Indian Health Service

Business Process Model and Notation (BPMN) 2.0: An Introductory Overview

HOWARD HAYS, MD, MSPH, FAAFP, FAMIA
CHIEF MEDICAL INFORMATION OFFICER (CMIO)

ROBERT LARIO, PH.D., MSE, MBA
IHS BUSINESS PROCESS MODELING CONSULTANT

Meet Our Speakers

Dr. Howard Hays, MD

Chief Medical Information Officer (CMIO)
IHS Office of Information Technology

Robert Lario, PhD

Business Process Consultant
IHS Office of Information Technology

Session Objectives

This session aims to create an awareness of Business Process Modeling and Notation (BPMN)

Topics covered:
- What is Modeling?
- What is BPMN?
- How to is BPMN used?
- Introduce the visual notation.

Learning Objectives

At the end of this session, attendees will:
- Identify a BPMN model instance.
- Have a basic understanding of how to read a BPMN model instance.

This is not a BPMN or Modeling tutorial, nor a complete description of the entire language.

IHS Health IT Modernization Overview

Dr. Howard Hays
Chief Medical Information Officer (CMIO)
IHS Office of Information Technology

Need for Health IT Modernization

After a system-wide analysis and Tribal Consultation/Urban Confer, the IHS determined the need to fully replace RPMS in order to fulfill its mission.

INTERNAL FINDINGS			EXTERNAL FINDINGS
Outdated System	**Creates Challenges**	**Significant Dependencies**	**Unsustainable**
The Resource and Patient Management System (RPMS) has served the I/T/U for **more than 40 years**.	Technology advances, the regulatory environment, and the distributed deployment model created **significant challenges** for RPMS development and operations.	The U.S. Department of Veterans Affairs' **VistA system is scheduled for replacement** – affecting the IHS dependencies.	The HHS/IHS Health IT Modernization Research Project (2018-19) confirmed that **RPMS is unsustainable**.

Several independent audits **identified challenges in the current health IT systems** to inform future Modernization efforts. |

Executive Summary

To fulfill its mission to deliver comprehensive health care across Indian Country, the IHS will provide an enterprise electronic health record solution to Tribes, urban Indian organizations, and IHS sites of care.

Sustainable Funding

from Congress to maintain and operate a modernized health IT infrastructure.

Stabilize Support

through an enterprise approach that includes staff training, business processes, and technology maintenance.

Liberate Data

to ensure it is accessible across the enterprise by clinicians, patients, and partners alike to improve safety, quality, and patient outcomes.

Selected Enterprise EHR Vendor

The IHS selected **General Dynamics Information Technology, Inc.** (GDIT) to build, configure, and maintain the new IHS enterprise EHR solution that uses Oracle Health technology

GENERAL DYNAMICS
Information Technology

ORACLE
Health

Competition was full and open, rigorously adhered to Federal Acquisition Regulations, engaged hundreds of I/T/U end-users in product demonstrations, and culminated in a 10-year Indefinite Delivery / Indefinite Quantity contract with GDIT.

