

Business Process Simulation

Simulation is the imitation of real things or processes by a simulation model. The model allows to assess the thing/process and experiment with its parameters.

Business Process Simulation (BPS) is the imitation of a real business process by a business process model (e.g., BPMN). The simulation enables you to run what-if analysis for the process, to test process parameters, and to predict the process performance.

Simulation examples:

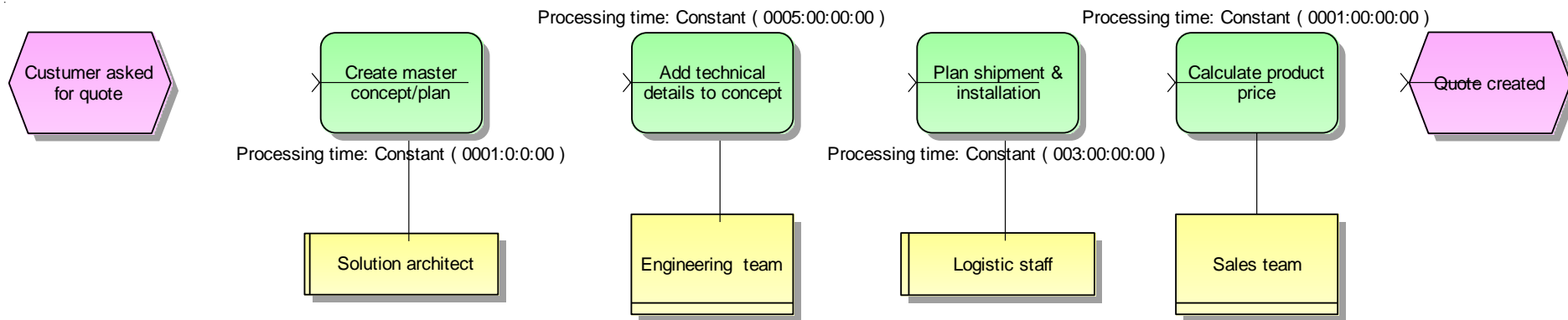
- Flight simulator
- Manufacturing process simulation
- Finance (risk assessment)
- New product models
- Weather forecast
- ...

Business Process Simulation – Deterministic vs. Probabilistic

Deterministic Simulation uses fixed and predefined process times, start events, and process parameters. Each simulation run returns the same result. Allows to run What-if analysis for deterministic process variables or the workflow design.

Probabilistic Simulation varies the parameters of the process model elements by using measured or estimated frequencies. Allows to imitate the real business process by considering arrival rates, process and wait time distributions and other process dynamics.

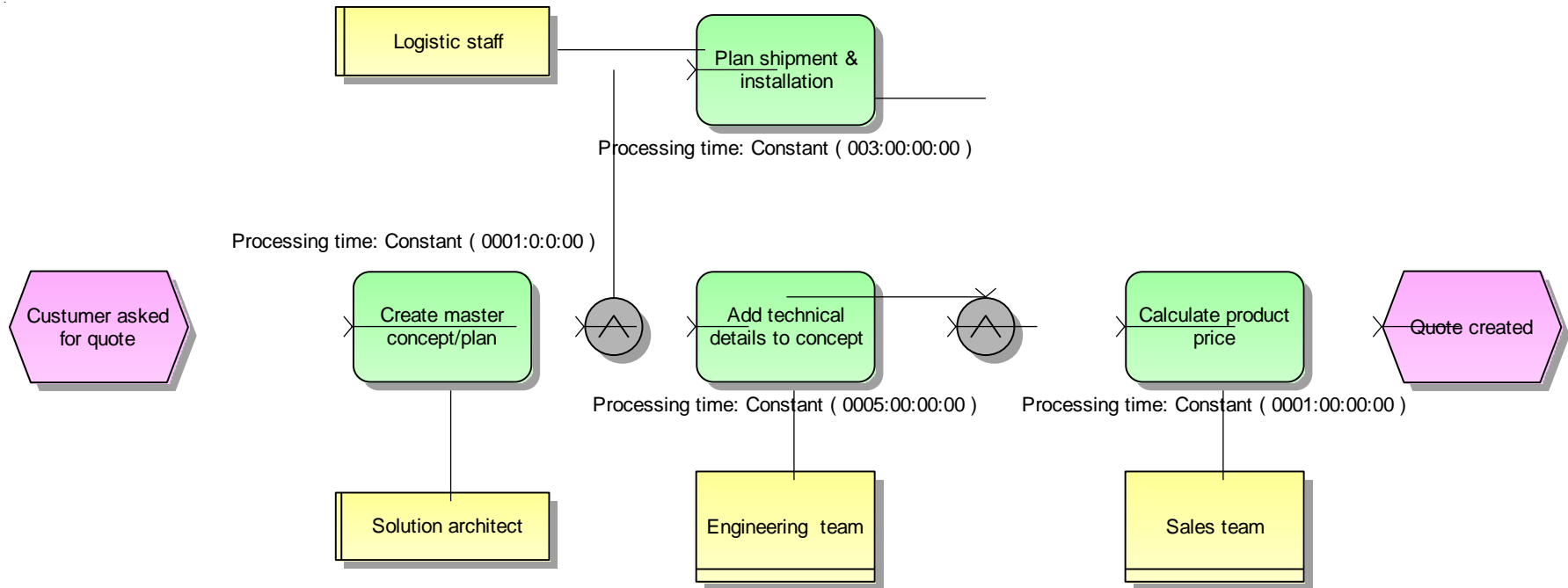
BPS – Deterministic simulation example



Processing time format is day:hours:min:sec

Process cycle time is: 10 days

BPS – Deterministic simulation example (2)



Processing time format is day:hours:min:sec

Process cycle time is: 7 days

BPS – Probabilistic Simulation

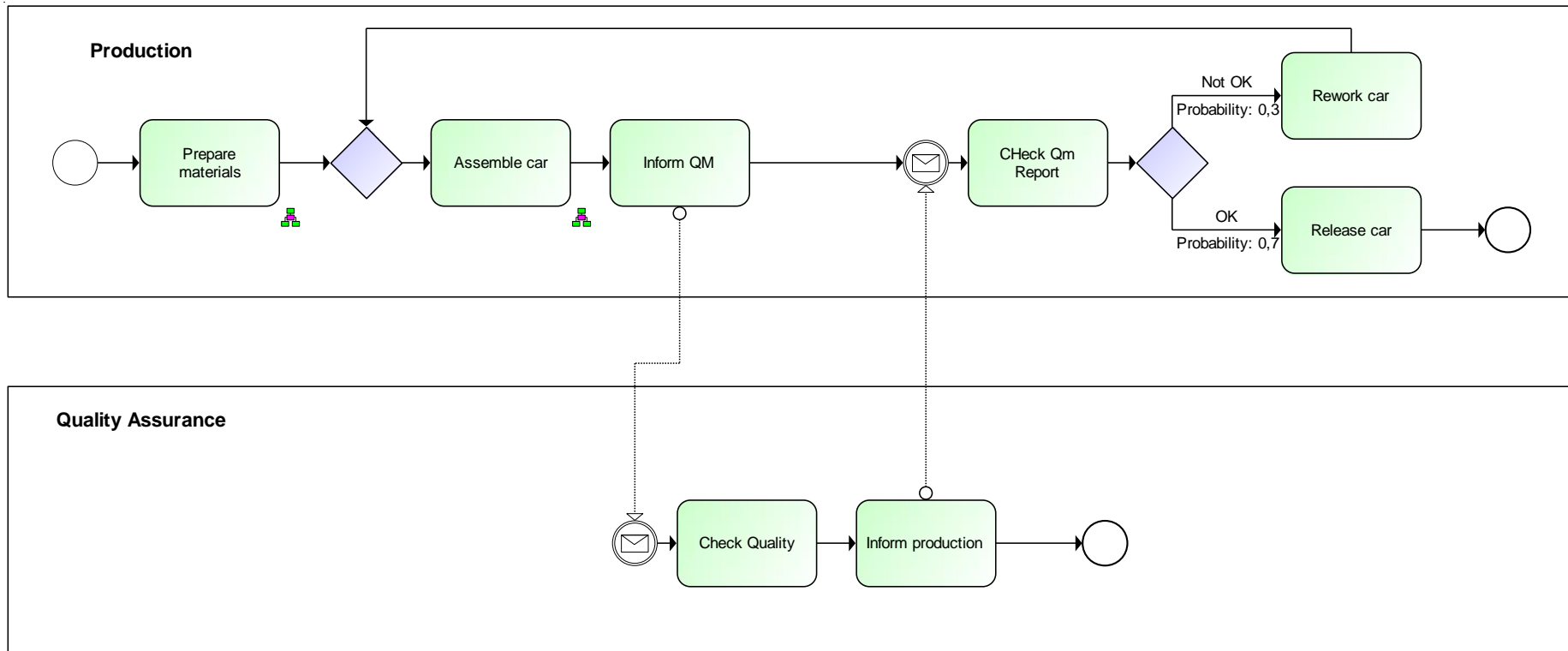
Prerequisites:

- repetitive and frequently executed business processes
- mature processes
- accurate business process model

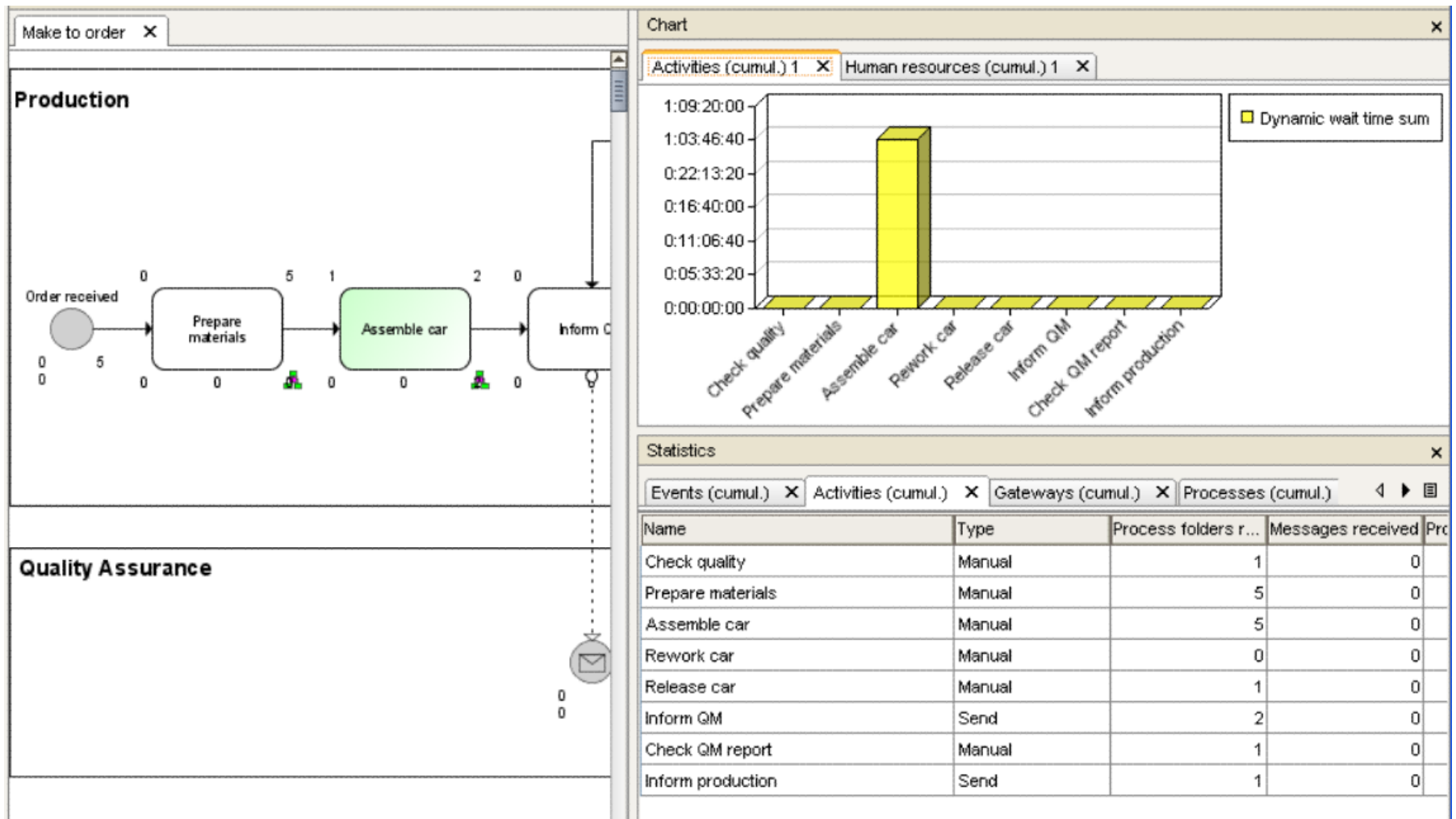
Steps to execute a probabilistic BPS:

1. Define your simulation objective(s) and derive appropriate KPIs.
2. Collect simulation input data (processing times distribution, resources, business rules rule paths probabilities,...)
3. Enhance your model by the simulation information.
4. Validate the model (as-is process) by simulation runs.
5. Define the to-be process.
6. Run the simulation experiments (do several runs!)
7. Collect and analyze the simulation results.

