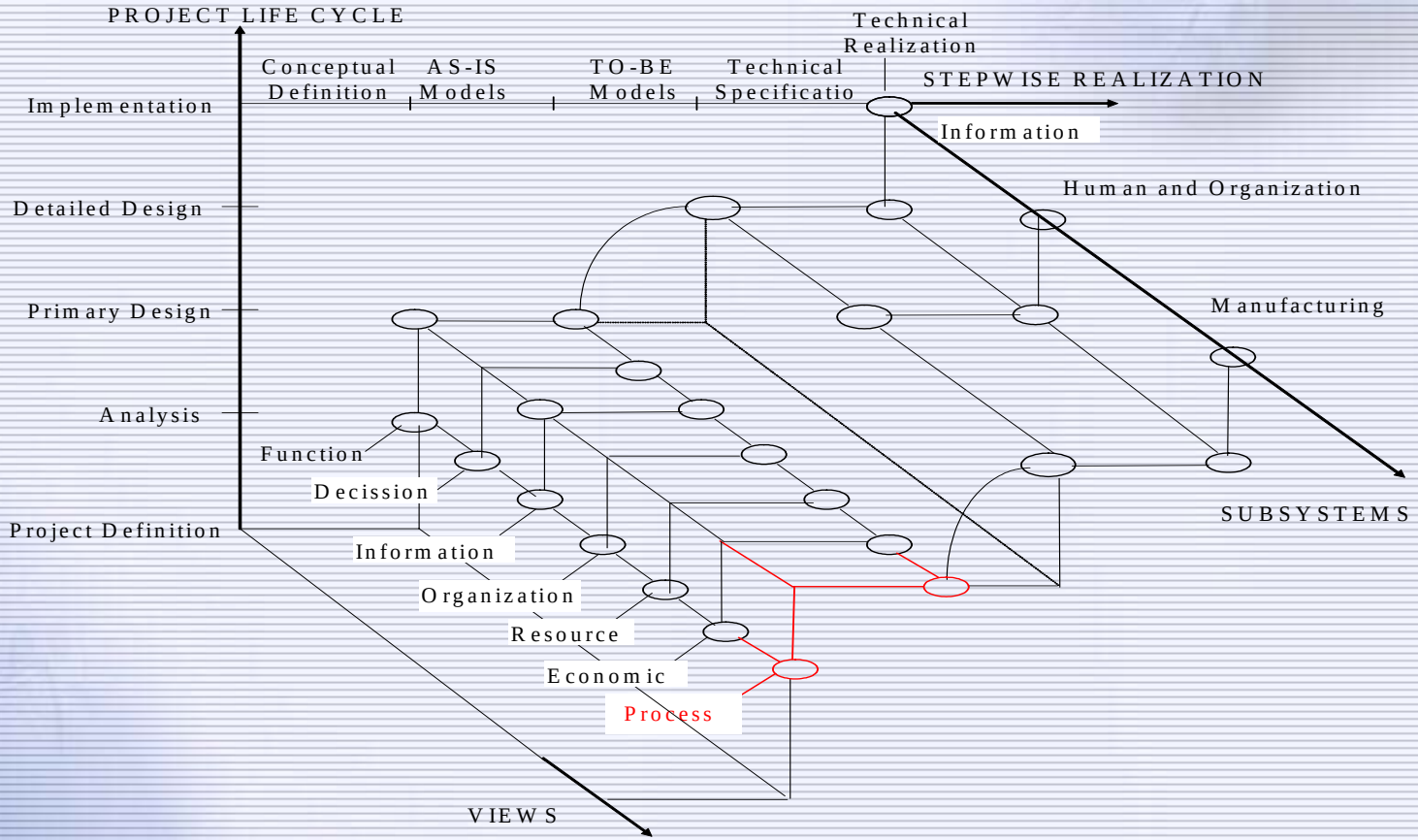


ARIS (Architecture of Integrated Information System)

GERAM (ISO 15704:2000 Annex A)



Based on Chinese situation, Stair-Like CIMS Architecture (SLA) was proposed in 1993



SLA first presented the concept of Economic View in an enterprise architecture context on May 14-15, 2001, at the ISO/TC184/SC5 conference held in Beijing. SC5 accepted our proposal to add an Economic View in Architecture.

Explanation

- 1. Not need to be limited in discrete parts manufacturing industry.
- 2. Mapping from models designed to realization is needed.
- 3. Add new views, especially the economic view and process view.
- 4. Do Reverse Mapping to check if the realization has met the aim of TO-BE model design.

A good way to see the elephant: "Stair-Like CIM System Architecture" (SLA)

Function View

Information View

Decision View

Organization View

Economic View

Resource View

+Process View

Minimal views vs. optimal views

ISO/FDIS 19439	SLA
Function view	Function view
	+ Process view
Information view	Information view
Resource view	Resource view
Organization view	Organization view
	+ Decision view
	+ Economic view

A precise understanding of the definition of “View” is required.

A definition of “view”

It can be found the definition of “view” from ISO 15745-1 :

projection of a model, which is seen from a given perspective or vantage point and omits entities that are not relevant to this perspective.

The problem involved

- Relationship and difference between View and Model
- After having Function View, is it necessary to establish Process View
- After having Organization View , is it necessary to establish Decision View
- Can we put “What to do” and “How to do” in one model? Together or separate?
- Why do we divide the enterprise model into several views?

Reasons for having views of a model

- Accommodate multiple users
  - Examining content
  - Defining content
- Expose content to enable interoperability
- Reduce apparent complexity
- Provide focus
- Enable modularity of process
- Enable “need to know” restrictions
- Move toward particular domain knowledge
- Enable interoperation with larger knowledge sets

Definition of enterprise model view

selective perception or representation of an enterprise model that emphasizes some particular aspect and disregards others

- **“one aspect” or “a few aspects” (just like, except hologram, a photo can only take one plane.)**
- **“one form of representation” or “several forms of representation”**
- **“What is the purpose to divide enterprise model into several views?”**

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After distinguishing the differences between function and process, the requirement for building an international standard of "Process model/view" was raised.