Improve Patient Care & Coordination

Patients

Partners

Providers

Enterprise Electronic Health Record Solution
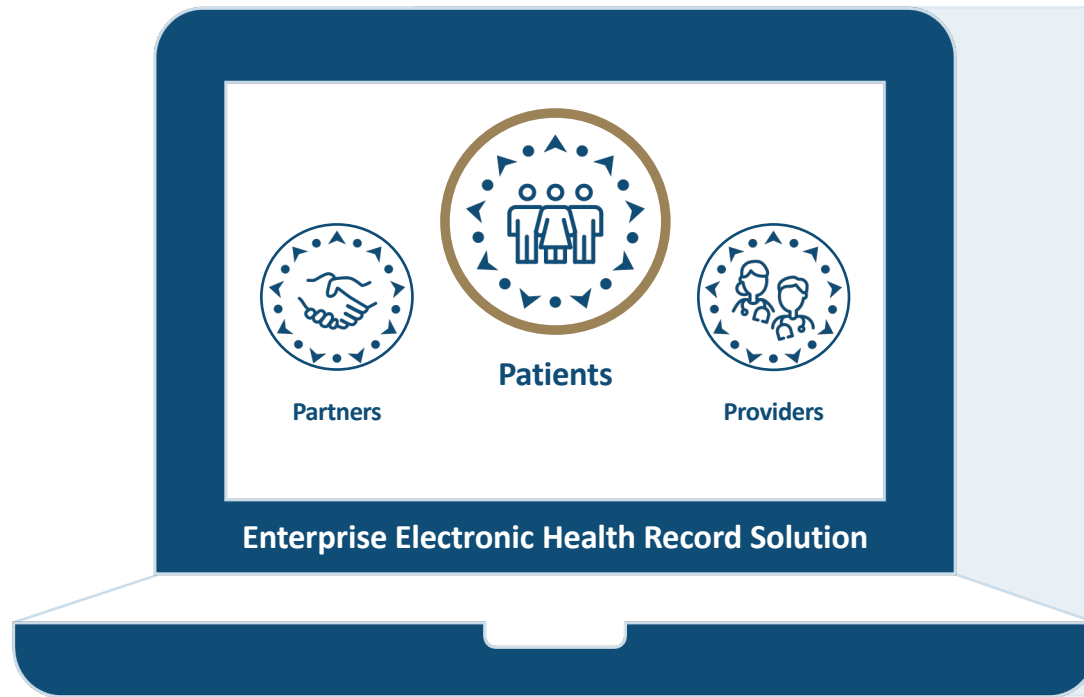
Provide the best possible EHR, managed by its users, for its users, that will drive high-quality health care through sustainable, modern, and easy to use tools

Workflow Research & Alignment Plan Process (WRAP)
and
Business Process Model & Notation (BPMN)

Robert Lario, PhD
Business Process Consultant
IHS Office of Information Technology

The WRAP Project in IHS

- IHS has a lot of divergence in common processes because RPMS is highly configurable

- Transition to a new system will be smoother if current processes are well understood and aligned

- Convene domain-specific subject matter experts (SME) and informaticists in virtual work sessions to develop and validate "shared best practice" workflows a variety of common, critical, and high-risk processes

- Develop a series of business process diagrams that describe preferred workflows, and use these diagrams to inform configuration, training, and change management for the new systems

- Experience gained doing process modeling can be leveraged further to model more cognitive workflows, e.g. clinical decision support

Benefits of WRAP

- Enterprise-focused project provides an **opportunity to improve standardization** across IHS
- Opportunity to identify and **align with evidence-based best practices**
- Opportunity to **incorporate these workflows into current systems** (RPMS EHR), even before migration to new EHR
  - **Compliance with RPMS standardization could be a selection factor for migration**
- Understand where significant process changes will occur, so that **training is optimized and targeted** to ensure users have successful transition
- **Maximize preparedness** for new solution

WRAP Engagement & Participation

WRAP Success Factors

Field Engagement
Engaging the field to enable successful techno-social change

Comprehensive Service Lines
Prioritized workflows, consolidated approach

Effective Partnership
WRAP enables a collaborative partnership among I/T/U users, our contractors, and EHR vendor

Business Process Modeling to Date

Service Lines	WRAP Sessions	Models
25	312	84

SME Engagement

12,300+
Total Participant Encounters (2021 – Present)

2,200+
Unique Participants (2021 – Present)

WRAP Service Line Analysis

Care Delivery Services
47 models

1. Anaesthesia (3 models)
2. Emergency Department (3 models)
3. Hospitalization (1 model)
4. Labor Delivery Recovery Postpartum (4 models)
5. Patterns and Subprocesses (8 models)
6. Primary Care (6 models)
7. Residential Treatment Centers (2 models)
8. Substance Use Disorder (3 models)
9. Surgery (12 models)
10. Swing Beds (1 model)
11. Telehealth (3 models)
12. Urgent Care (1 model)

Support Services
25 models

1. Community Health Aide Program (3 models)
2. Employee Health (5 models)
3. Imaging (1 model)
4. Laboratory (4 models)
5. Medication Management and Administration (5 models)
6. Nutrition (4 models)
7. Problem List, Allergies, Medications, Procedures, Immunizations (3 models)

Business Services
12 models

1. Consults and Referrals (1 model)
2. Patient Portal (1 model)
3. Population Health (1 model)
4. Public Health (5 models)
5. Reporting (1 model)
6. Revenue Cycle Management (3 models)

What is a Business Process?