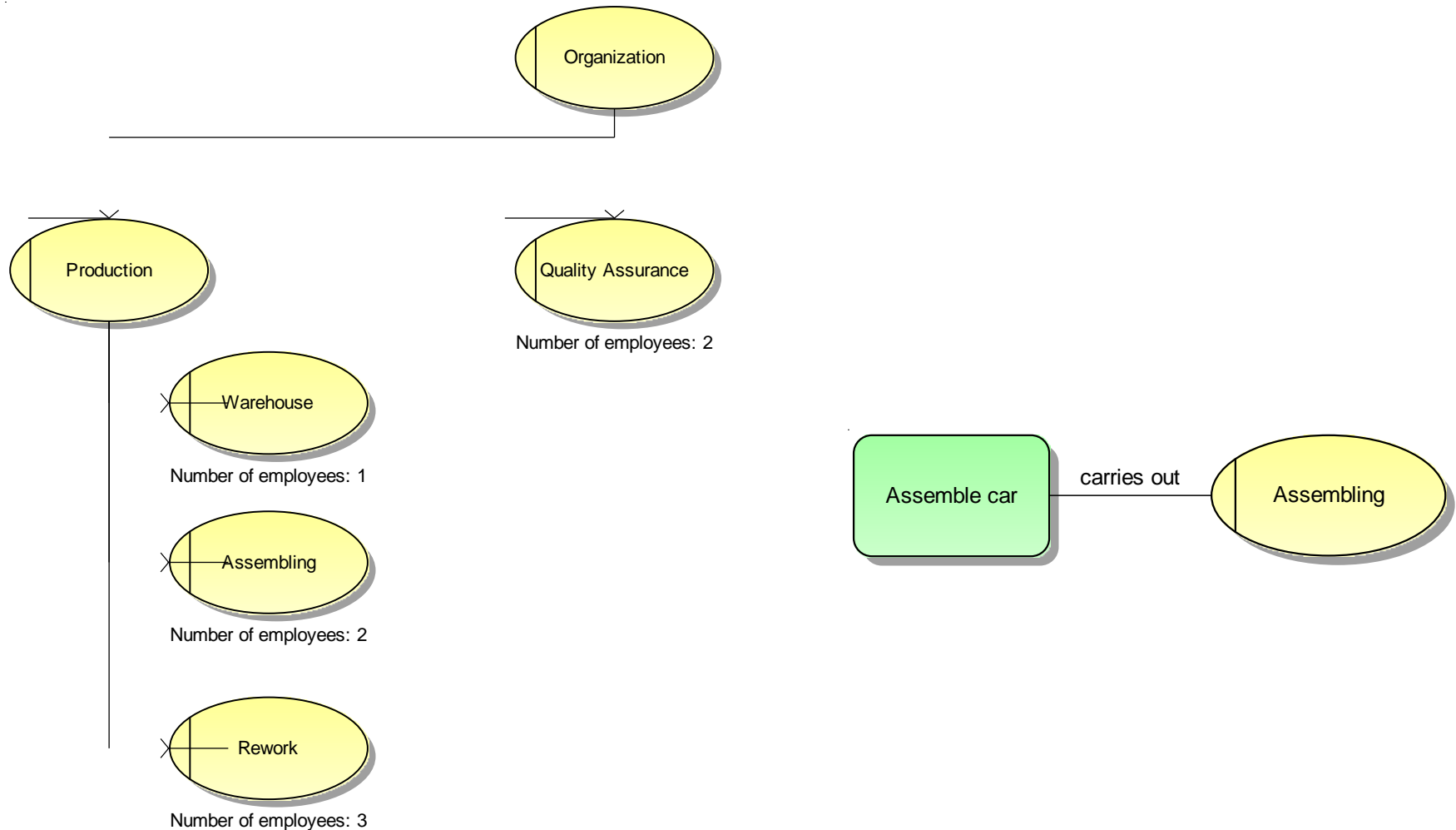
BPS example – Model overview



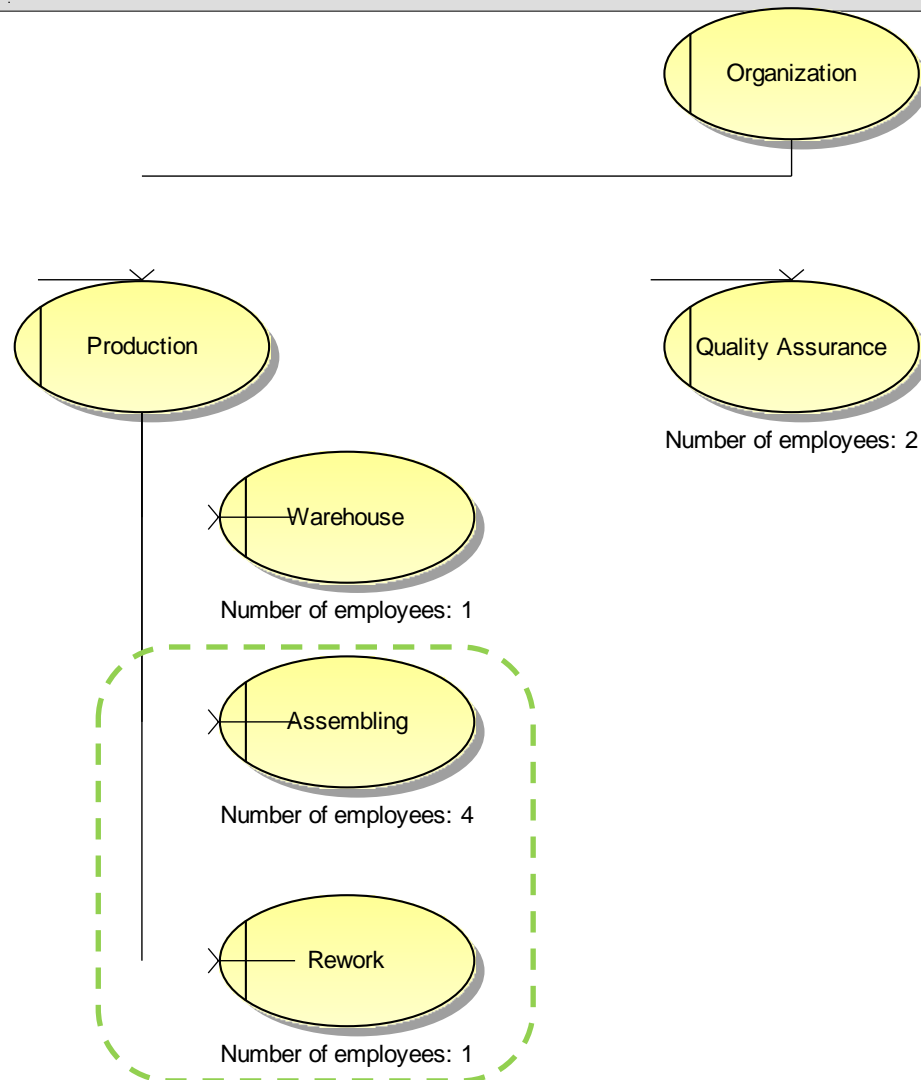
BPS example – Finding the Bottleneck



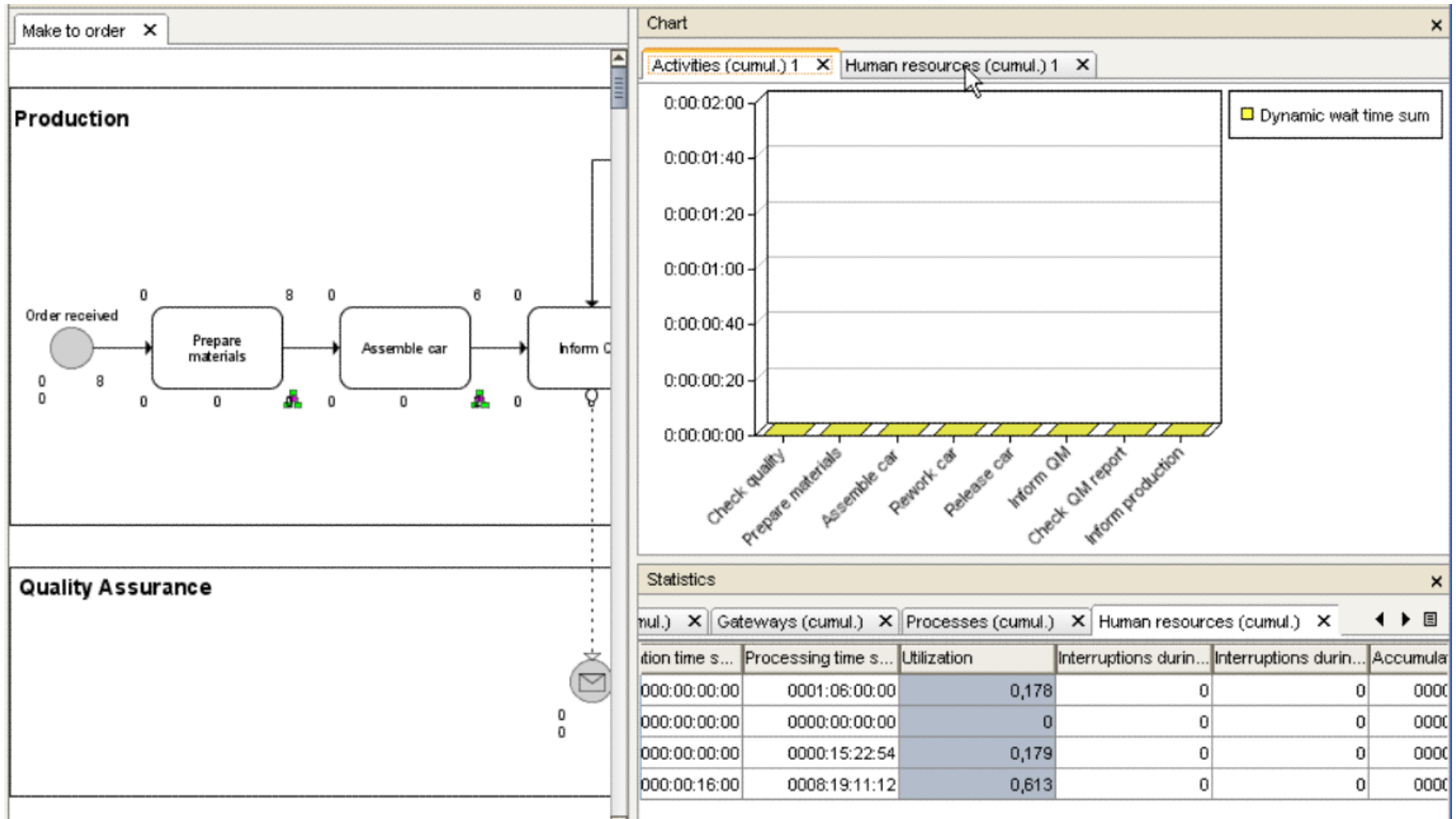
BPS example – Analyzing the bottleneck



BPS example - What-if analysis



BPS example - Rerun simulation



Process Reference Models

Reference models provide **recommendations on standard process models** and **organizational setups** for companies working in the same industry sector. It is up to each individual company to implement the reference model according to its needs.

Process Reference Models:

- Allow to benchmark and challenge internal processes
- Provide knowledge on industry standards and best practices
- Allow to participate on the experiences and background of experts in a specific area
- Gain knowledge on typical process setups and implementation for certain industries
- Support the definition of the To-Be process model
- Open the view beyond the enterprises scope
- ...



Process Reference Models

Reference Models:

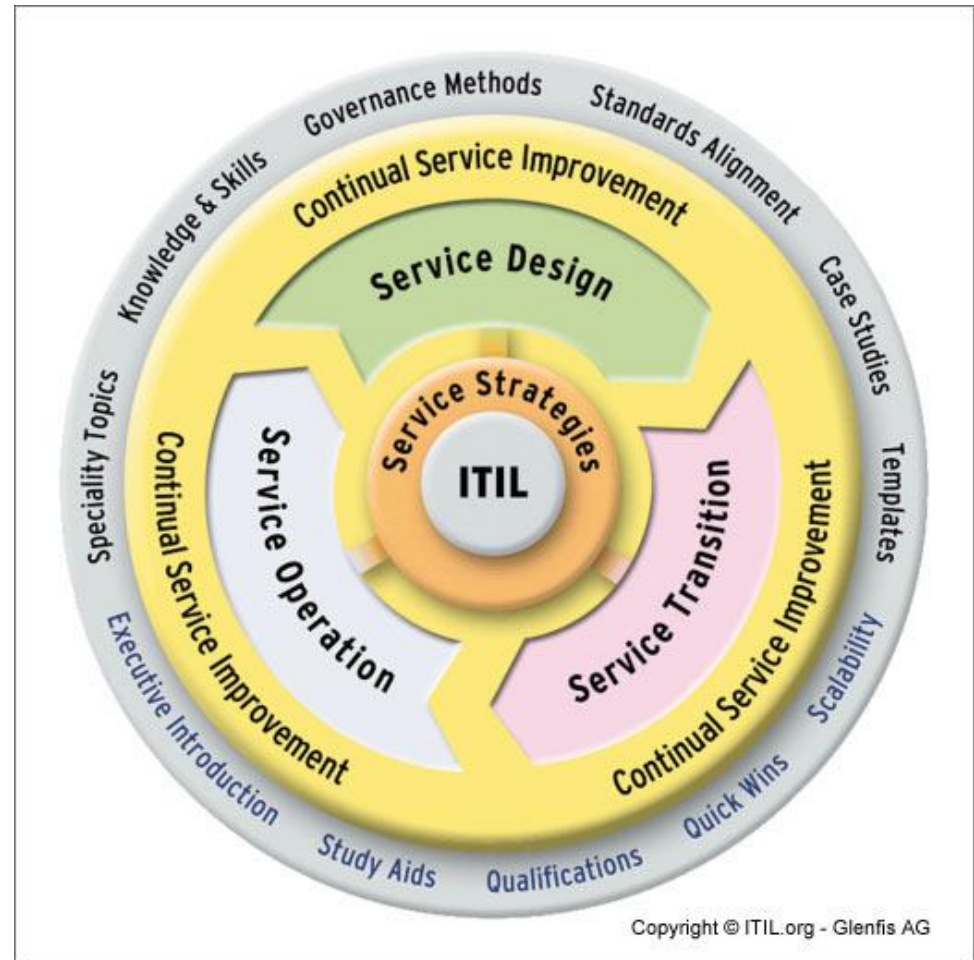
- IT Infrastructure Library (ITIL) - <http://www.itiil-officialsite.com/home/home.asp>
- Supply Chain Operation Reference Model (SCOR) - <https://www.supply-chain.org/>
- ARIS Healthcare Model - http://www.ids-scheer.com/en/ARIS/ARIS_Reference_Models_/ARIS_Healthcare/112181.html
- ...