Definitions

- 3.32
- **function view**

  enterprise model view that enables the representation and modification of the processes of the enterprise, their functionalities, behaviours, inputs and outputs
- 3.33
- **functionality**

  referring to the purpose for which the process exists

Method Comparisons (IDEFØ, 1X, and IDEF3)

IDEFØ	IDEF1x	IDEF3
What you do	**What you need to know**	**How you do it**
Functional dependencies	***Information Management or Database Design***	***Precedence and Cause-&-Effect***
Used to "target" activities that need improvement	**Information or Data Requirements**	**Reduce Cycle Time**
A modeling method	**Analysis method (1) / Design method (1X)**	**A description method**

The important role of “Process view” has been recognized widely

Why it is necessary for us to develop the standard?

- There are lots of process-modeling methods, such as IDEF3, EPC, Gantt chart, PERT chart, Petri Net, etc. It is necessary to develop method to converge all of these methods.
- Workflow becomes the core technique of management information system. It is necessary to integrate these systems based on interoperable process modeling methods.
- TC184 and other technique committees are preparing to develop standards for supply chain, e-business, value-chain and concurrent engineering. All of these standards will use process description methods. We should develop a process modeling standard at first to support these tasks.

Necessity (continue)

- Reference models are the base of knowledge management. They are certain kinds of enterprise knowledge and can support new system constructing and restructuring. In order to reuse these models, it needs a standard to support process model information exchange.
- IEEE has begun the process. IDEF0 became IEEE Standard (Software Engineering Standards Committee of the IEEE Computer Society，IEEE Std 1320.1-1998．IEEE Standard for Functional Modeling Language-Syntax and Semantics for IDEF0．Approved 25 June 1998 IEEE-SA Standards Board). It is a sign that we should consider about the standardization of enterprise modeling methods. The Standard of Process Modeling Method (SPM) is a good initial topic.

Provide a total solution for all kinds of process modeling for system integration

- In different stages and different aspects of the work for system integration, there are different requirements for process modeling. For example, capturing of basic process information is most important in stage of requirement analysis; status of resource is focused on in stage of project management; effects of process running is cared about in stage of implementation of process models. SPM must satisfy all these requirements.
- It can help understanding and communication between enterprise manager, process experts, and process analyzer; it can provide plenty of means for analyzing process, including value chain analysis, simulation, ABC calculation, etc; it can support many implementation methods, including workflow management, project management, and process monitoring, etc.

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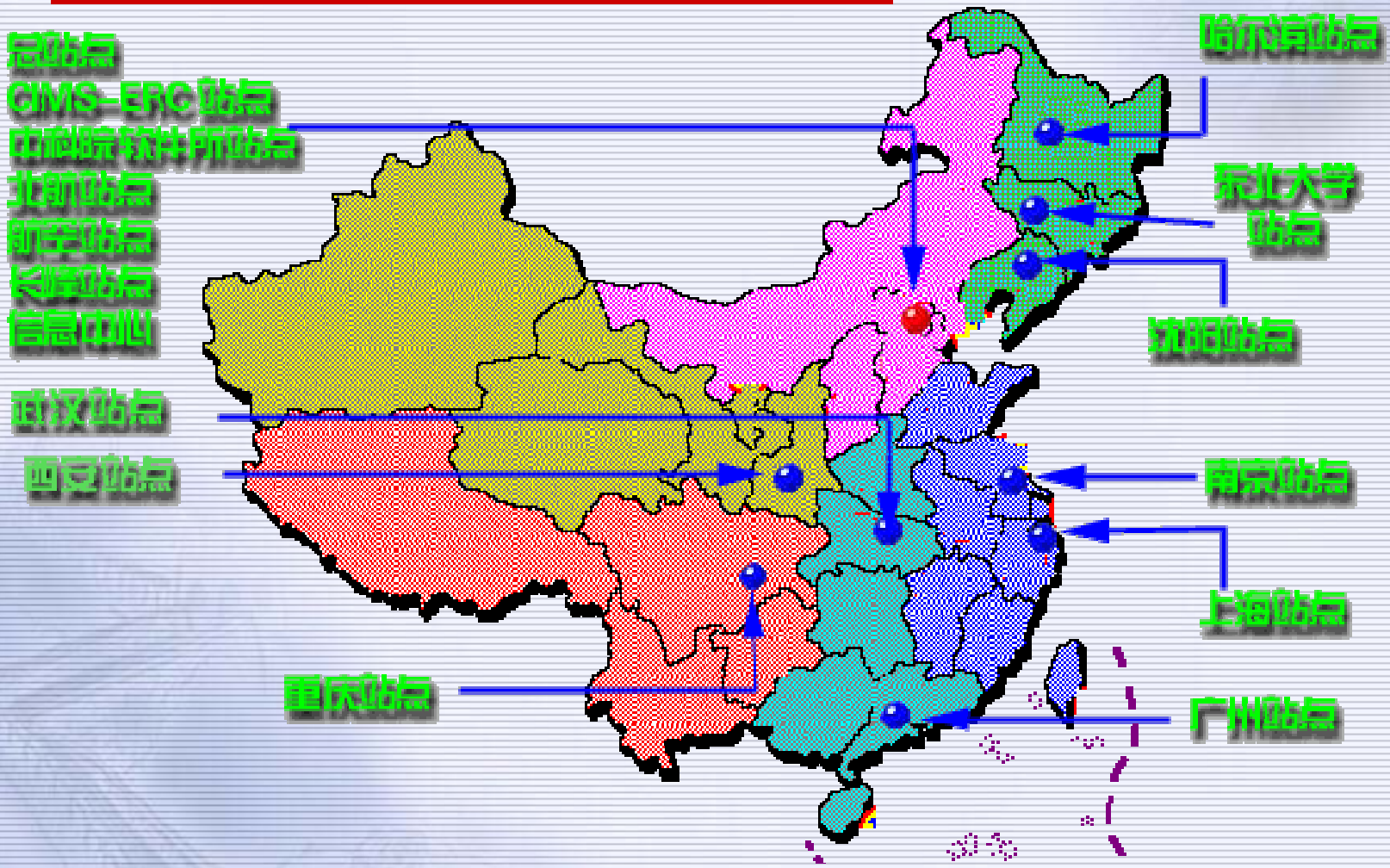
Effects of applying enterprise modeling and system architecture in practice

(Due to time limit, only introduce some of our direct experiences)

What CIMS-ERC has done in accordance with this understanding.