A series of interrelated activities, tasks, or steps an organization performs systematically to achieve specific business objectives or produce desired outputs.

Designed to create value by transforming inputs into valuable outputs, goods, or services.

Fundamental to how organizations operate and achieve their goals efficiently.

What is Modeling and Why do It?

Delivery of Care is Complex

Modeling Helps

To manage complexity

To understand the problem, expectations & requirement

To detect errors and omissions early in the lifecycle

To communicate and share with stakeholders

To evolve our understanding

To understand the impact of change

To ensure that resources are utilized efficiently

Business Process

Key characteristics

➢ Clear Objective

➢ Sequence of Activities

➢ Inputs and Outputs

➢ Cross-functional

➢ Measurable

➢ Repeatable and Scalable

➢ Time and Resource Constraints

Examples

➢ Order Fulfillment Process

➢ Customer Service Process

➢ Hiring Process

➢ Care Delivery Process

➢ Telehealth Process

BPMN Origins

In 2000, the Business Process Management Institute (BPMI—now merged into the OMG) started developing the Business Process Modeling Language (BPML - an XML process execution language) and recognized the need for a graphical representation.

In August 2001, the Notation Working Group was formed. The group was composed of 35 companies, organizations, or individuals.

BPMN 1.0
◦ May 2004, the BPMN 1.0 specification was released to the public.
◦ February 2005, BPMN 1.0 was adopted as an OMG standard.

BPMN 2.0
◦ January 2011, BPMN 2.0 was adopted as an OMG standard.
◦ July 2013, BPMN 2.0 was adopted as an ISO standard (ISO/IEC 19510:2013).

Business Process Model and Notation™ provides businesses with the capability of capturing their internal procedures

Business Process Model and Notation (BPMN) is a Visual Language to Depict Processes

Key characteristics

- **Visual Representation:** BPMN uses symbols, shapes, and arrows to create diagrams that visually represent the flow and logic of a business process.

- **Standardized Notation:** BPMN is an industry-standard notation, meaning it follows specific rules and conventions.

- **Process Elements:** BPMN defines a set of elements or symbols to represent various components of a business process.

- **Process Flow:** BPMN diagrams show the sequence of activities and events in a process, as well as the conditions and decisions that determine how the process progresses.

- **Collaboration:** BPMN can be used to model both individual processes and complex collaborations involving multiple participants or organizations.