Process Reference Models: IT Infrastructure Library (ITIL)

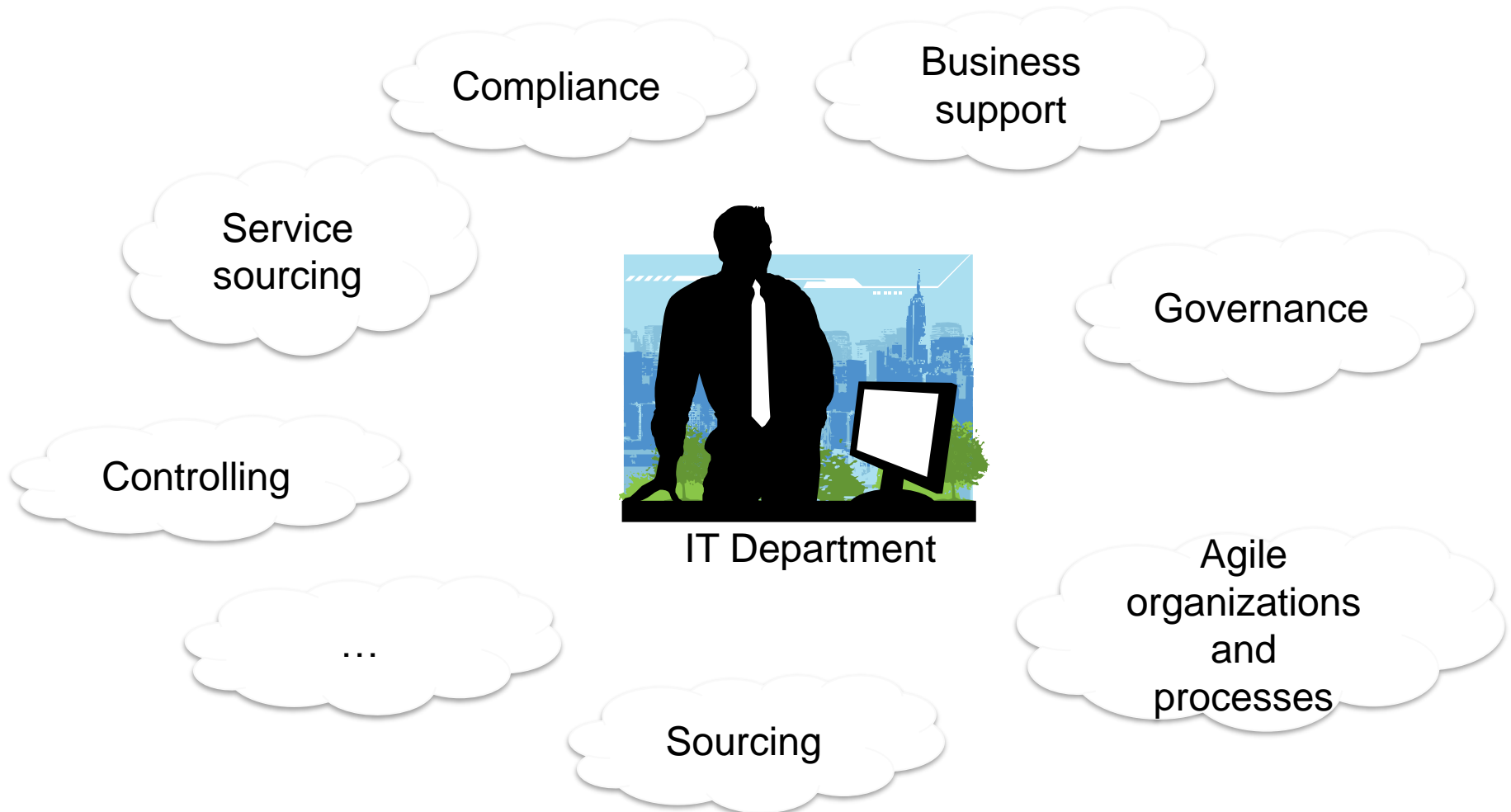
- ITIL framework is a source of good practice in service management.
- ITIL is used by organizations worldwide to establish and improve capabilities in service management
- ITIL supports the management of the complete service lifecycle

ITIL Versions:

- 2000 - ITIL v2
- 2007 – ITIL v3
- 2011 – ITIL Edition 2011



ITIL – Why?



ITIL: IT Services



A **service** is a means of **delivering value to customers** by facilitating outcomes customers want to achieve **without the ownership of specific costs and risks.**
[ITIL v3 Service Strategy]

Service management is a set of specialized organizational **capabilities for providing value to customers** in the form of services.
[ITIL v3 Service Strategy]

ITIL Books (V3)

Service Strategy

- What is our business and who is our customer? Which services need to be offered?
- How can we, as a service provider, differentiate ourselves from competitors?
- Which investments are beneficial?

Service Design

- How should we plan and design our services, architectures, processes, etc.?
- How can the risks and costs resulting from design flaws be reduced?
- How do we ensure that our services will perform as they are designed to do?

Continual Service Improvement

- How do we improve the service quality on a continual basis?
- How do we increase the value our IT services create?
- How do we improve process effectiveness and/or efficiency?

Service Operations

- How do we finally conduct, control, measure and manage our services and processes that are planned by Service Design and implemented by Service Transition?
- Which ongoing, technology-based activities are necessary to deliver and support services?
- How do we handle our day-to-day operations to provide the most value to our customers?



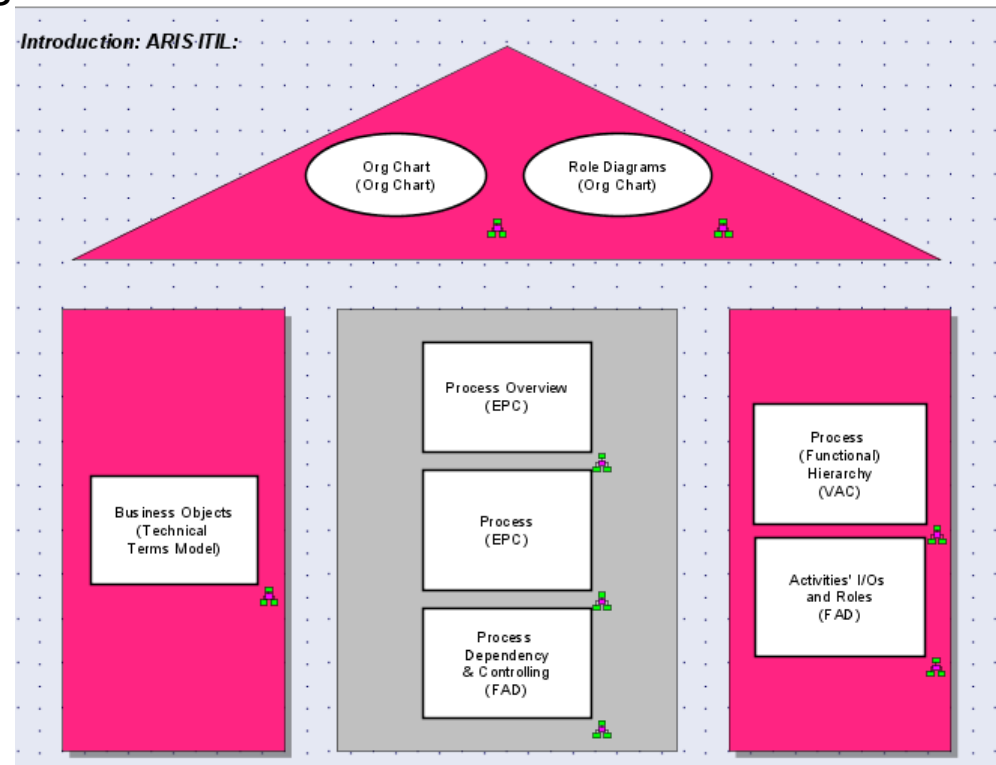
Service Transition

- How do we establish and maintain the integrity of all service assets?
- How do we plan, build, test and deploy the releases into production without adverse effects on the live environment?
- How do we store and present all the information about our service assets to provide relevant insight and knowledge for all processes within the service lifecycle?

ARIS ITIL Reference Model

The ARIS ITIL Model includes:

- Process Hierarchies
- Activity I/Os and Roles
- Example Organisational Charts
- Role Diagrams
- Business Object Models
- Process Models & Dependencies



ITIL – Incident Management

In ITIL terminology, an '**incident**' is defined as:

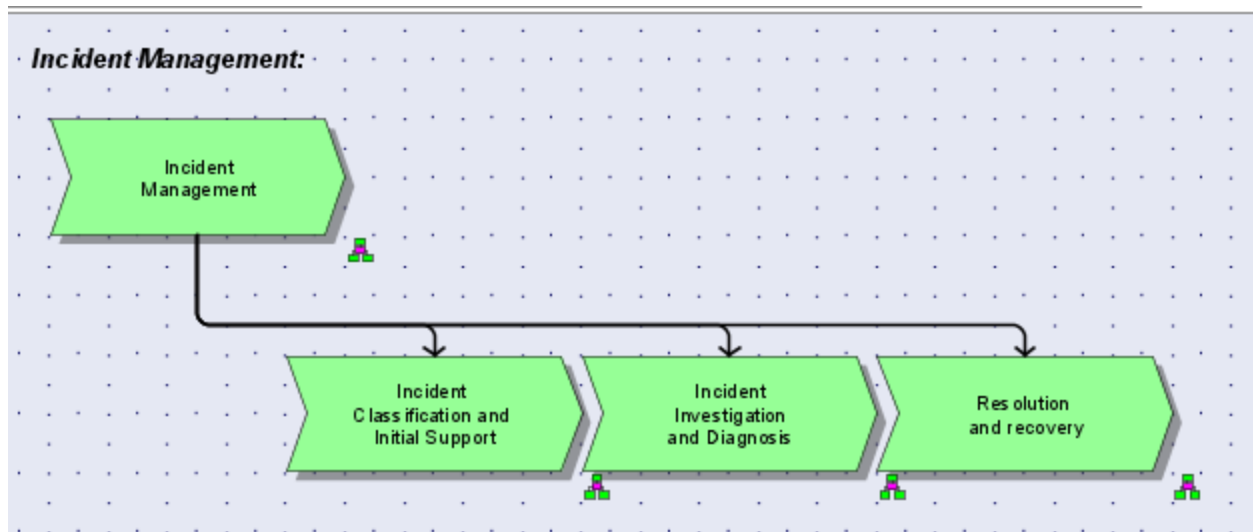
- An unplanned interruption to an IT service or reduction in the quality of an IT service. Failure of a configuration item that has not yet impacted service is also an incident, for example failure of one disk from a mirror set.

Incident Management is the process for dealing with all incidents; this can include failures, questions or queries reported by the users (usually via a telephone call to the Service Desk), by technical staff, or automatically detected and reported by event monitoring tools.

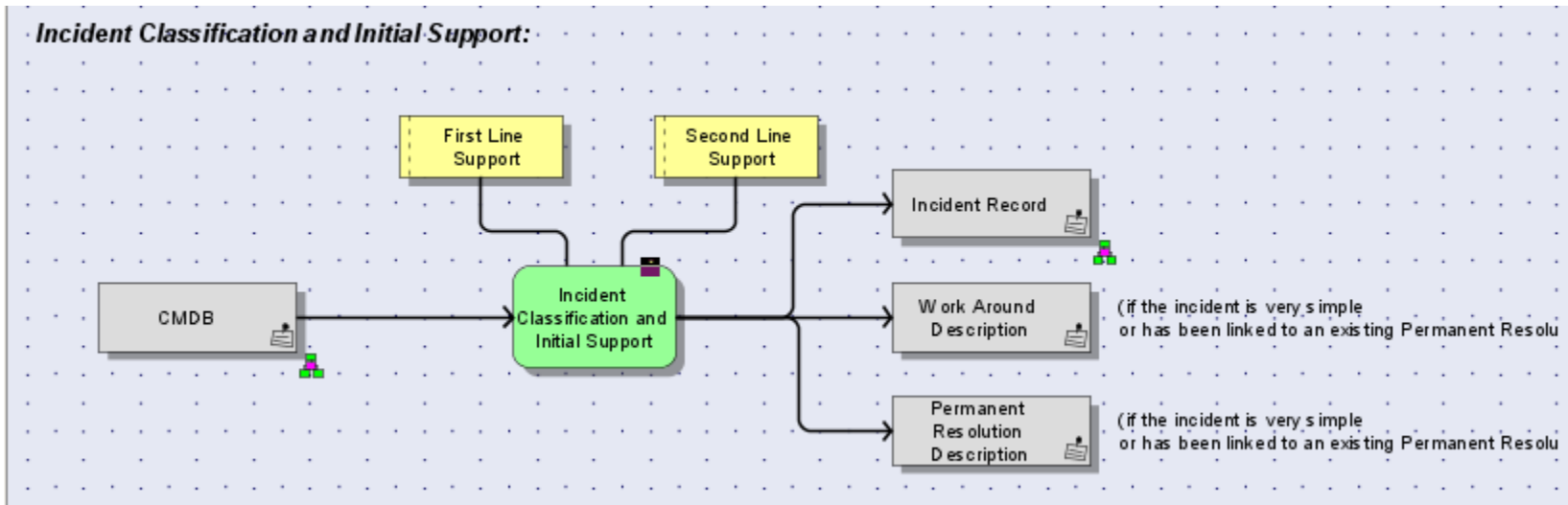
[Source: ITIL v3 Service Operations]