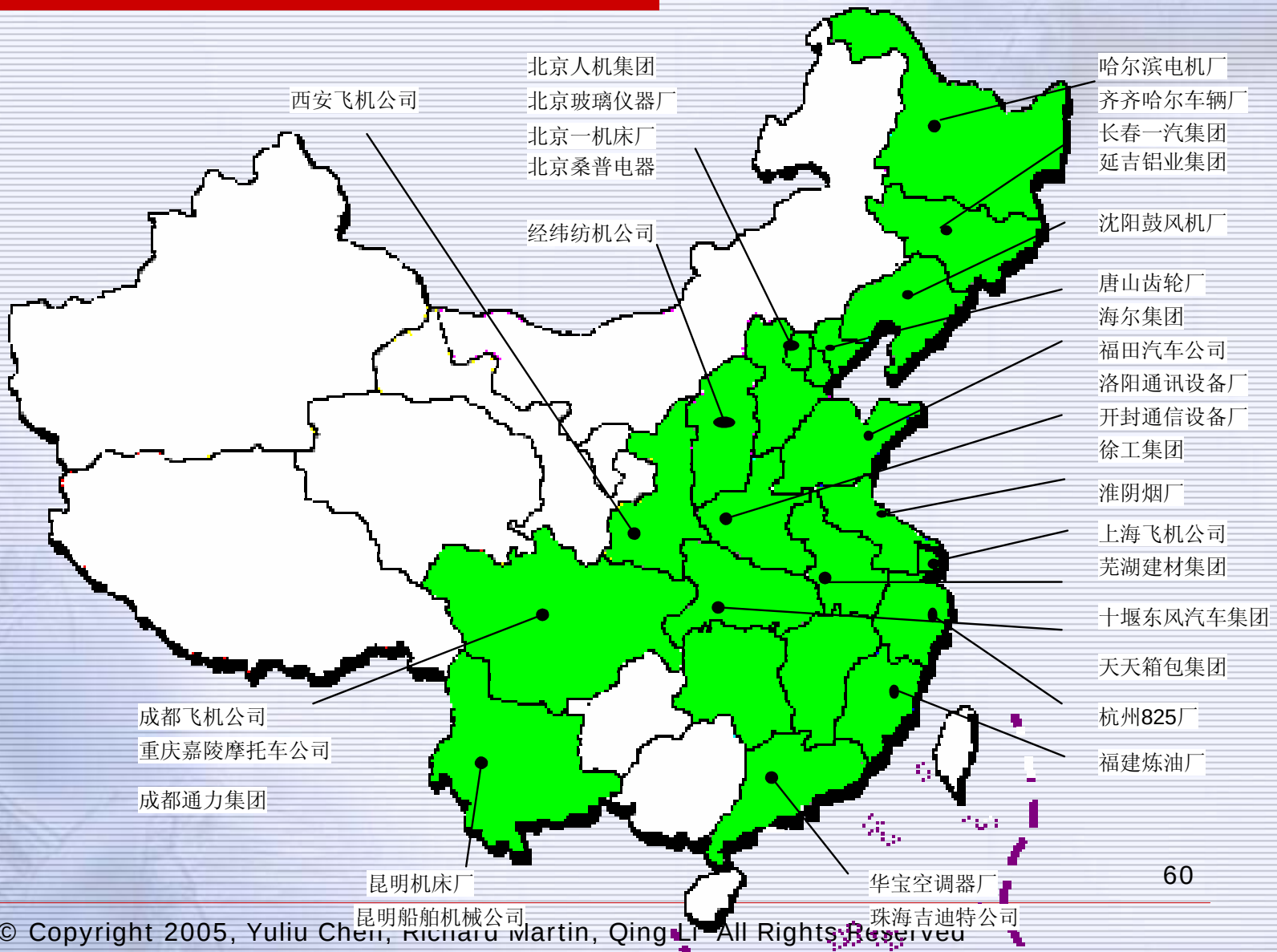
The distribution of CIMSNET nodes



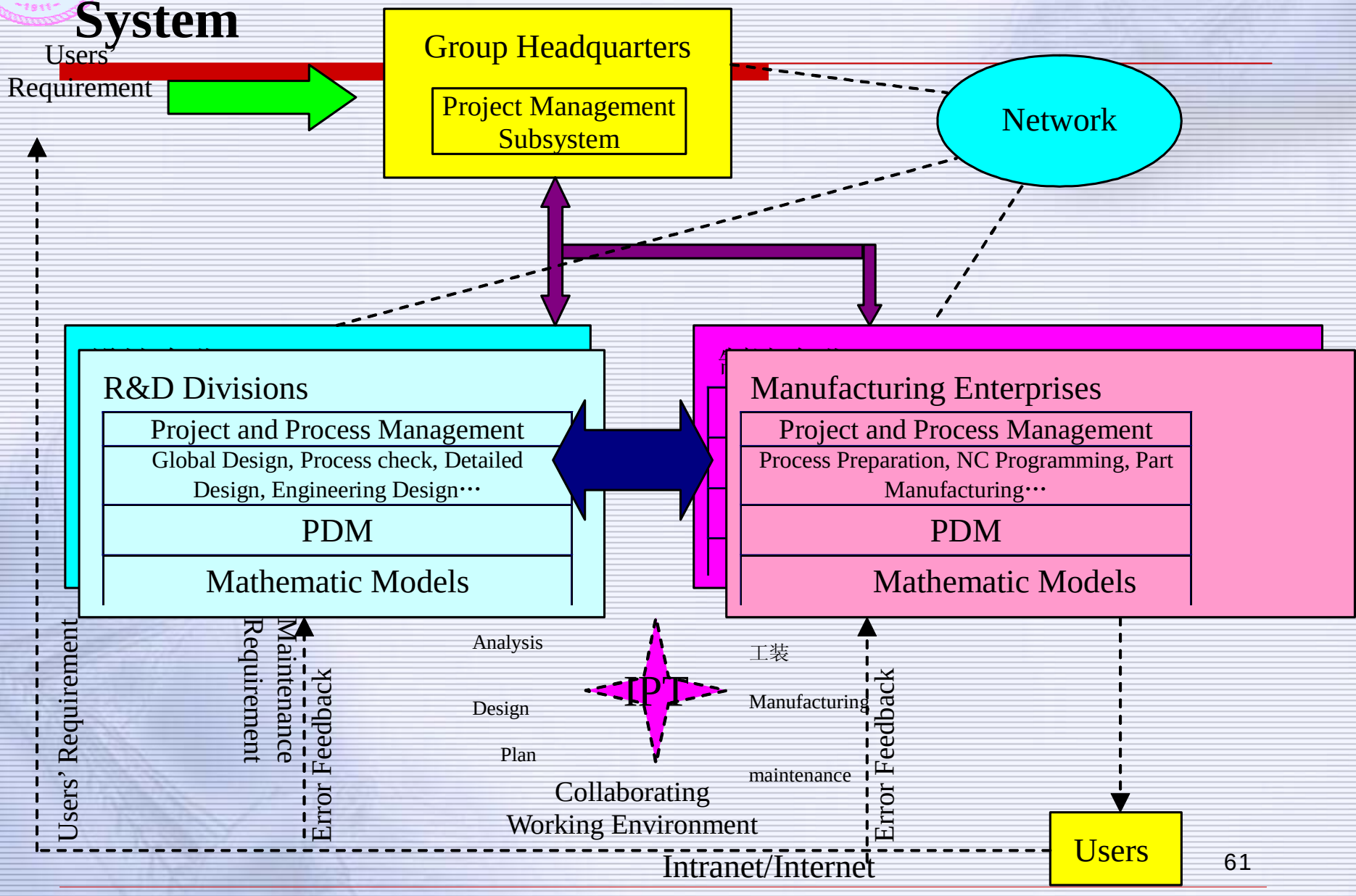
The Progress in Engineering of CIMS-ERC

- More than 60 enterprises CIMS engineering undertaken
- More than 10 industrial areas covered
  - ----Machinery Textile machinery Electronics
  - ----Chemical Metallurgy Light Industry
  - ----Aeronautics Astronauts etc..
- More than 13 provinces distributed
- A close relationship between enterprises and CIMS ERC has been created
- More than 200 million Yuan (RMB) funds obtained

The List of CIMS Engineering projects undertaken by CIMS ERC



Chinese Aviation Industry Integrated Manufacturing System



Typical Awards

- **CIMS ERC**
  University LEAD Award" on Development and Applications of CIMS issued by ASME of the U.S. in 1994
- **Chengdu Aircraft Co.**

  "Enterprise LEAD Award" on Applications of CIMS issued by SSTC in 1996

  Second class, Prize of "National Advance in Science and Technology" in 1997
- **Jingwei Textile Machinery Co.**

  "Enterprise LEAD Award" on Applications of CIMS issued by SSTC in 1996
- **Accelerating the product innovation with VPD**

  Second class, Prize of "National Advance in Science and Technology" in 2000

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- "Economic view" as Annex B in the revised 15704 was raised from CIM implementations in China.

A list of Chinese National Standards in the field of manufacturing

1	GB/T 15312-1994	制造业自动化术语 Manufacturing automation terminology		本标准适用于与自动化技术有关的生产、工程、科研和教育等部门。	本标准规定了以机电领域为主的制造业所用自动化技术的基本术语。 包括：“通用术语”、“技术信息系统”、“管理信息系统”、“制造自动化系统”、“通信和网络”五大类。	本标准起草单位：北京机械工业自动化所 本标准起草人：张锡麟、孙珍芬。 UDC 681.5 L 60	1994-12-22	1995-10-01