- **Process Analysis and Improvement:** BPMN diagrams are valuable tools for analyzing and improving business processes.
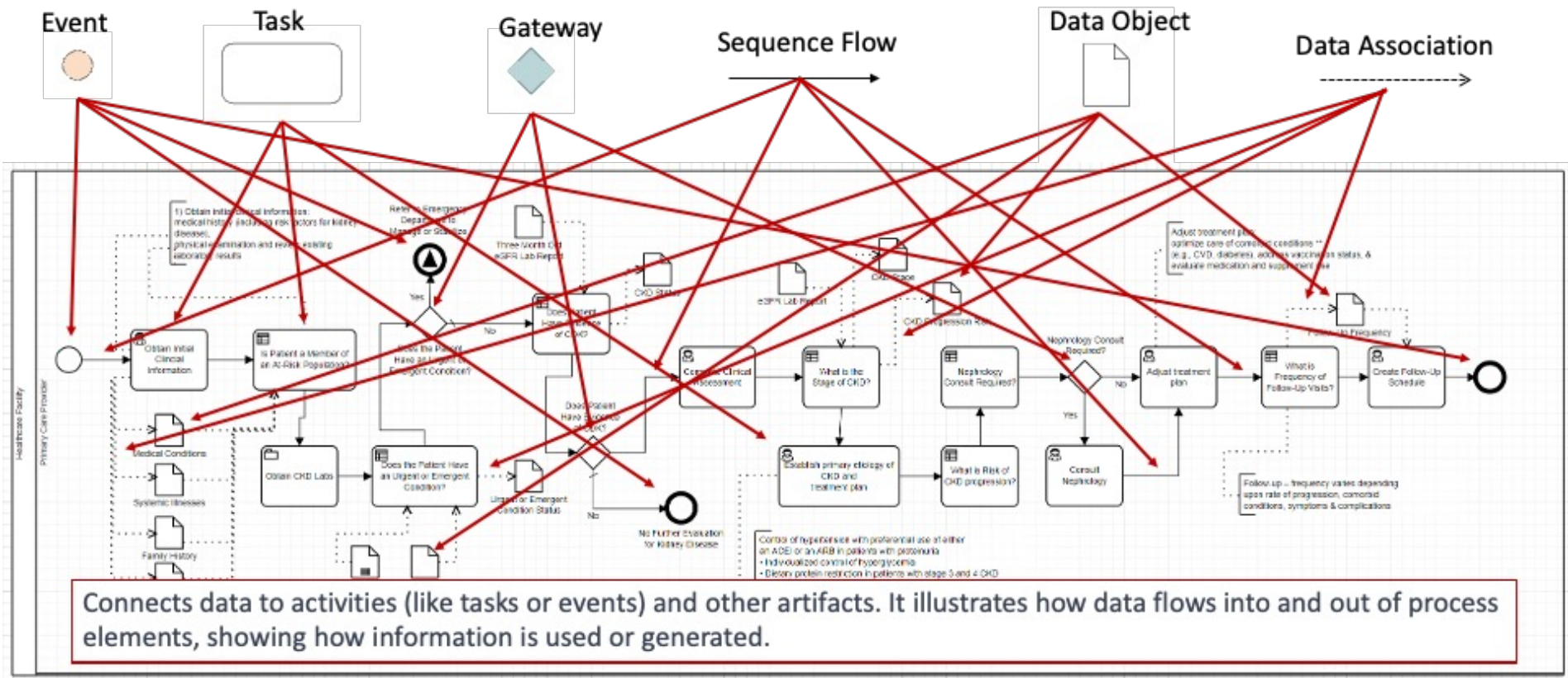
Event Task Gateway Sequence Flow Data Object Data Association

Connects data to activities (like tasks or events) and other artifacts. It illustrates how data flows into and out of process elements, showing how information is used or generated.

Key BPMN Elements

Flow Objects

Events

Gateways

Activity / Tasks

Connecting

Sequence Flow

Message Flow

Association
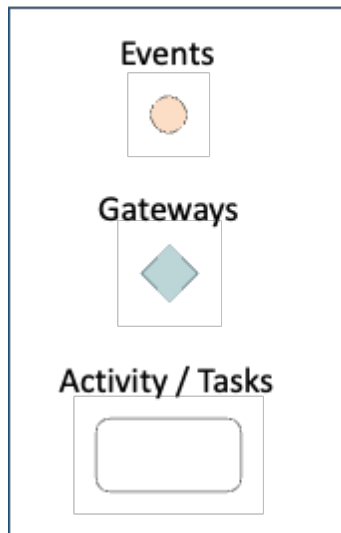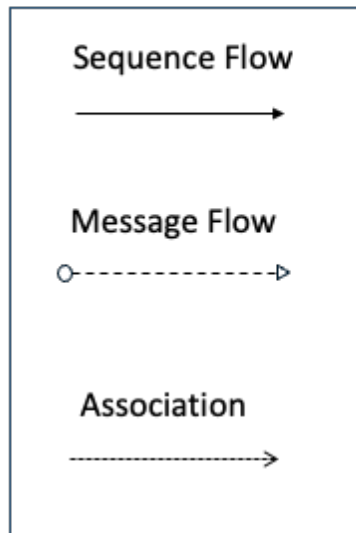
Pool

Lanes with a Pool

Data Object

Text Annotation

Events

Represent specific points in a business process where something significant happens or triggers a change in the flow of the process.