ARIS ITIL Reference Model - Process Hierarchies



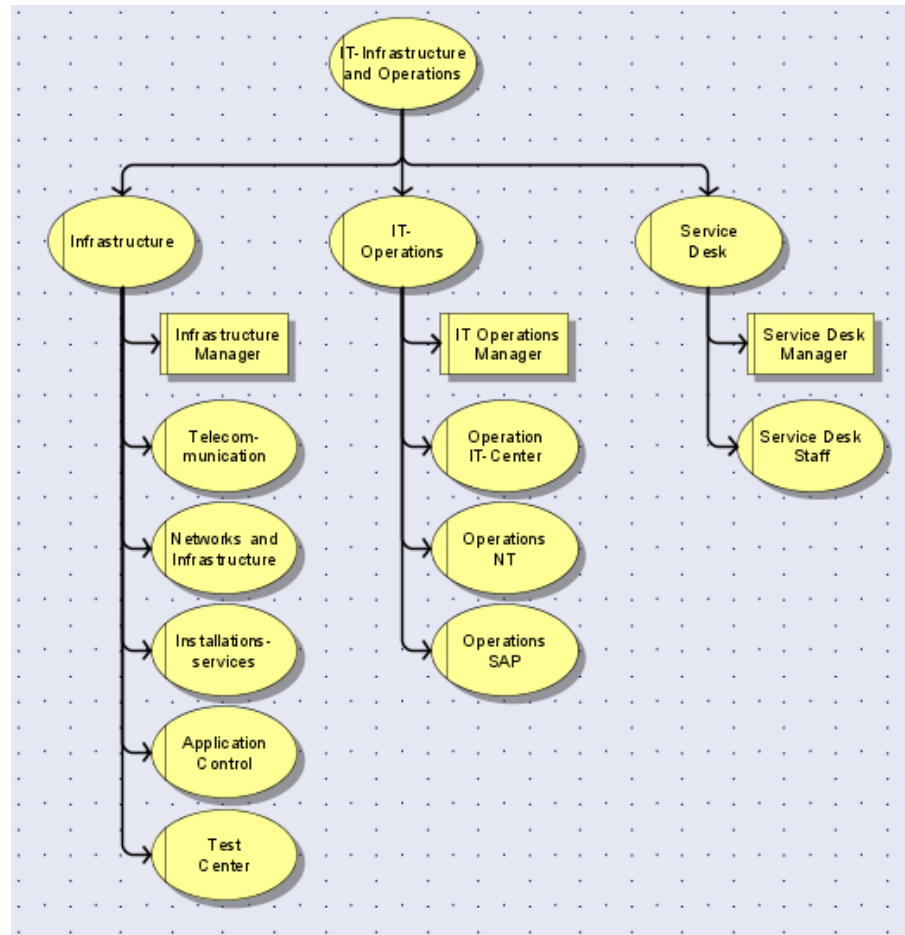
ARIS ITIL Reference Model - Activity I/Os and Roles



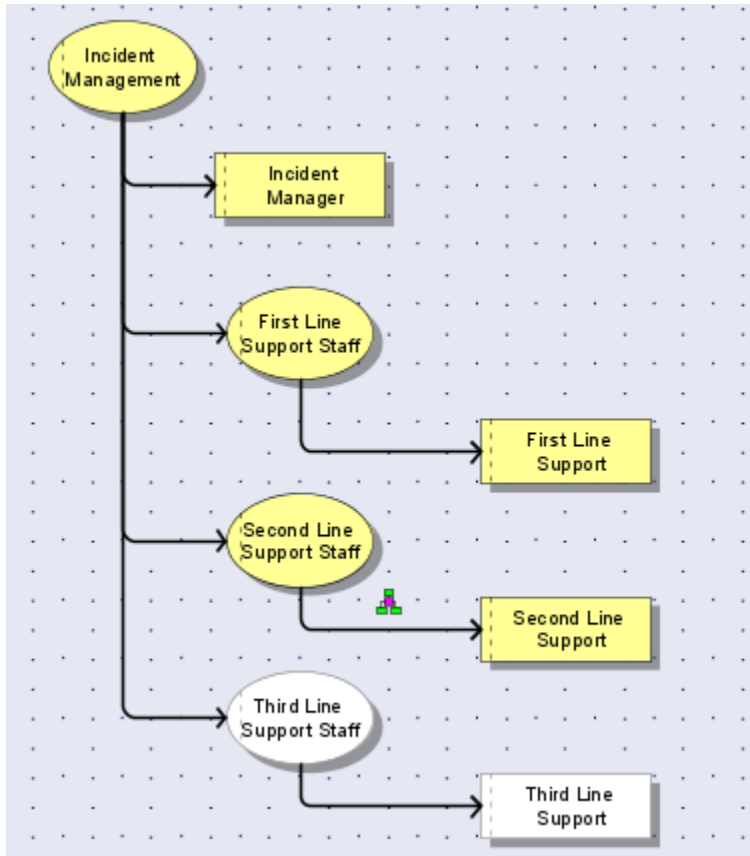
Initial diagnosis

- If the incident has been routed via the Service Desk, the Service Desk Analyst must carry out initial diagnosis, typically while the user is still on the telephone – if the call is raised in this way – to try to discover the full symptoms of the incident and to determine exactly what has gone wrong and how to correct it. It is at this stage that diagnostic scripts and known error information can be most valuable in allowing earlier and accurate diagnosis.
- If possible, the Service Desk Analyst will resolve the incident while the user is still on the telephone – and close the incident if the resolution is successful.

ARIS ITIL Reference Model - Organisational Charts



ARIS ITIL Reference Model – Role Diagrams



6.6.6 Incident Management roles¶

The following roles are needed for the Incident Management process.¶

6.6.6.1 Incident Manager¶

An Incident Manager has the responsibility for:¶

- Driving the efficiency and effectiveness of the Incident Management process.¶
- Producing management information.¶
- Managing the work of incident support staff (first- and second-line).¶
- Monitoring the effectiveness of Incident Management and making recommendations for improvement.¶
- Developing and maintaining the Incident Management systems.¶
- Managing Major Incidents.¶
- Developing and maintaining the Incident Management process and procedures.¶

In many organizations the role of Incident Manager is assigned to the Service Desk Supervisor—though in larger organizations with high volumes a separate role may be necessary. In either case it is important that the Incident Manager is given the authority to manage incidents effectively through first, second and third line.¶

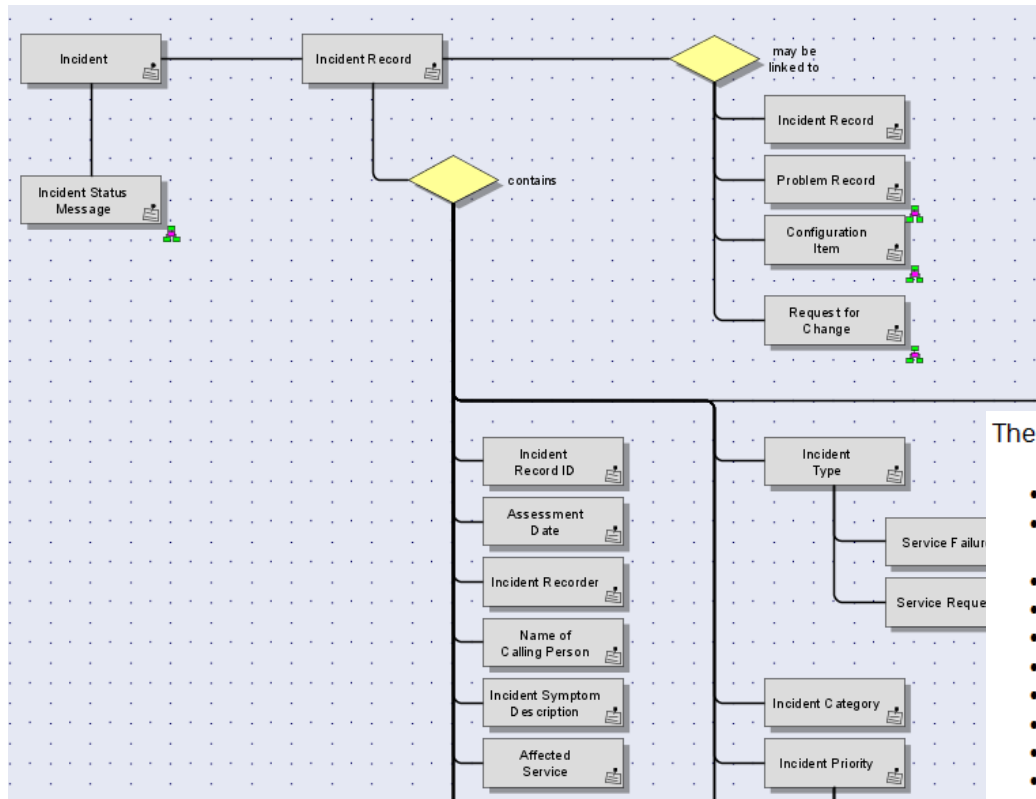
6.6.6.2 First line¶

This is covered in detail under the Service Desk (section 6.1) and will not be repeated here.¶

6.6.6.3 Second line¶

Many organizations will choose to have a second-line support group, made up of staff with greater (though still general) technical skills than the Service Desk—

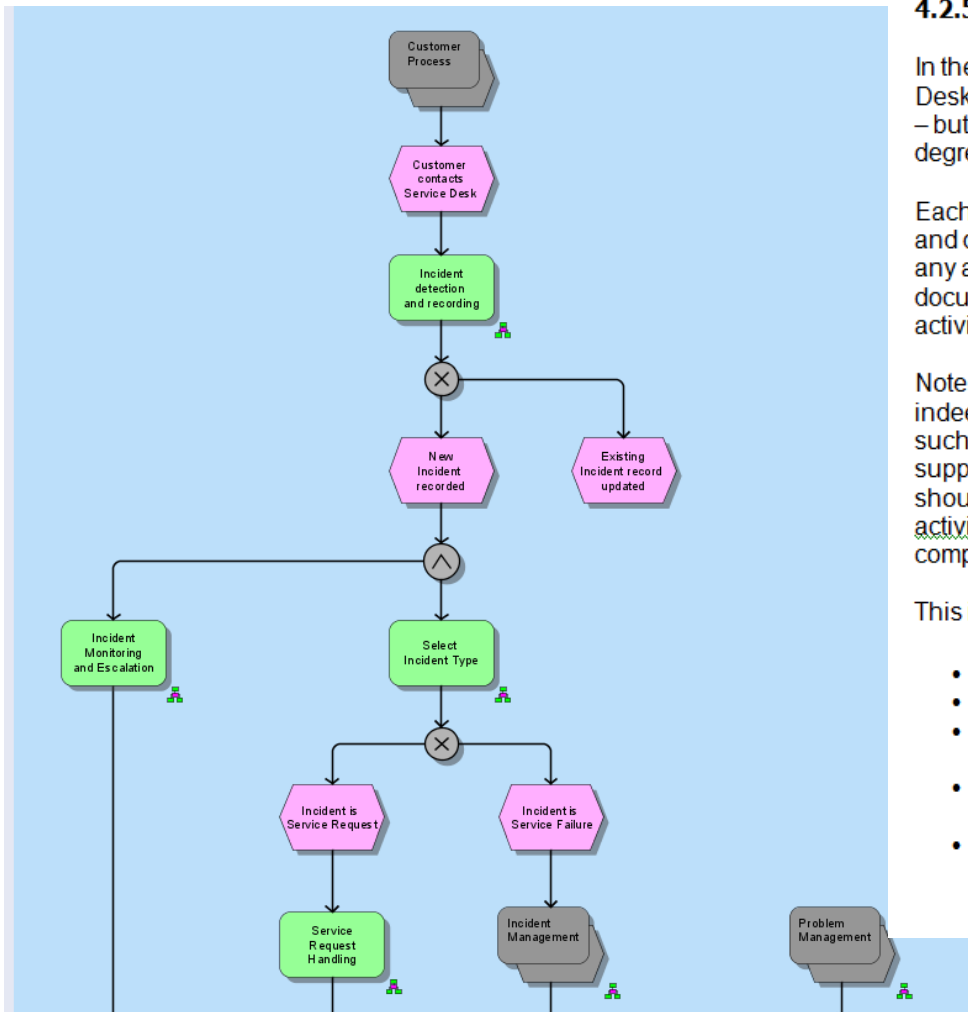
ARIS ITIL Reference Model – Business Object Models



The information needed for each incident is likely to include:

- Unique reference number
- Incident categorization (often broken down into between two and four levels of sub-categories)
- Incident **urgency**
- Incident **impact**
- Incident prioritization
- Date/time recorded
- Name/ID of the person and/or group recording the incident
- Method of notification (telephone, automatic, e-mail, in person, etc.)
- Name/department/phone/location of **user**
- Call-back method (telephone, mail, etc.)
- Description of symptoms
- Incident **status** (active, waiting, **closed**, etc.)
- Related CI
- Support group/person to which the incident is allocated
- Related **problem/Known Error**
- Activities undertaken to resolve the incident
- **Resolution** date and time

ARIS ITIL Reference Model – Process Models



4.2.5.7 Investigation and Diagnosis

In the case of incidents where the user is just seeking information, the Service Desk should be able to provide this fairly quickly and resolve the service request – but if a **fault** is being reported, this is an incident and likely to require some degree of investigation and **diagnosis**.

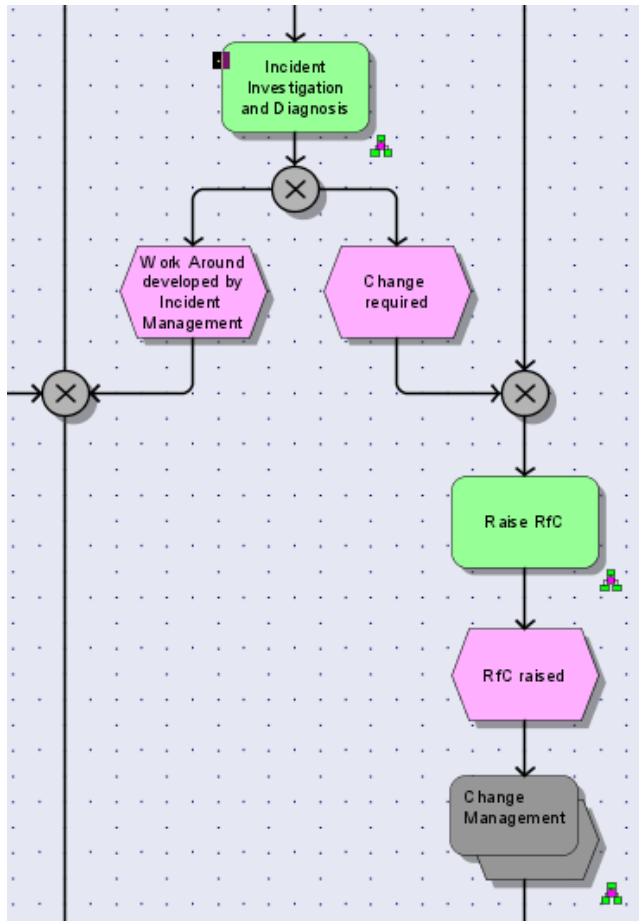
Each of the support groups involved with the incident handling will investigate and diagnose what has gone wrong – and all such activities (including details of any actions taken to try to resolve or re-create the incident) should be fully documented in the incident record so that a complete historical **record** of all activities is maintained at all times.