2	GB/T 16978-1997	工业自动化词汇 Industrial automation glossary	idt ISO/TR 11065-92 Industrial automation glossary	本标准的目的是为了统一在工业自动化领域常用专业术语的名称与定义。	本标准定义了工业制造环境中有关的自动化名词术语。	本标准起草单位：北京机械工业自动化所 本标准起草人：郝淑芬 ICS 25.010 J 07	1997-09-02	1998-04-01
3	GB/T18725-2002	制造业信息化 技术术语Technical terminology ofmanufacturing informationization		本标准适用于与制造业信息化技术有关的科研、生产、工程、管理、经营、教育等部门。	本标准定义了制造业信息化领域的有关技术术语。	本标准起草单位：北京机械工业自动化所 本标准起草人：郝淑芬 ICS 25.010 J 07	2002-05-20	2002-12-01
4	GB 16655-1996	工业自动化系统 集成制造系统安全的基本要求	eqv ISO 11161 -94 Industrial automation systems -- Safety of integrated manufacturing systems -- Basic requirements	本标准不包括单台设备的安全要求。	本标准规定了集成系统安全的基本要求准则。 本标准提出了集成系统的设计、构成、安装、编程、操作、维护、使用、修理等阶段有关安全要求和建议。	本标准起草单位：北京机械工业自动化所 本标准起草：全国工业自动化系统标准化技术委员会秘书处起草。 ICS 25.040.01 L67	1996-12-17	1997-07-01

5	GB/T 16642-1996	计算机集成制造系统（CIMS）体系结构	neq ISO 7498 Information technology -- Open Systems Interconnection -- Basic Reference Model ENV 40003 Computer Integrated Manufacturing - Systems Architecture - Framework for Enterprise Modelling	本标准可用于支持企业CIMS建模，进而指导CIMS的实施运行。	本标准规定了计算机集成制造系统（CIMS）参考模型的体系框架（包括建模框架和集成基础结构框架）。	本标准起草单位：北京机械工业自动化所 本标准起草人：邓子琼等 ICS 35.100 L67	1996-12-17	1997-05-01
6	GB/T19662-2005	工业自动化系统 制造报文规范 术语 Industrial automation system: terminology for manufacturing message specification		本标准收录的术语来自GB/T 16720系列标准。 本标准适用于GB/T 16720工业自动化系统制造报文规范系列标准的读者及用户。可供制造报文规范的使用者在开发和研究中参考，可供科研、教学等技术工作者使用	本标准规定了工业自动化系统 制造报文规范中常用的技术术语。	本标准起草单位：北京机械工业自动化所，北京航空航天大学等 本标准起草人：魏文娟、郝淑芬等。 ICS 25.040.40 J 07	2005-01-24	2005-06-01