Indicating a process's start, intermediate steps, and end points.

Depict the timing and sequence of a process's activities, decisions, and interactions.

Start Events: Initiation points of a process or a particular sequence of activities. They signify when the process begins. For example, a "Receive Order" start event could mark the beginning of an order processing process when a customer places an order.

Circle with a single outline:

Intermediate Events: Occur during a process, indicating a specific occurrence influencing the process flow. For example, an "Approval Required" intermediate event might indicate a point where an approval decision is needed before proceeding with the next steps of the process.

Circle with two thin outlines:

End Events: Mark the conclusion of a process or a specific sequence of activities. They signify when the process has been completed or terminated. For example, a "Delivery Complete" end event could represent the successful completion of a delivery process.

Circle with single bold outlines:

Example to Discuss

When I get hungry, I'll order a pizza online. However, my building has electrical issues, so if I lose power while ordering, I'll opt for a peanut butter and jelly sandwich and discuss the situation with the landlord. Once I finish placing the order, I'll patiently wait for the pizza to arrive, and after that, I'll thoroughly enjoy eating it. Occasionally, my Mom might visit with some cookies, and I'll happily indulge in them too. Regardless of the scenario, I'll definitely need a nap once I'm finished.

Events
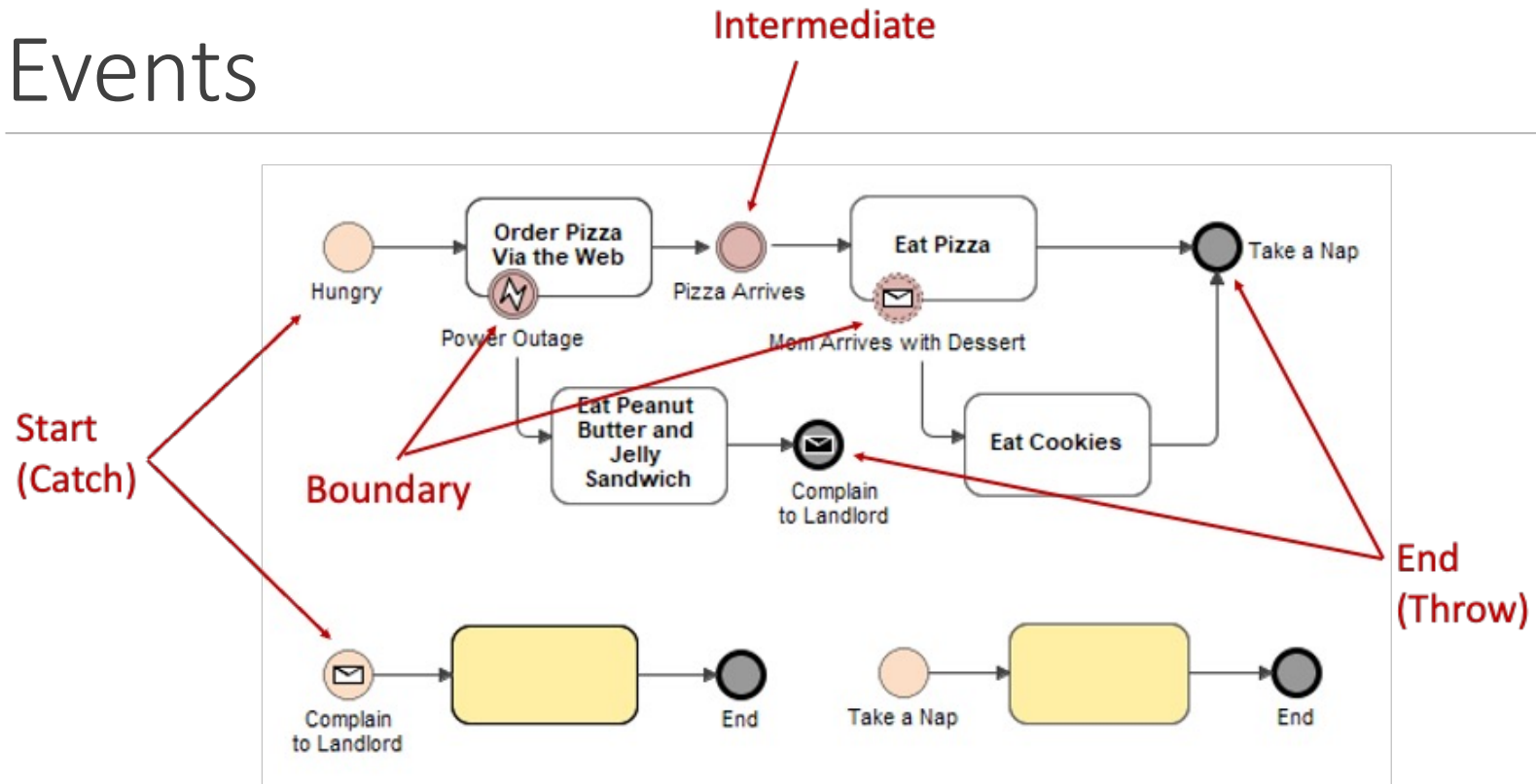
Events (Throw & Catch)
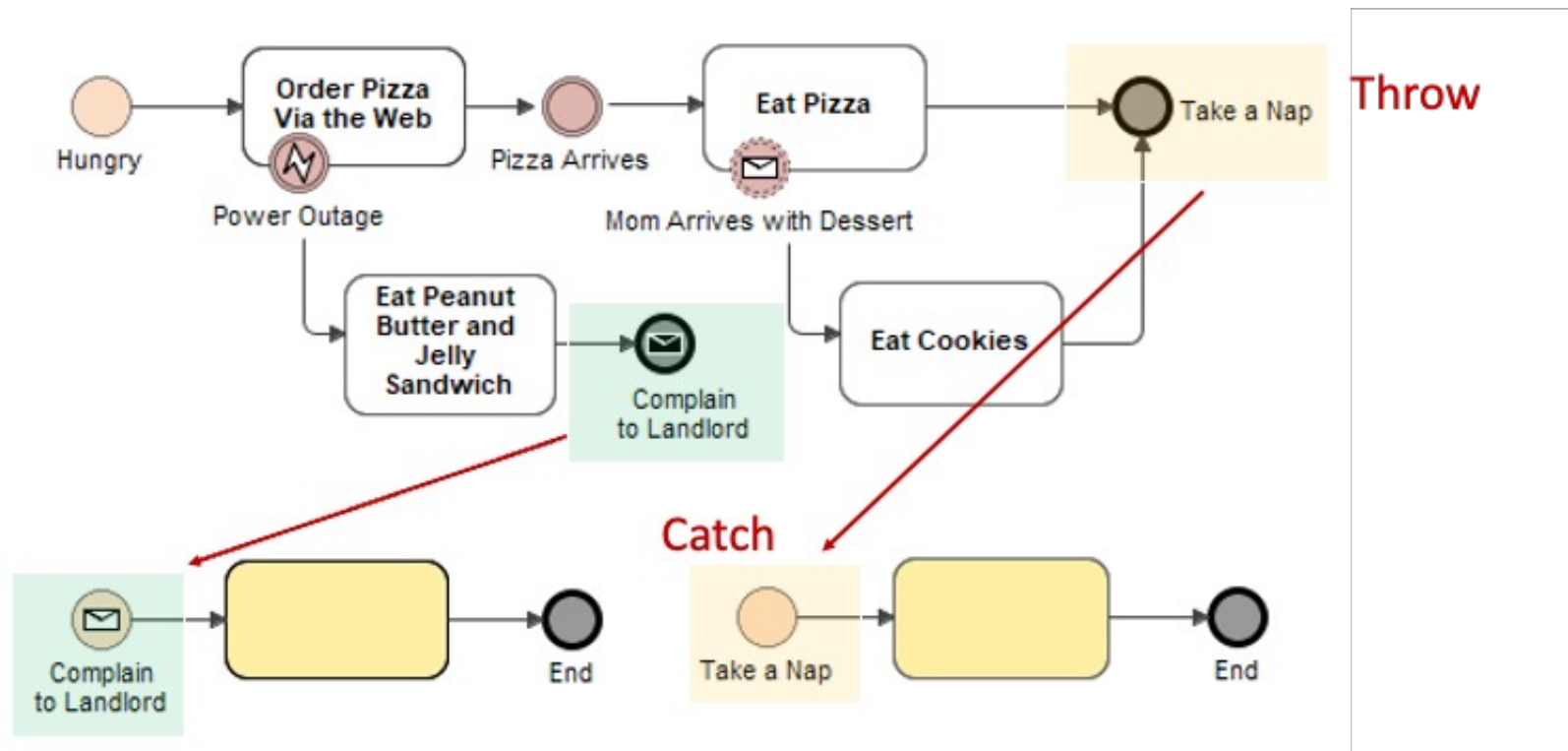
Task Types