Note: Valuable time can often be lost if investigation and diagnostic action (or indeed **resolution** or **recovery** actions) are performed serially. Where possible, such activities should be performed in parallel to reduce overall timescales – and support tools should be designed and/or selected to allow this. However, care should be taken to coordinate activities, particularly resolution or recovery **activities**, otherwise the actions of different groups may conflict or further complicate a resolution!

This investigation is likely to include such actions as:

- Establishing exactly what has gone wrong or being sought by the user
- Understanding the chronological order of **events**
- Confirming the full **impact** of the incident, including the number and range of users affected
- Identifying any events that could have triggered the incident (e.g. a recent **change**, some user action?)
- Knowledge searches looking for previous occurrences by searching previous **Incident/Problem Records** and/or **Known Error Databases** or manufacturers'/**suppliers'** Error Logs or Knowledge Databases.

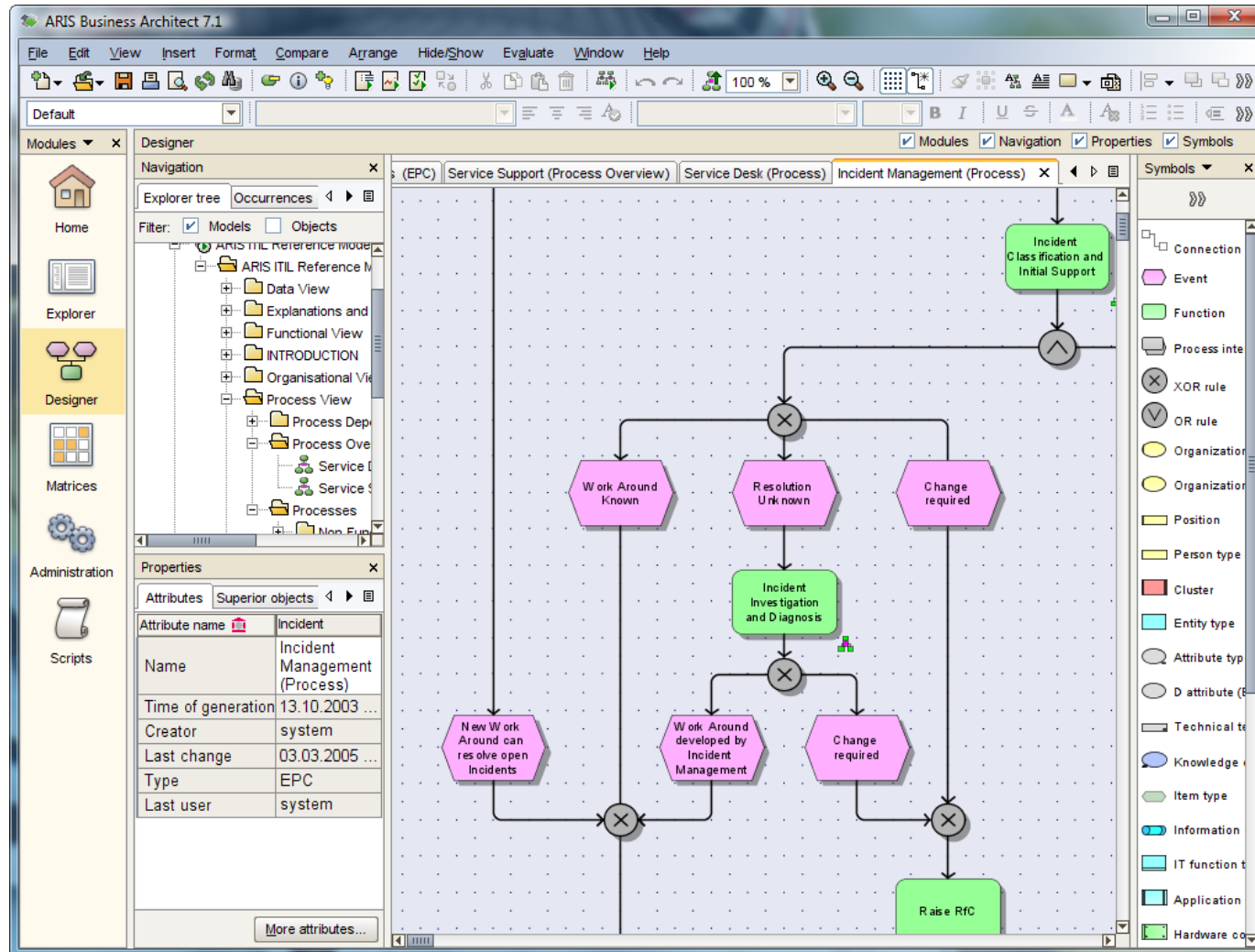
ARIS ITIL Reference Model – Process Dependencies



The interfaces with **Incident Management** include:

- **Problem Management:** Incident Management forms part of the overall process of dealing with problems in the organization. Incidents are often caused by underlying problems, which must be solved to prevent the incident from recurring. Incident Management provides a point where these are reported.
- **Configuration Management** provides the data used to identify and progress incidents. One of the uses of the CMS is to identify faulty equipment and to assess the impact of an incident. It is also used to identify the users affected by potential problems. The CMS also contains information about which categories of incident should be assigned to which support group. In turn, Incident Management can maintain the status of faulty CIs. It can also assist Configuration Management to audit the infrastructure when working to resolve an incident.
- **Change Management:** Where a change is required to implement a workaround or resolution, this will need to be logged as an RFC and progressed through Change Management. In turn, Incident Management is able to detect and resolve incidents that arise from failed changes.
- **Capacity Management:** Incident Management provides a trigger for

ARIS ITIL Reference Model - Demo



Process Reference Models: ARIS Healthcare Reference Model

[Homepage](#) > [ARIS](#) > [ARIS Reference Models](#)

ARIS Healthcare

The Professional Tool for Optimizing Healthcare Processes



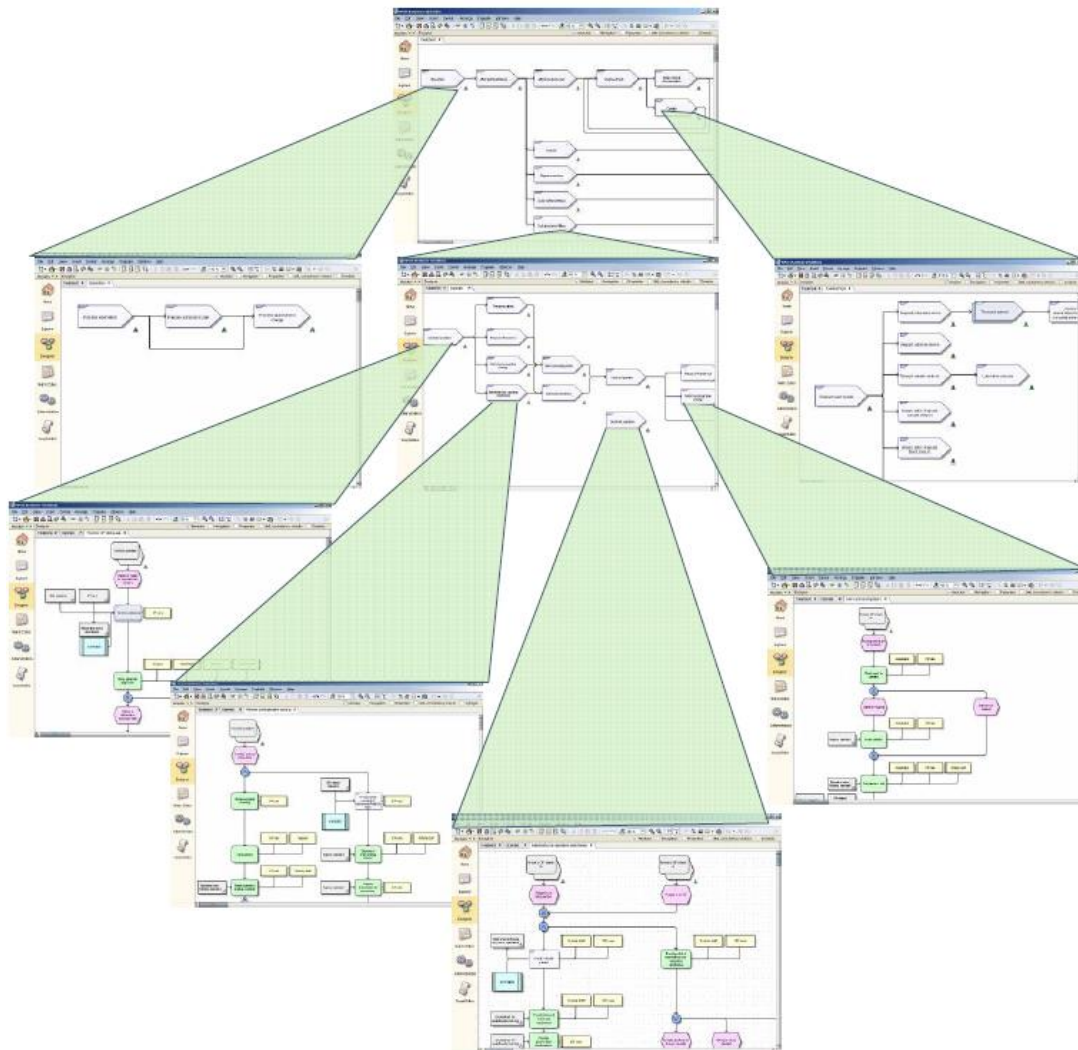
ARIS Healthcare provides healthcare companies and institutions with a fast and effective way to get started with business process optimization, based on an ARIS database containing comprehensive best practice experience from a host of healthcare projects. Instead of starting their modeling from scratch, organizations can leverage proven results, regardless of whether the processes involve complex treatments

or interactions across institutional boundaries.

Your Benefits:

- ▶ Comprehensive reference model for healthcare processes and related structures across multiple process levels.
- ▶ Flexible configuration of the predefined processes to existing situations.
- ▶ Sophisticated functionality for analyzing processes prior to implementation, making it possible to pinpoint bottlenecks, compare alternative process options, identify system/organization breaks, and more.
- ▶ Identify required information system capabilities: After configuring and enhancing the process repository, ARIS Platform can easily integrate the company-specific models with major enterprise-wide applications, including SAP and business process execution products.
- ▶ Compare process performance to targets: After allocating predefined KPIs and defining performance targets for the processes, companies can measure and compare their process performance based on the KPIs.

ARIS Healthcare Reference Model - Level



Process Area Map (Level 1)

Your access into the value chains. Viewing and customizing the Reference Models is simple. The models are easy to understand and work with.



Main Process Models (Level 2)

Expresses context as a subset of the company's Process Area Map processes. ARIS Reference Models give you the flexibility to configure your processes, using the Reference Models as a template. The models can also be shared over your network to facilitate communication about process issues.



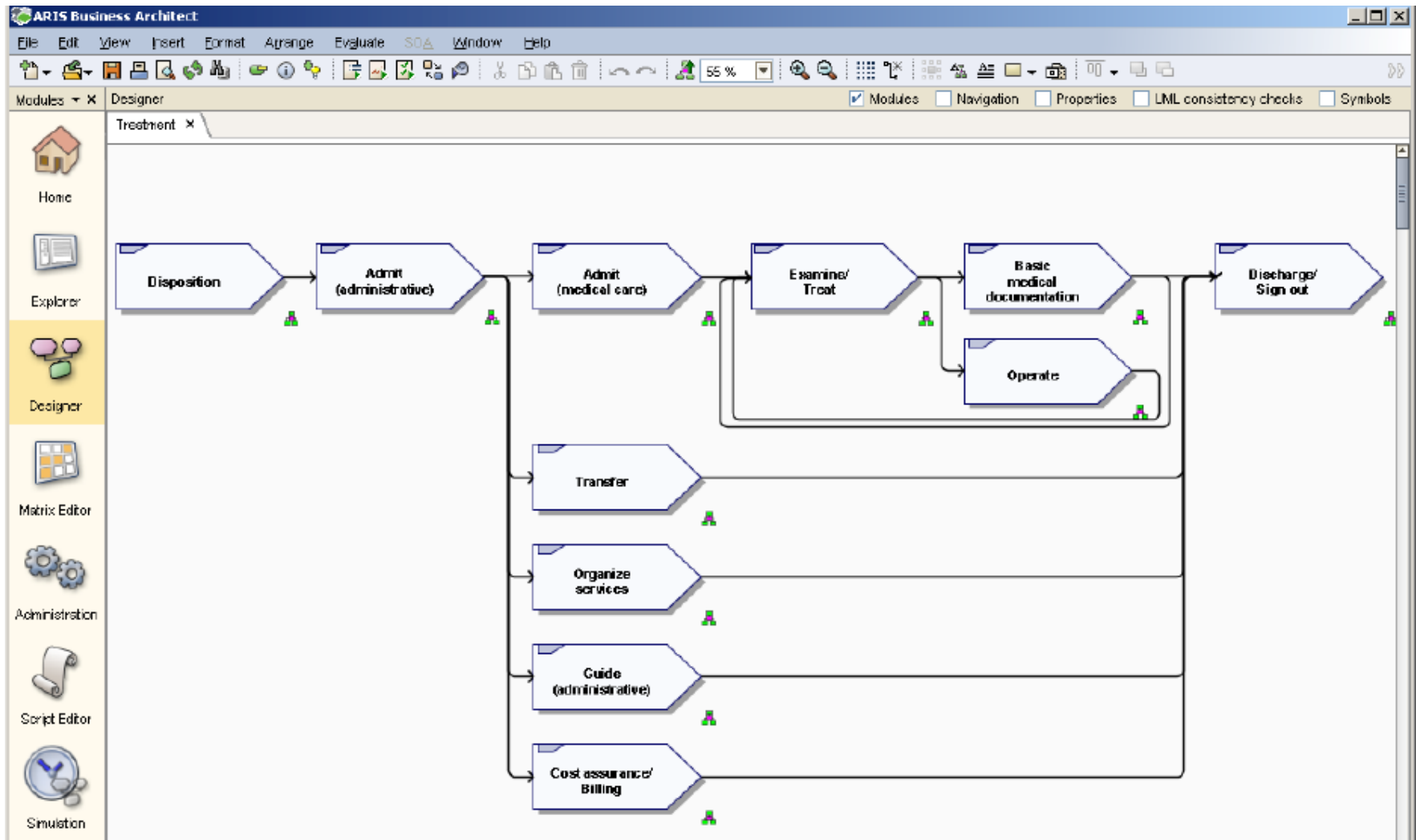
Process Models (Level 3) including Data Input / Output and Organization

What are the key steps that make up your process configuration? At this level, you can look at data elements upon which your processes rely. With ARIS, you can also look at additional relevant information, such as systems and human resources. ARIS Reference Models give you the ability to quickly and easily expand the scope of the business model.