7	GB/T 16720.1-2005 (替代 1996版)	工业自动化系统 制造报文规范（MMS）第1部分：服务定义	Idt ISO 9506.1-2003 Industrial automation systems -- Manufacturing Message Specification -- Part 1: Service definition	本部分的目的是定义制造报文规范提供的各种服务。	“工业自动化系统 制造报文规范”的总标题下,由以下四部分组成: 第1部分：服务定义 本部分是为便于信息处理系统互连而制定的系列标准之一。它作为于其他标准的应用服务元素（ASE）被开放系统互连基本参考模型列入开放系统互连环境的应用层中。 第2部分：协议规范 制造报文规范是一个工业自动化应用层的标准，以支持计算机集成制造（CIM）环境中可编程设备的双向报文通信。 第3部分：工业机器人伴同标准 本标准规定了需要由MMS伴同标准规定的协议元素的抽象语法记法表示的各种机器人专用服务和协议及机器人专用的标准化对象。 第4部分：数值控制用伴同标准: 描述数控制造设备和装置的语义.	本标准起草单位：北京机械工业自动化所,北京四方继保自动化有限公司 本标准起草人：魏文娟、任雁铭等。 ICS 25.040.40 J 07	2005-01-24	2005-06-01
8	GB/T 16720.2-2005 (替代 1996版)	工业自动化系统 制造报文规范（MMS）第2部分：协议规范	Idt ISO 9506.2-2003 Industrial automation systems -- Manufacturing Message Specification -- Part 2: Protocol specification	本部分为各种制造和过程控制设备提供广泛的服务。是便于信息处理系统互连而制定的成套标准之一		本标准起草单位：北京机械工业自动化所,北京四方继保自动化有限公司。 本标准起草人：魏文娟、郝淑芬等。	2005-01-24	2005-06-01
9	GB/T 16720.3-1996	工业自动化系统 制造报文规范(MMS) 第3部分：工业机器人伴同标准	eqv ISO/IEC 9506.3-91 Industrial automation systems -- Manufacturing message specification -- Part 3: Companion standard for robotics	本部分适用于使用机器人和机器人系统的开放式通信系统。		本标准起草单位：北京机械工业自动化所等。 本标准起草人：胡景谬等	1996-12-26	1997-07-01
10	GB/T 16720.4-1998	工业自动化系统 制造报文规范(MMS) 第4部分：数值控制用伴同标准	eqv ISO/IEC 9506.4-92 Industrial automation systems -- Manufacturing Message Specification -- Part 4: Companion standard for numerical control	本部分为制造报文规范定义了数值控制的语义。它被用于数值制造系统或设备连到符合OSI模型的通信网络并使用MMS服务和MMS协议的场合。		本标准起草单位：北京机械工业自动化所 本标准起草人：曾庆宏、郝淑芬等 ICS 25.040.01 L 67	1998-11-05	1999-06-01

11	GB/T 16980.1-1997	工业自动化系统 车间生产 第1部分：标准化参考模型和确定需求的方法论	idt ISO/TR 10314.1-90 Industrial automation -- Shop floor production -- Part 1: Reference model for standardization and a methodology for identification of requirements	本标准描述的参考模型是用于确定在制造车间生产范围内的一些标准。	“工业自动化系统 车间生产”由两部分组成: 第1部分描述参考模型和方法论，为的是确定可能的标准需求。第2部分讨论该参考模型和方法论在工业自动化车间生产标准的一般领域的应用。 本标准提出和描述了一种手段，以判别在什么地方可能需要一些新的或应修订的制造标准。	本标准起草单位：北京机械工业自动化所 本标准起草人：曾庆宏、郝淑芬。 ICS 25-010 J 07
12	GB/T 16980.2-1997	工业自动化系统 车间生产 第2部分：标准化参考模型和方法论的应用	idt ISO/TR 10314.2-91 Industrial automation -- Shop floor production -- Part 2: Application of the reference model for standardization and methodology		本标准建立了一个车间生产的参考模型，并进而用作开发一种方法论的基础，以便识别和抽取标准的内容范围。	
13	GB/T18726-2002	现代设计工程集成技术的软件接口规范 Software interface specification of integrated technology for modern design engineering		本标准适用于指导企业在实施技术信息集成的过程中，定义不同软件的动态接口或在选购相关软件时作为判断其可集成程度的参考。	本标准定义并促使与技术信息系统（TIS）相关的不同软件系统提供信息交流的中间件。这些软件主要以下几类：PDM、CAD、CAPP等。	本标准起草单位：北京机械工业自动化所等 主要起草人：王涛等 ICS 25.040 J 07

14	GB/Z 18729 -2002	基于网络的企业信息集成规范 Network-based enterprise information integration specification		本指导性技术文件是适合我国国情的制造企业信息集成的指导性文件。	本指导性技术文件的主要内容: 1.企业信息集成规范 2实现虚拟企业的信息基础设施。	本标准起草单位：北京机械工业自动化所 ICS 25.040 J 07	2002-05-20	2002-12-01
15	GB/Z 18727 -2002	企业应用产品数据管理（PDM）实施规范 Implementation specification for enterprise application: Product Data Management (PDM)		本指导性技术文件适用于企业,PDM系统开发单位、PDM系统技术咨询服务单位以及提供PDM技术支持的单位。	本指导性技术文件为企业应用PDM技术时，提供实施规范。	本标准起草单位：北京机械工业自动化所 主要起草人：陈宏亮 ICS 25.040 J 07	2002-05-20	2002-12-01
16	GB/Z 18728 -2002	制造业企业资源计划（ERP）系统功能体系结构技术规范Technical specification for system function architecture : Manufacturing Enterprise Resource Planning (ERP)		本指导性技术文件给出的系统功能结构是一种工具，适用于离散制造业各类用户比较、评价ERP软件产品，为ERP软件厂商开发ERP、同时对用户修改和二次开发ERP软件系统也有重要的指导作用。	本指导性技术文件主要描述了离散制造业ERP系统的结构、逻辑、关键核心的软件功能，以及与其他主要自系统的关联。	本标准起草单位：北京机械工业自动化所 主要起草人：黄友森 ICS 25.040 J 07	2002-05-20	2002-12-01
17	GB/T 18755 .1-2002	工业自动化系统 制造自动化编程环境（MAPLE）第1部分：功能体系结构	idt ISO 13281.1-97 Industrial automation systems -- Manufacturing Automation Programming Environment (MAPLE) -- Functional architecture	适用于MAPLE标准的下列用户： 制造应用程序的开发者； 编辑制造程序的操作者； 需要应用制造数据的工程师； 制造应用系统集成商	本项标准是MAPLE系列标准之一(共两部分)。MAPLE是一个能力的结构集，它将对象（如用于先进制造技术的数据）与所需的用户工具连接起来。从而使制造软件程序便捷地开发和更新，使制造数据库的访问和管理统一。使制造数据源与软件工具可无缝地集成。	本标准起草单位：北京机械工业自动化所。 主要起草人：曾庆宏等。 ICS 25.040.40 J 07	2002-06-13	2003-01-01