User Task requires human interaction or intervention.

Service Task is performed by an automated system or external service.

Script Task is where a script or code is executed as part of the process.

Business Rule Task that applies predefined business rules or decision logic.

Manual Task is performed manually by a human.

Receive Task waits for a specific message or signal to be received.

Send Task sends a message or signal to another process or participant.

User Task	Service Task	Script Task	Business Rule Task

Manual Task	Receive Task	Send Task
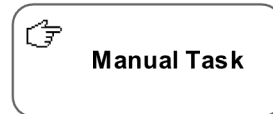
1) The **process starts** when a patient is admitted to the hospital for a medical condition.

2) A **script task** calculates the appropriate dosage of medication based on the patient's weight and medical history.

3) A **service task** requests the processing of blood tests for the patient's condition. It interacts with the laboratory information system (LIS) to initiate the tests.

4) A nurse (**user**) is assigned to administer the prescribed medication to the patient.

5) A healthcare provider **manually reviews** the patient's medical history, including allergies, previous treatments, and conditions. This information is crucial for treatment decisions.

Admit Patient → Prescription Dosage Calculation → Lab Test Processing → Nurse Medication Administration → Patient Medical History Review → Treatment Plan Approval → Patient Appointment Reminder → Patient Survey Response → ●

Admit Patient → **Prescription Dosage Calculation** → **Lab Test Processing** → **Nurse Medication Administration** → **Patient Medical History Review** → **Treatment Plan Approval** → **Patient Appointment Reminder** → **Patient Survey Response** → ○

9) process concludes when the patient's treatment is successfully **completed** and all necessary tasks have been executed.

8) A **receive task** waits for the patient to submit a post-treatment survey. Once the survey is received, the process continues.

7) An automated **send task** triggers the sending of an appointment reminder to the patient's phone via SMS.

6) A **business rule** task evaluates the proposed treatment plan against established medical guidelines.

Gateways

Exclusive (XOR Gateway): Mutually exclusive choices where only one of the outgoing paths is taken.

Inclusive: Multiple valid paths where more than one outgoing sequence flow can be taken.

Parallel: Split a process flow into multiple parallel paths that are executed concurrently.

Event-Based: Handle events that can trigger different paths in a process.

Complex: Complex decision logic that cannot be directly captured using other gateway types.

Parallel Event-Based: Split a process flow into multiple parallel paths that are executed concurrently.

Exclusive

Inclusive

Parallel

Event-Based

Complex

Parallel Event-Based

Connectors

Sequence Flow: Establishes sequence and order the flow will progress.

Conditional Sequence Flow: Used to model splitting decision points in a process.

Default Sequence Flow: Ensure that there is always a valid path for the process to follow, even when none of the specific conditions associated with other Sequence Flows are met.

Message Flow: Used to model the communication and information exchange between different participants or processes in a business process.

.

Association:.

Sequence Flow	⟶
Conditional Sequence Flow	◇⟶
Default Sequence Flow	⟋⟶
Message Flow	○-------▷
Association	-------⟶
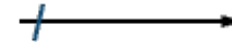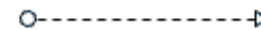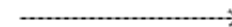
IHS Mission

To raise the physical, mental, social, and spiritual health of American Indians and Alaska Natives to the highest level

IHS Vision

Build healthy communities and quality health care systems through strong partnerships and culturally responsive practices

Questions?