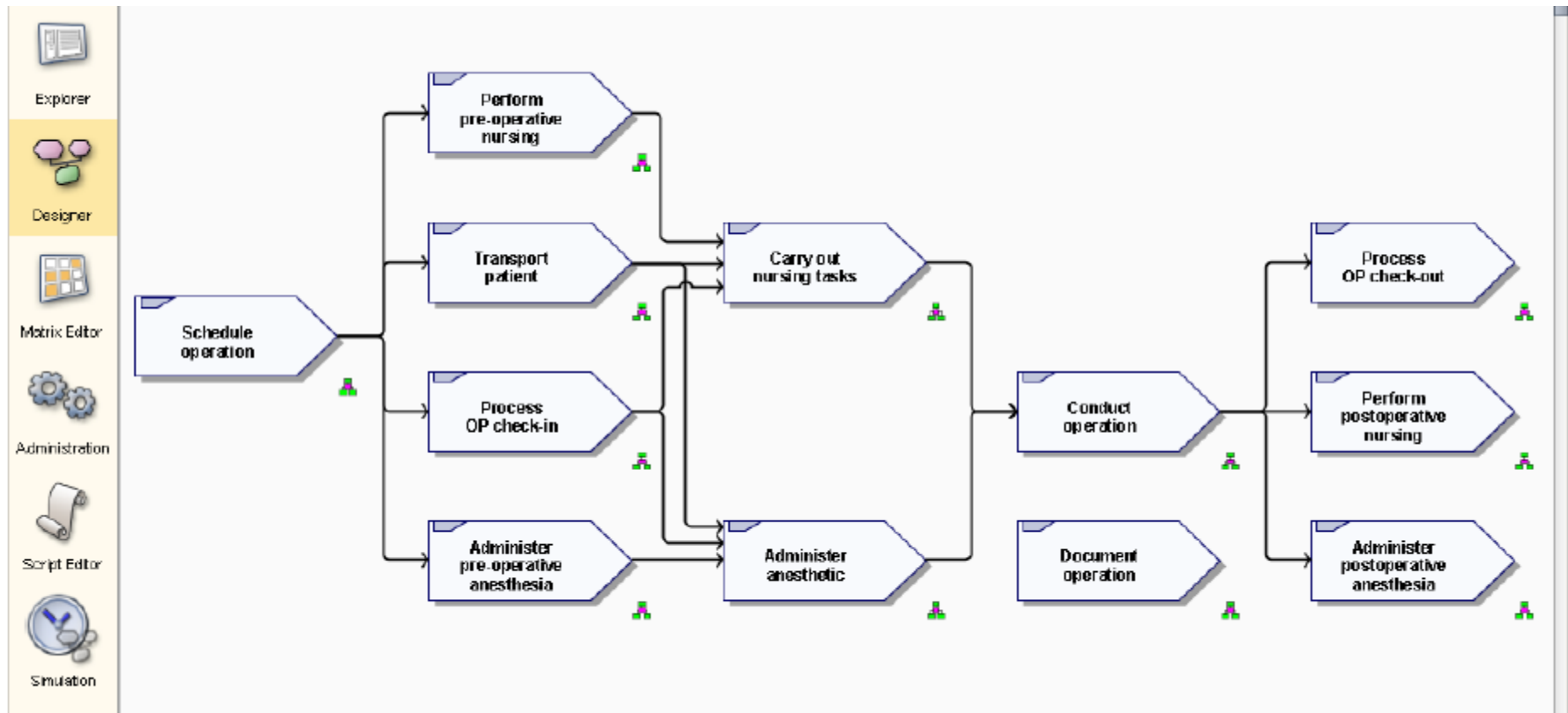
Take advantage of the world's number-one process modeling tools to help achieve a competitive advantage and adapt to changing conditions in your market.

ARIS Reference Models facilitate customization, analysis, and fine-tuning of your value chain procedures with easy to use modeling functionality. IDS can also support you in performing process measurement, as well as static and dynamic analysis with ARIS, our top-ranked process analysis tool.

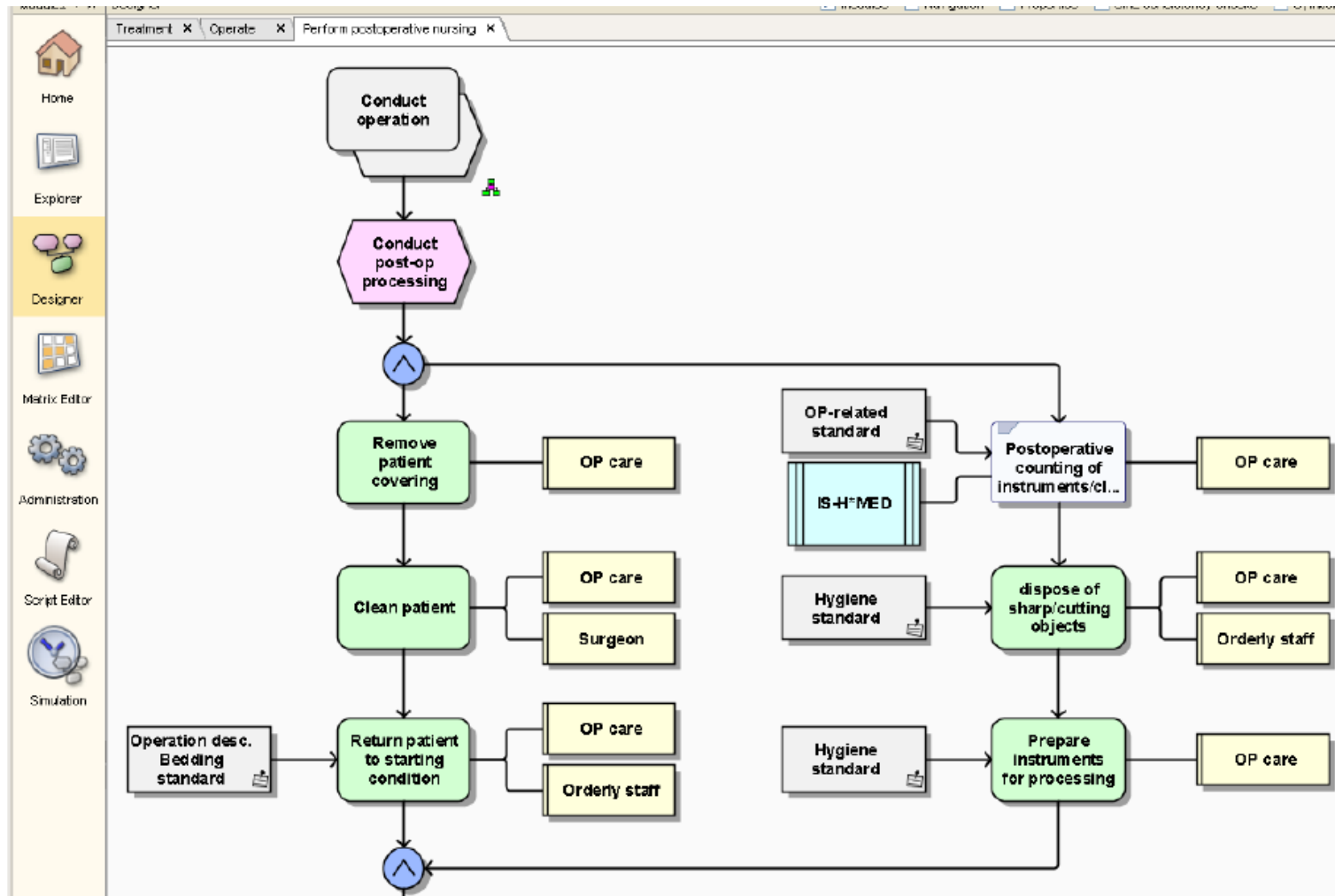
ARIS Healthcare Reference Model - Level 1



ARIS Healthcare Reference Model - Level 2



ARIS Healthcare Reference Model - Level 3



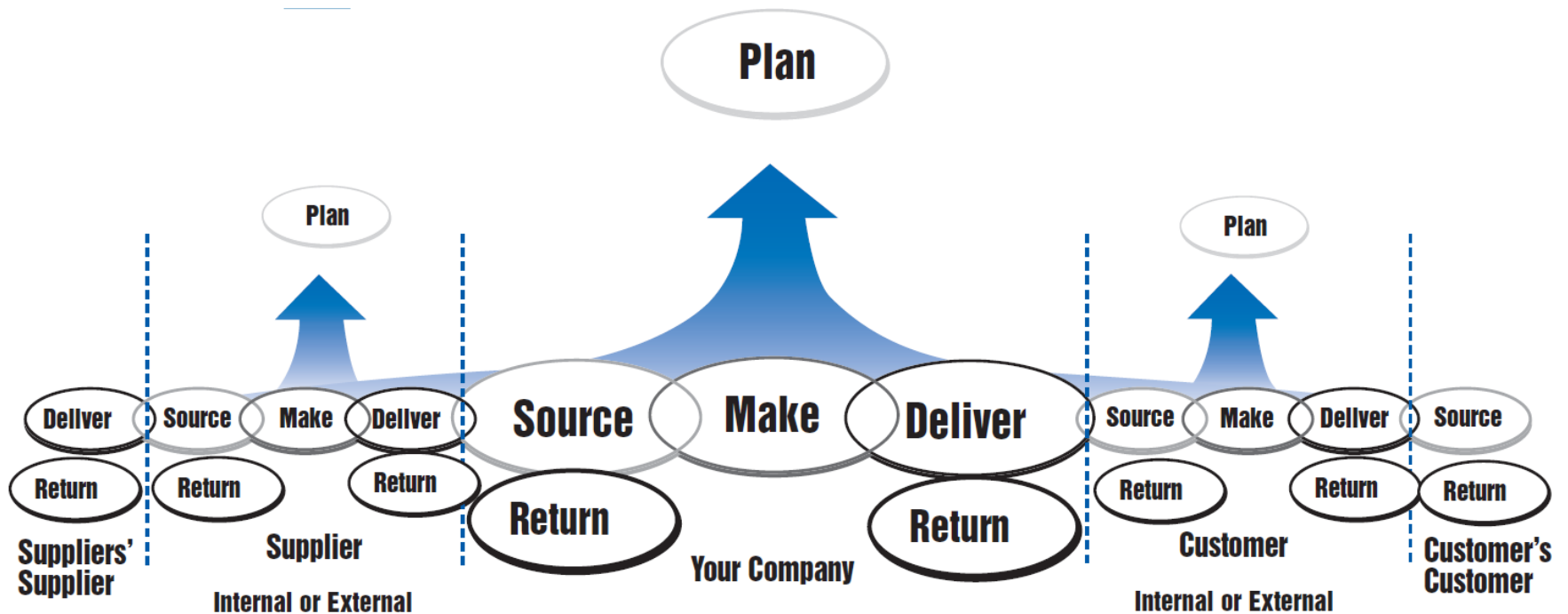
Process Reference Models: Supply Chain Operations Reference Model (SCOR)

The Supply Chain Operations Reference model (SCOR) is the product of the Supply Chain Council, Inc. (SCC), an independent, not-for-profit, global corporation with membership open to all companies and organizations interested in applying and advancing the state-of-the-art in supply chain management systems and practices. [Source: <http://www.supply-chain.org/about/scor/what/is>]

SCOR covers:

- All customer interactions, from order entry through paid invoice
- All product (physical material and service) transactions, from the supplier's supplier to the customer's customer, including equipment, supplies, spare parts, bulk product, software, etc.
- All market interactions, from the understanding of aggregate demand to the fulfillment of each order
- Information exchange between the business partners in the supply chain