18	GB/T 18755.2-2003	工业自动化系统与集成--制造自动化编程环境(MAPLE)--第2部分:服务与接口	idt ISO 13281.2-2000 integration -- Manufacturing Automation Programming Environment (MAPLE) -- Part 2: Services and interfaces	本部分的规定特别适用于MAPLE环境中的软件开发人员、系统集成人员和软件工具开发人员。	第2部分规定MAPLE和软件程序之间应用层的接口。建立了MAPLE需提供的服务和接口需求的最低要求。	本标准起草单位：北京机械工业自动化所。 主要起草人：郝淑芬等。 ICS 25.040.40 J 07	2003-05-26	2003-12-01
19	GB/T 18999-2003	工业自动化系统企业模型的概念与规则	idt ISO 14258-1998, ISO14258 1998/cor1-2000 Industrial Automation Systems - Concepts and Rules for Enterprise Models	本标准的用户主要是一些正在为集成和建模领域的某一部分制定详细标准的有关企业。	本标准为计算机可理解的制造企业模型规定了基本概念及规则,以便于企业各种过程的互操作。	本标准起草单位：北京机械工业自动化所 主要起草人：黎晓东等 ICS 25.040.40 J 07	2003-04-15	2003-12-01
20	GB/T 18757-2002	工业自动化系统企业参考体系结构与方法论的需求	idt ISO 15704-2000 Industrial automation systems—Requirements for enterprise-reference architectures and methodology	适应范围：包括企业在其整个生命周期中，执行各种企业创新项目和逐步改进项目时所必须的各种要素。	本标准规定了企业参考体系结构与方法论的需求，以及将这种体系结构与方法论看作完整的企业参考体系结构与方法论必须满足的需求。它为计算机集成制造提供了一个企业建模、体系结构的概念框架。成为计算机集成制造领域的一个重要技术基础标准。	本标准起草单位：北京机械工业自动化所、清华大学。 主要起草人：郝淑芬等。 ICS 25.040.40 J 07	2002-06-13	2003-01-01
21	GB/Z 19219-2003	工业自动化--时限通信体系结构--时限通信系统的用户需求和网络管理	idt ISO/TR 13283-1998 Industrial automation -- Time-critical communications architectures -- User requirements and network management for time-critical communications systems	本标准化指导性技术文件针对用于离散零件制造应用的时限通信系统。也可用于其他场合，包括过程控制。	本标准化指导性技术文件提出了系统支持时限通信系统的系统和网络管理的用户需求。这种网络管理是针对应用过程中或各应用过程之间在同等对同等或多同等通信中的时限通信体系结构。本标准化指导性技术文件还描述了时限通信系统内的网络管理的模型、特性和功能	本标准起草单位：北京机械工业自动化所。 主要起草人：黎晓东等 ICS 25.040.40 J 07	2003-06-26	2004-01-01

22	GB/T19659.1-2005	工业自动化系统与集成 开放系统应用集成框架 第1部分：通用参考描述	idt ISO 15745-1-2003 Industrial automation systems and integration -- Open systems application integration framework -- Part 1: Generic reference description	本标准适用于工业自动化应用，如离散制造、过程自动化、电子组装、半导体制造及大范围物流处理系统。也适用于其他自动控制领域：如公用事业自动化等。	本标准定义了应用集成框架——描述集成模型和应用互操作专规的一组元素和规则。 第1部分定义了通用元素和规则，用以描述集成模型和应用互操作专规及它们的组件专规——过程专规、信息交换专规和资源专规。	本标准起草单位：北京机械工业自动化所 主要起草人：郝淑芬等。 ICS 25.040.40 J 07	2005-01-25	2005-06-01
23	GB/Txxxxx.1-2005	工业自动化系统与集成 制造软件互操作性建规 第1部分： 框架结构	idt ISO16100-1：2002 Industrial automation systems and integration -- Manufacturing software capability profiling for interoperability -- Part 1: Framework					
24	GB/Txxxxx.2-2005	工业自动化系统与集成 制造软件互操作性建规 第2部分：专规方法论	idt ISO16100-2：2003 Industrial automation systems and integration -- Manufacturing software capability profiling for interoperability -- Part 2: Profiling methodology					

Agenda

- Background ("informationization" in China)
- Correct understanding of CIM system architecture and its views
- The requirement for building an international standard of "Process model/view" was raised.
- Effects of applying enterprise modeling and system architecture in practice.
- How many ISO standards in this field have been translated into Chinese and applied in industries.
- "Economic view" as Annex B in the revised 15704 was raised from CIM implementations in China.

“Economic view” as Annex B in the revised ISO 15704 was raised from CIM implementations in China

(with little modification in the text of 15704 about the introduction of economic view)

Introduction

- Entrepreneurs or business managers can scarcely implement CIM based on their confidence in advanced technology. They expect that the return on investment can be known in the designing phase of a new system.
- As a farseeing business- person, he/she should take into his/her consideration not only tangible benefit, but also, more importantly, intangible benefit.
- However, how to evaluate this return is a difficult but "must-be-solved" problem. Similarly, when it is required to evaluate different alternatives, the models in those existing system architectures are not able to connect functionality with economic consequences so that design trade-off can be made. Especially, the evaluation of the intangible benefits has been a barrier for enterprise investors to decide whether Computer Integrated Manufacturing should be carried out.