SCOR – Areas of use

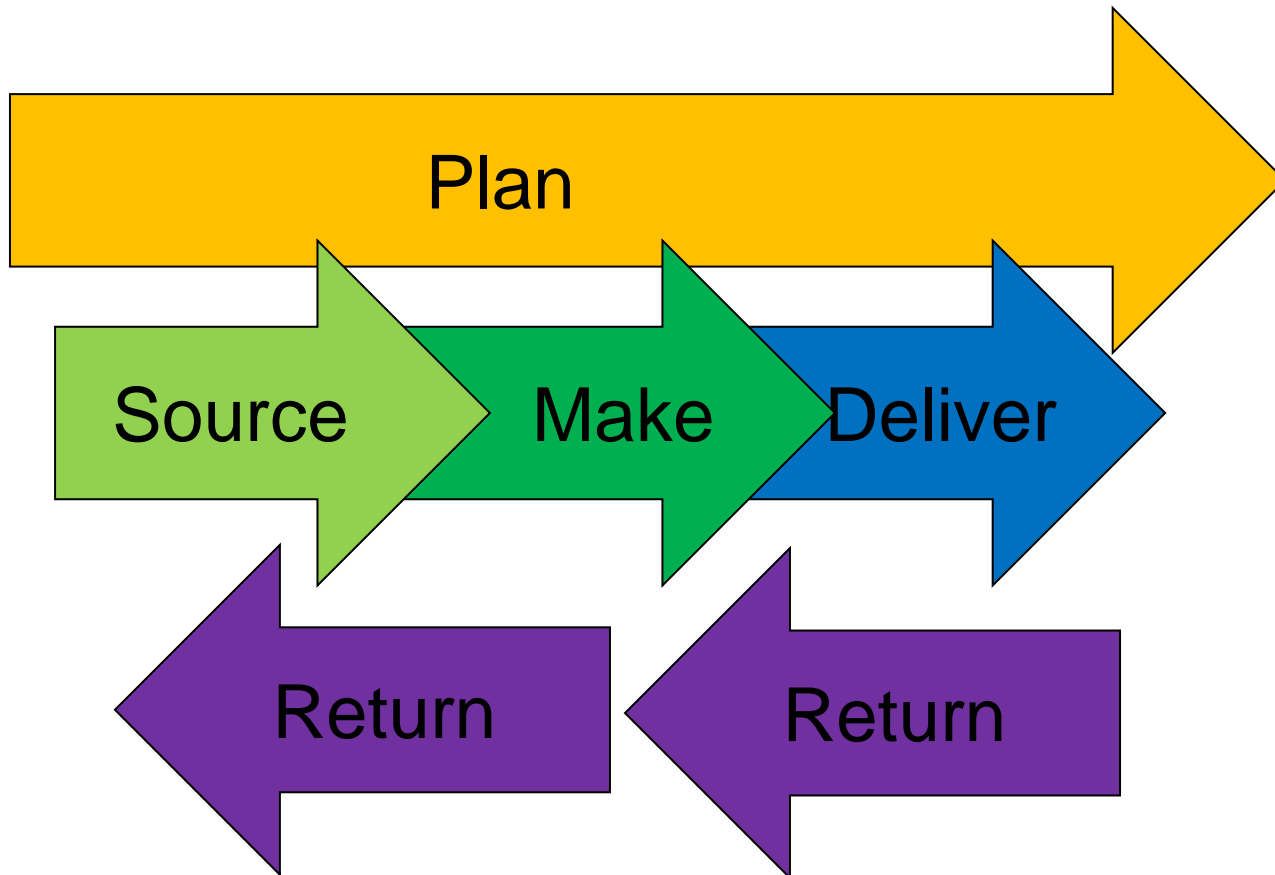


SCOR – Areas of use (2)

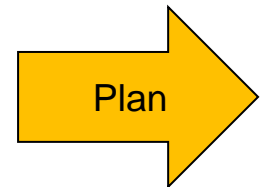
- Supply chain documentation (internal + business partners)
 - Documentation
 - Formal model for communication w/ suppliers and customers
- Process Assessments /Improvement
 - Benchmarking
 - Best Practices
 - Definition of the To-Be processes
- Information system design/requirements engineering
 - Vendor assessment
 - Definition of requirements on SCM Tooling



SCOR Process Model



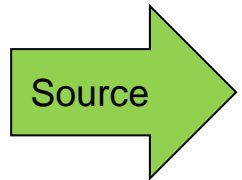
SCOR Process Model



Demand/Supply Planning and Management

- Balance resources with requirements and establish/communicate plans for the whole supply chain, including Return, and the execution processes of Source, Make, and Deliver.
- Management of business rules, supply chain performance, data collection, inventory, capital assets, transportation, planning configuration, regulatory requirements and compliance, and supply chain risk.
- Align the supply chain unit plan with the financial plan.

SCOR Process Model



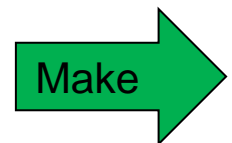
Sourcing Stocked, Make-to-Order, and Engineer-to-Order Product

- Schedule deliveries; receive, verify, and transfer product; and authorize supplier payments.
- Identify and select supply sources when not predetermined, as for engineer-to-order product.
- Manage business rules, assess supplier performance, and maintain data.
- Manage inventory, capital assets, incoming product, supplier network, import/export requirements, supplier agreements, and supply chain source risk.

SCOR Process Model

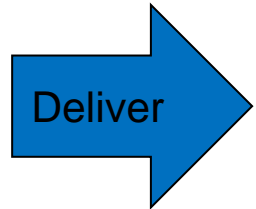
Make-to-Stock, Make-to-Order, and Engineer-to-Order Production Execution

- Schedule production activities, issue product, produce and test, package, stage product, and release product to deliver. With the addition of Green to SCOR, there are now processes specifically for Waste Disposal in MAKE.
- Finalize engineering for engineer-to-order product.
- Manage rules, performance, data, in-process products (WIP), equipment and facilities, transportation, production network, regulatory compliance for production, and supply chain make risk.



SCOR Process Model

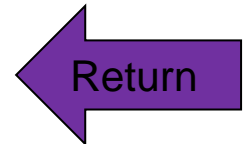
Order, Warehouse, Transportation, and Installation Management for Stocked, Make-to-Order, and Engineer-to-Order Product



- All order management steps from processing customer inquiries and quotes to routing shipments and selecting carriers.
- Warehouse management from receiving and picking product to load and ship product.
- Receive and verify product at customer site and install, if necessary.
- Invoicing customer.
- Manage Deliver business rules, performance, information, finished product inventories, capital assets, transportation, product life cycle, import/export requirements, and supply chain deliver risk.

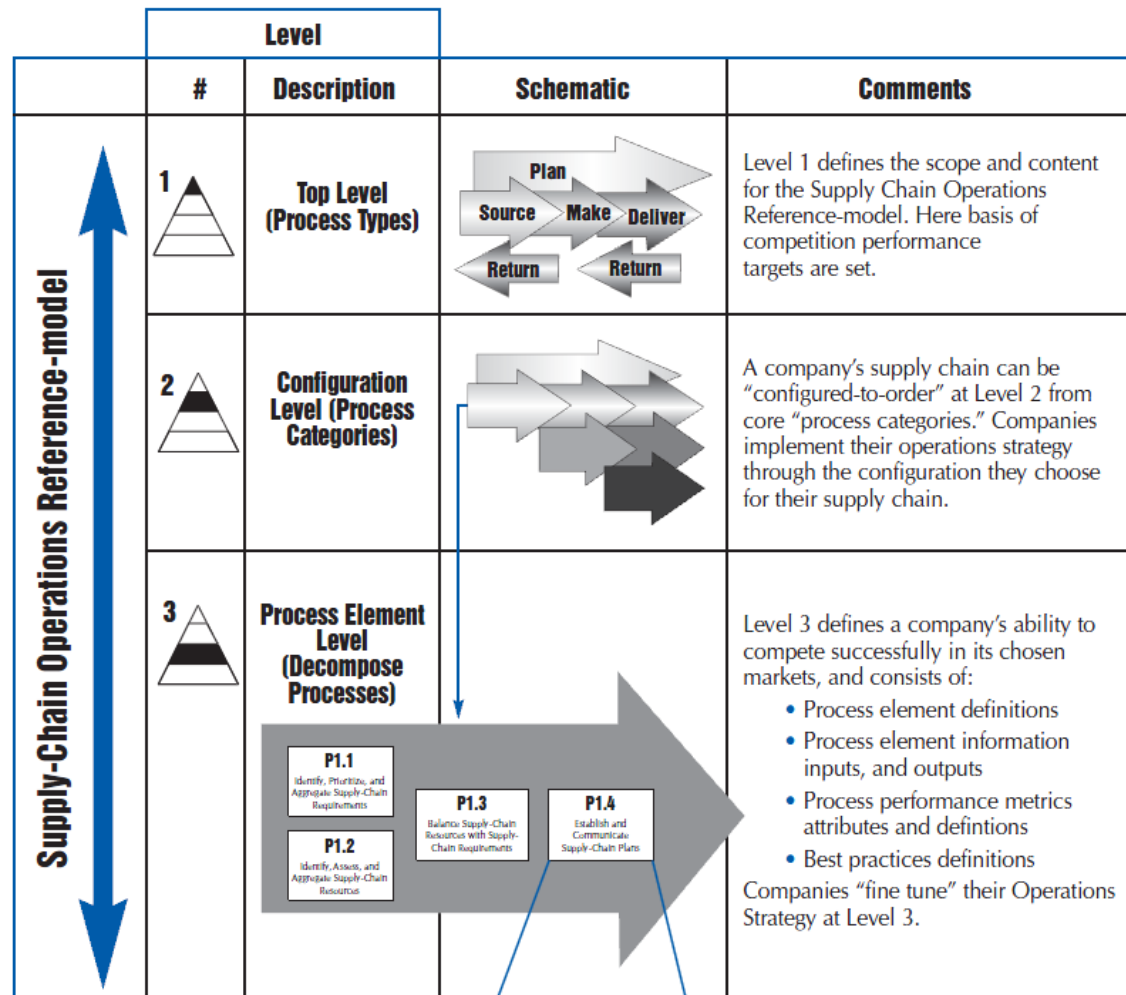
SCOR Process Model

Return of Raw Materials and Receipt of Returns of Finished Goods

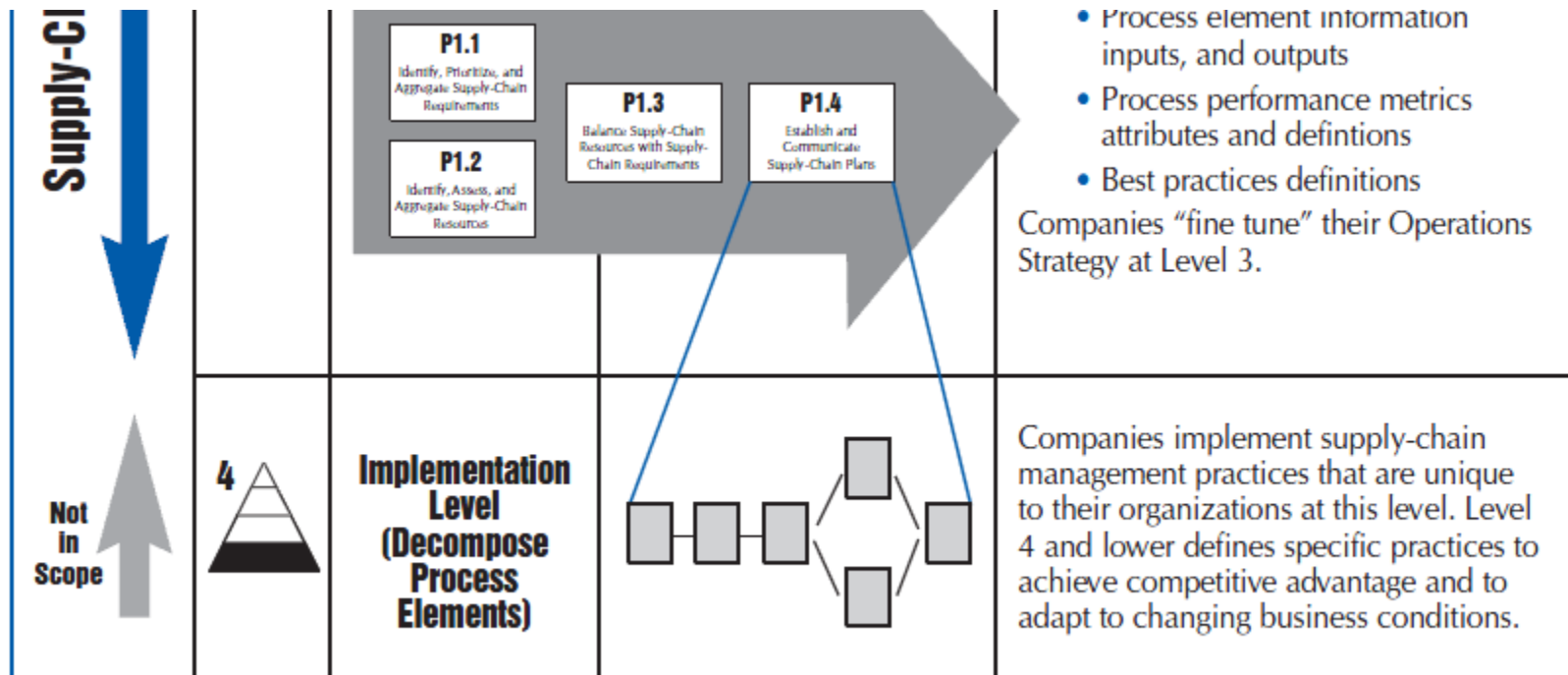


- All Return **Defective Product** steps from source – identify product condition, disposition product, request product return authorization, schedule product shipment, and return defective product – and deliver – authorize product return, schedule return receipt, receive product, and transfer defective product.
- All Return **Maintenance, Repair, and Overhaul** product steps from source – identify product condition, disposition product, request product return authorization, schedule product shipment, and return MRO product – and deliver – authorize product return, schedule return receipt, receive product, and transfer MRO product.
- All Return **Excess Product** steps from source – identify product condition, disposition product, request product return authorization, schedule product shipment, and return excess product – and deliver – authorize product return, schedule return receipt, receive product, and transfer excess product.
- Manage Return business rules, performance, data collection, return inventory, capital assets, transportation, network configuration, regulatory requirements and compliance, and supply chain return risk.