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- Economic View consists of a group of models, which is used to describe economic factors and their relationships in an integrated system. There are many methods, such as graphical, mathematical, and even descriptive methods, to describe economic factors. In order to improve the competitive edge of an enterprise and assure its successful operation, a three-layer framework is constructed, expressed as graphic form, based on enterprise modeling methods and reference models in the general enterprise reference architecture.

The Released Economic View

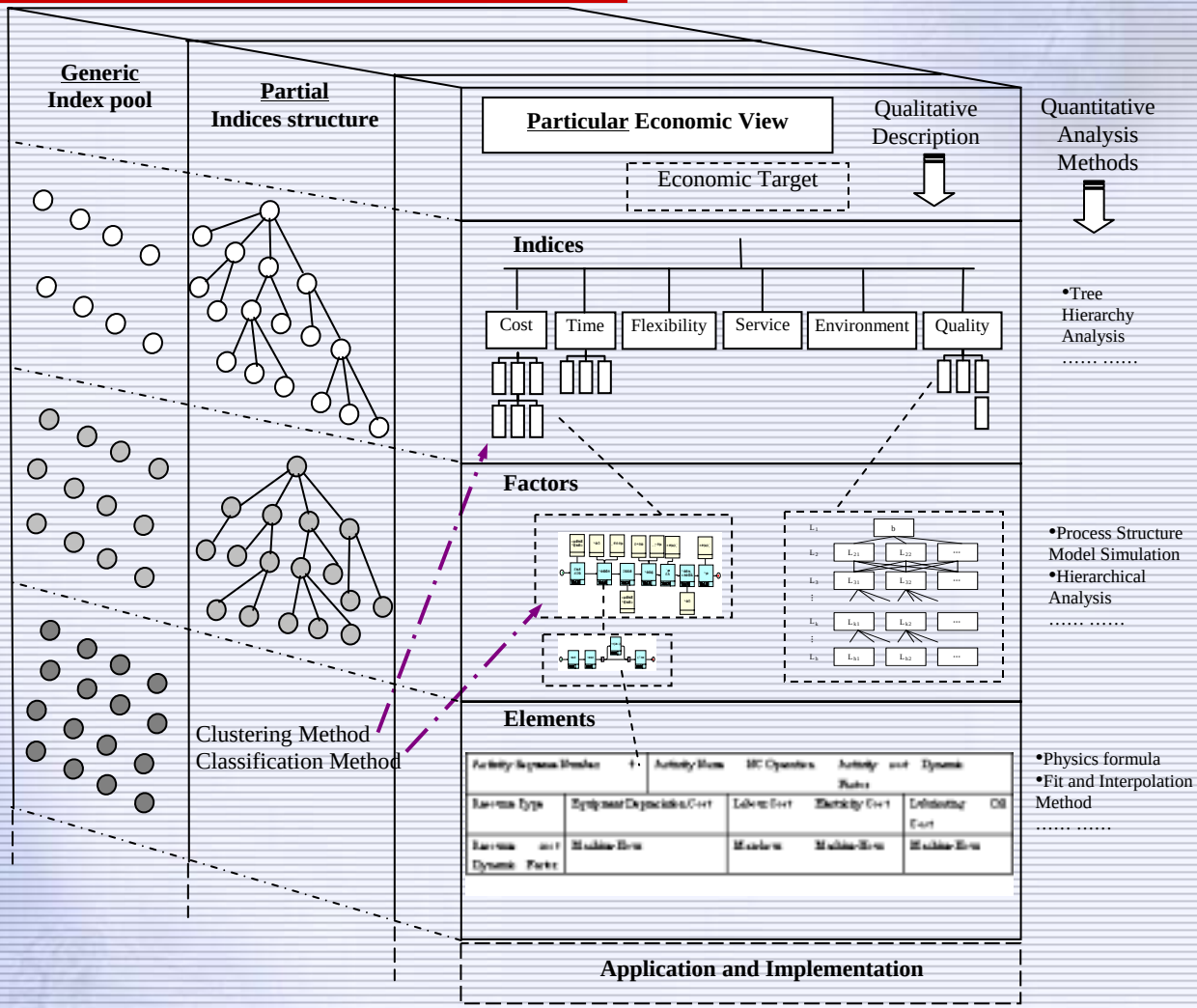

Figure 1. Framework for Economic View

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- The framework has established the relationships between different layers from the top-level strategic targets of an enterprise to some operable factors, then the bottom elements. It also provides some analysis methods to collect data to support decision optimization of the enterprise. After that, optimization results can be imposed on these factors to realize enterprise strategy and improve its competitive ability.

Application of Economic View

- **ABC Model**
  - **The modeling formalism is based on IDEF0 method. Since ABC focuses on functional activities and so does IDEF0 method, IDEF0 model has been extended to include activity based costing data. It can be assured that no activity will be missed for cost assignments with the integration with IDEF0 model. Here, a separate economic model that corresponds to the IDEF0 model of function view will be constructed. There are four attributes in each model block: 1) node number, 2) activity name, 3) cost driver and 4) cost value. The first two attributes are taken directly from IDEF0 model, whereas the latter two are to be defined by designers.**

Example of a cost hierarchy

- The cost model forms a hierarchy exactly like the IDEF0 model. Sub-processes are defined down to bottom-level activities that are the most basic elements.

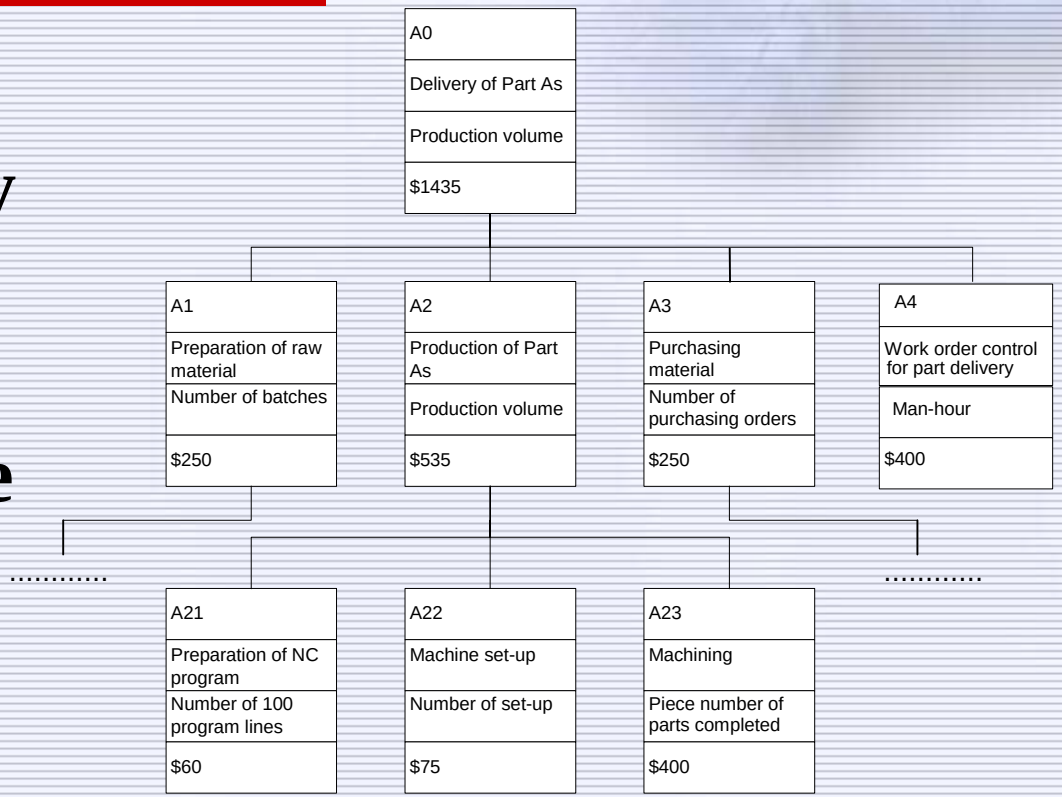

Fig. 2. Example of a cost hierarchy

Treatment of intangible factors

- **AHP Model**
  - **Since investing in CIM is not for the sake of the technology itself, it is important to have the resulting business and manufacturing processes meet the target performance. These operational measures should be derived from the company goals that align with corporate strategies. The questions are 1) whether the invested technology can effectively bring the business to the target, and 2) if the investment is economically sound. Activity-based costing technique discussed in the above slide takes care of the tangible aspect and deals with the second question. Hence, the first question will be handled by using Analytic Hierarchy Process (AHP) method.**

(continue)

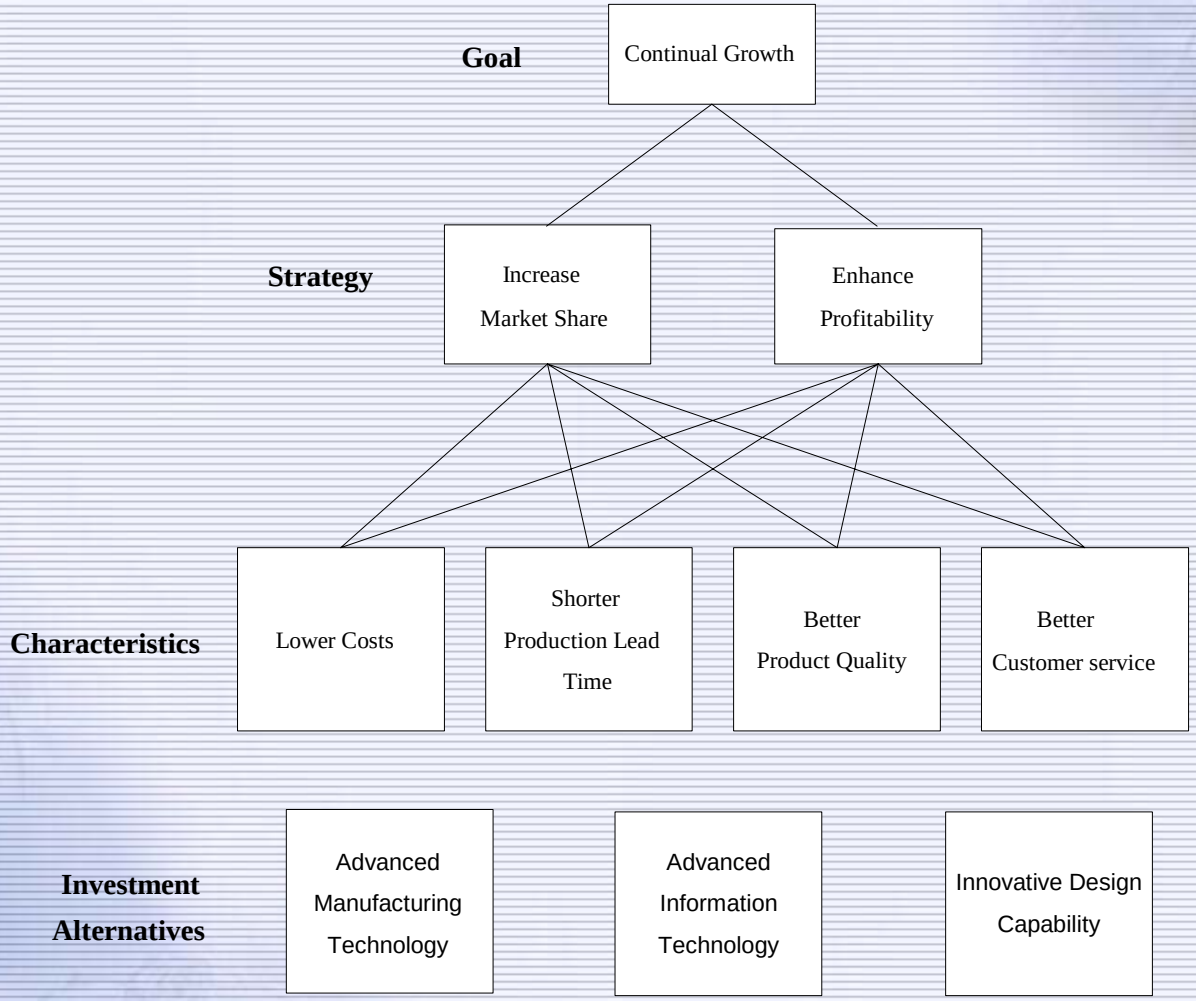

Fig. 3. The hierarchy of advancement investment

Thanks!