SCOR – The Three Levels of Process Detail



SCOR – Implementation Level



SCOR Process Categories – Level 1 Process Definitions

Process	Definition
Plan	Processes that balance aggregate demand and supply to develop a course of action which best meets sourcing, production and delivery requirements
Source	Processes that procure goods and services to meet planned or actual demand
Make	Processes that transform product to a finished state to meet planned or actual demand
Deliver	Processes that provide finished goods and services to meet planned or actual demand, typically including order management, transportation management, and distribution management
Return	Processes associated with returning or receiving returned products for any reason. These processes extend into post-delivery customer support

SCOR Process Categories – Level 2 Process Types

Process Type	Characteristics
Planning	<p>A process that aligns expected resources to meet expected demand requirements.</p> <p>Planning processes:</p> <ul style="list-style-type: none">• Balance aggregated demand and supply• Consider consistent planning horizon• (Generally) occur at regular, periodic intervals• Can contribute to supply-chain response time
Execution	<p>A process triggered by planned or actual demand that changes the state of material goods. Execution processes:</p> <ul style="list-style-type: none">• Generally involve cycle time<ol style="list-style-type: none">1. Scheduling/sequencing2. Transforming product, and/or3. Moving product to the next process• Can contribute to the order fulfillment
Enable	<p>A process that prepares, maintains, or manages information or relationships on which planning and execution processes rely</p>

SCOR Process Categories

“SCOR Configuration Toolkit”

SCOR Process

Plan

Source

Make

Deliver

Return

Process
Type

Planning

Execution

Enable

P1

P2

P3

P4

P5

S1 - S3

M1 - M3

D1 - D4

S/DR1 -
S/DR3Process
Category

EP

ES

EM

ED

ER

SCOR Process Categories – Level 2 Process Types (2)

Stocked Product (S1, M1, D1)

- Inventory Driven (Plan)
- Standard Material Orders
- High Fill-rate, short turnaround

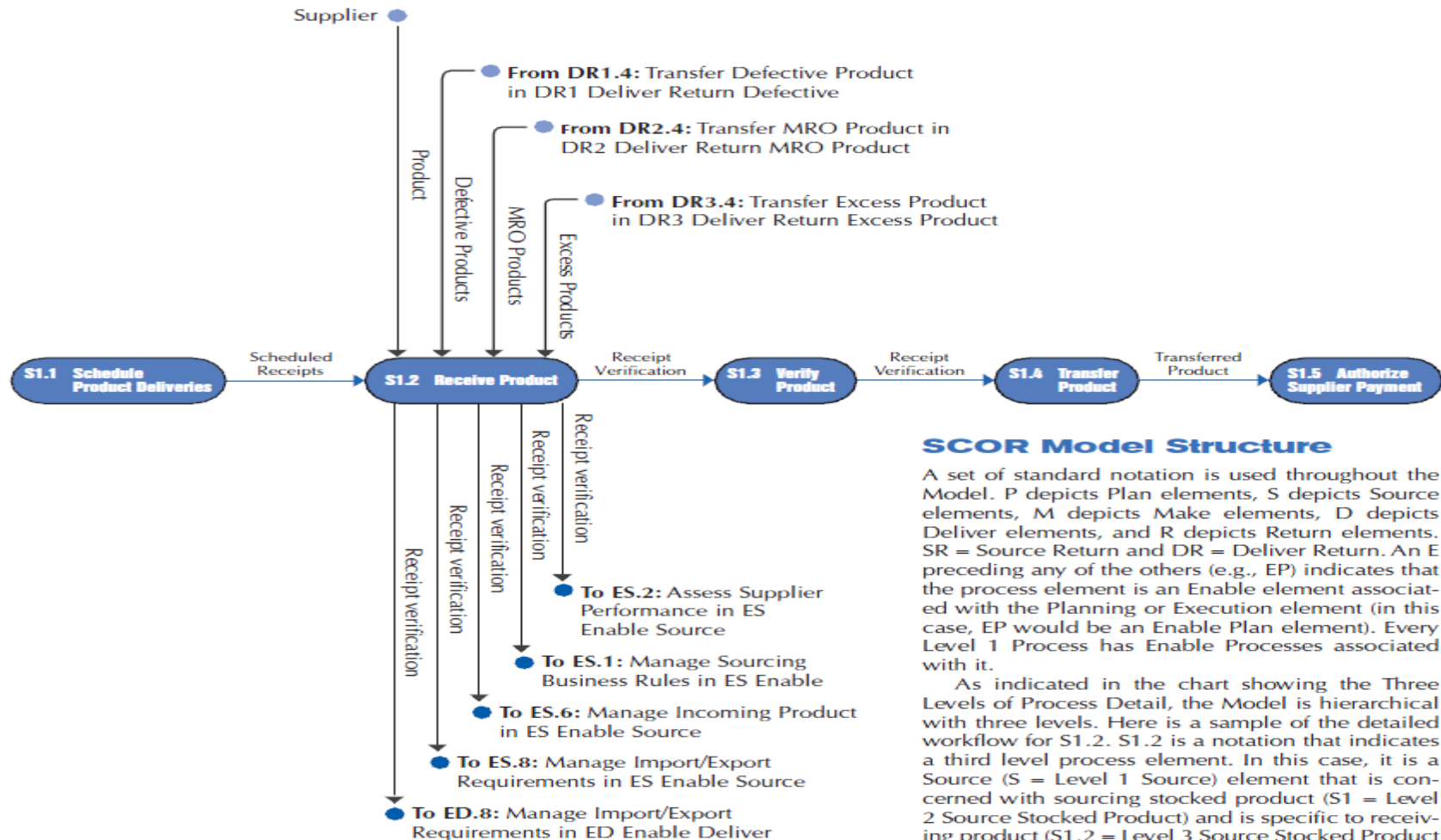
Make-to-Order (S2, M2, D2)

- Customer Order Driven
- Configurable Materials
- Longer turn-around times

Engineer-to-Order (S3, M3, D3, D4)

- Customer Requirements Driven
- Sourcing New Materials
- Longest long lead-times, low fill rates

SCOR Process Categories – Level 3 Detailed Process Elements



SCOR Model Structure

A set of standard notation is used throughout the Model. P depicts Plan elements, S depicts Source elements, M depicts Make elements, D depicts Deliver elements, and R depicts Return elements. SR = Source Return and DR = Deliver Return. An E preceding any of the others (e.g., EP) indicates that the process element is an Enable element associated with the Planning or Execution element (in this case, EP would be an Enable Plan element). Every Level 1 Process has Enable Processes associated with it.

As indicated in the chart showing the Three Levels of Process Detail, the Model is hierarchical with three levels. Here is a sample of the detailed workflow for S1.2. S1.2 is a notation that indicates a third level process element. In this case, it is a Source (S = Level 1 Source) element that is concerned with sourcing stocked product (S1 = Level 2 Source Stocked Product) and is specific to receiving product (S1.2 = Level 3 Source Stocked Product Receive Product). Though the other S1 processes are shown here to Level 2, the Level 3 detail is only included for S1.2.

SCOR Process Categories – Level 3 Detailed Process Elements

Process Element: Schedule Product Deliveries		Process Element Number: S1.1			
Process Element Definition					
Scheduling and managing the execution of the individual deliveries of products against an existing contract or purchase order. The requirements for product release are determined based on the detailed sourcing plan or other types of product pull signals.					
Performance Attributes		Metric			
Flexibility and Responsiveness	Total Source Lead Time % of EDI Transactions				
Cost	Product management and Planing Costs as a % of Product Acquisition Costs				
Reliability	% Defective, Defective parts per million (dppm) Completion to budget and scope of service description				
Asset	Raw Material or product Days of Supply				
Best practice		Features			
Utilized EDI transaction to reduce cycle time and costs	EDI interface for 830, 850, 856 & 862 transactions				
VMI agreements allow suppliers to manage (replenish) inventory	Supplier managed inventories with scheduling interfaces to external suppliers systems				
Mechanical (Kanban) pull signals are used to notify suppliers of the need to deliver product	Electronic Kanban support				
Consignment agreements are used to reduce assets and cycle time while increasing the availability of critical items	Consignment inventory management				
Advanced ship notices allow for right synchronization between source and make processes	Banket order support with scheduling interfaces to external supplier systems				
Inputs		Plan	Source	Make	Deliver
Sourcing Plans	P2.4				
Source Execution Data		ES.2			
Logistic Selection		ES.6			
Production Schedule				M1.1, M2.1, M3.2	
Replenishment Signals				M1.2, M2.2, M3.3	D1.3
Outputs		Plan	Source	Make	Deliver
Procurement Signal (Supplier)					
Sourced Product on Order	P2.2	ES.9			
Scheduled receipts				M1.1, M2.1, M3.2	

SCOR Process Categories – Level 3 Detailed Process Elements (Performance Attributes)

Performance Attributes	Metric
Supply Chain Reliability	% Schedules Changed within Supplier's Lead Time
Supply Chain Responsiveness	<ul style="list-style-type: none">• Average Release Cycle of Changes,• Average Days per Engineering Change,• Schedule Product Deliveries Cycle Time,• Average Days per Schedule Change
Supply Chain Costs	Cost to Schedule Product Deliveries, Quantity per shipment

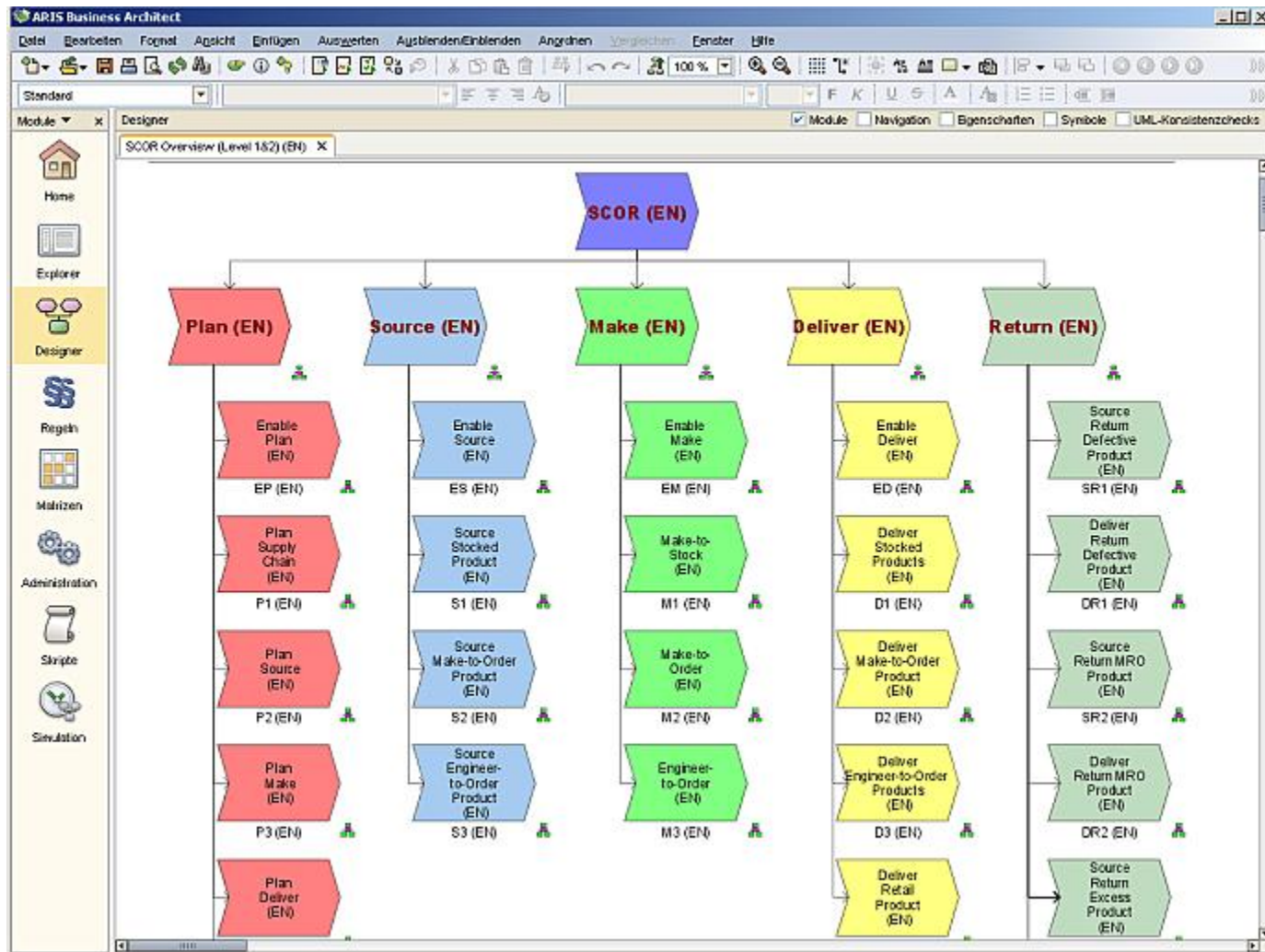
SCOR Process Categories – Level 3 Detailed Process Elements (Best Practices)

Best Practices	Description/Definition
Bundle deliveries	Bundle deliveries of different products into single shipment when possible
Infrequent product delivery	Minimize need for frequent shipments by accurately determining product needs
Advanced Ship Notices Allow for Tight Synchronization between Source and Make Processes	Blanket order support with scheduling interfaces to external supplier systems

SCOR Performance Attributes

Level 1 Metrics	Performance Attributes				
	Customer-Facing			Internal-Facing	
	Reliability	Responsiveness	Agility	Cost	Assets
Perfect Order Fulfillment (RL.1.1)	✓				
Order Fulfillment Cycle Time (RS.1.1)		✓			
Upside Supply Chain Flexibility (AG.1.1)			✓		
Upside Supply Chain Adaptability (AG.1.2)			✓		
Downside Supply Chain Adaptability (AG.1.3)			✓		
Supply Chain Management Cost (CO.1.1)				✓	
Cost of Goods Sold (CO.1.2)				✓	
Cash-to-Cash Cycle Time (AM.1.1)					✓
Return on Supply Chain Fixed Assets (AM.1.2)					✓
Return on Working Capital (AM.1.2)					✓

SCOR – ARIS Model



SCOR – ARIS Model (2)