Please email the Modernization Program at Modernization@ihs.gov

Stay Connected with IHS

Stay informed on the Health IT Modernization Program at www.IHS.gov/HIT
or by following us on social media

Facebook

LinkedIn

X (formerly Twitter)

Thank You

Dr. Howard Hays, MD
Chief Medical Information Officer (CMIO), IHS Office of Information Technology
Howard.Hays@ihs.gov

Robert Lario, PhD
Business Process Consultant, IHS Office of Information Technology
Robert.Lario@ihs.gov

Next Steps

Register for the Modernization Summit

Take the Modernization Awareness Survey

<<Coming Soon>>

Visit the Resource Hub for the GRTGR Guide and more

Addendum

Start – Events (Catch)

◯ None Start Event

⬤ Interrupting - Message Start Event

⬤ Non-interrupting - Message Start Event

⬤ Interrupting - Timer Start Event

⬤ Non-interrupting - Timer Start Event

⬤ Interrupting - Conditional Start Event

⬤ Non-interrupting - Conditional Start Event

⬤ Interrupting - Signal Start Event

⬤ Non-interrupting - Signal Start Event

⬤ Interrupting - Multiple Start Event

⬤ Non-interrupting - Multiple Start Event

⬤ Interrupting - Parallel Multiple Start Event

⬤ Non-interrupting - Parallel Multiple Start Event

⬤ Interrupting - Escalation Start Event

⬤ Non-interrupting - Escalation Start Event

⬤ Interrupting - Error Start Event

⬤ Interrupting - Compensation Start Event

Intermediate – Events (Throw and Catch)

○ Interrupting - None Intermediate Event

✉ Catch - Message Intermediate Event

✉ Interrupting - Boundary - Catch - Message Intermediate Event

✉ Non-interrupting - Boundary - Catch - Message Intermediate Event

✉ Throw - Message Intermediate Event

⏱ Timer Intermediate Event

⏱ Interrupting - Boundary - Timer Intermediate Event

⏱ Non-interrupting Boundary - Timer Intermediate Event

▤ Conditional Intermediate Event

▤ Interrupting - Boundary - Conditional Intermediate Event

▤ Non-interrupting - Boundary - Conditional Intermediate Event

Ⓐ Catch - Escalation Intermediate Event

Ⓐ Interrupting - Boundary - Catch - Escalation Intermediate Event

Ⓐ Non-interrupting - Boundary - Catch - Escalation Intermediate Event

Ⓐ Throw - Escalation Intermediate Event

Ⓝ Boundary - Catch - Error Intermediate Event

⏪ Boundary - Catch - Compensation Intermediate Event

⏪ Throw - Compensation Intermediate Event

➡ Catch - Link Intermediate Event

➡ Throw - Link Intermediate Event

⊗ Boundary - Catch - Cancel Intermediate Event

Intermediate – Events (Continued)

- Catch - Signal Intermediate Event
- Interrupting - Boundary - Catch - Signal Intermediate Event
- Non-interrupting - Boundary - Catch - Signal Intermediate Event
- Interrupting - Boundary - Throw - Signal Intermediate Event
- Catch - Multiple Intermediate Event
- Interrupting - Boundary - Catch - Multiple Intermediate Event
- Non-interrupting Boundary - Catch - Multiple Intermediate Event
- Throw - Multiple Intermediate Event
- Catch - Parallel Multiple Intermediate Event
- Interrupting - Boundary - Catch - Parallel Multiple Intermediate Event
- Non-interrupting Boundary - Catch - Parallel Multiple Intermediate Event

End – Events (Throw)

○ None End Event

✉ Message End Event

▲ Signal End Event

⬠ Multiple End Event

△ Escalation End Event

⚡ Error End Event

◀◀ Compensation End Event

✖ Cancel End Event

◉ Terminate End Event

Message Flow

Help hide details and focus attention on the "Collaboration"

Pools and Lanes

A Pool is a graphical container used to represent the involvement of different organizational entities or participants in a business process.
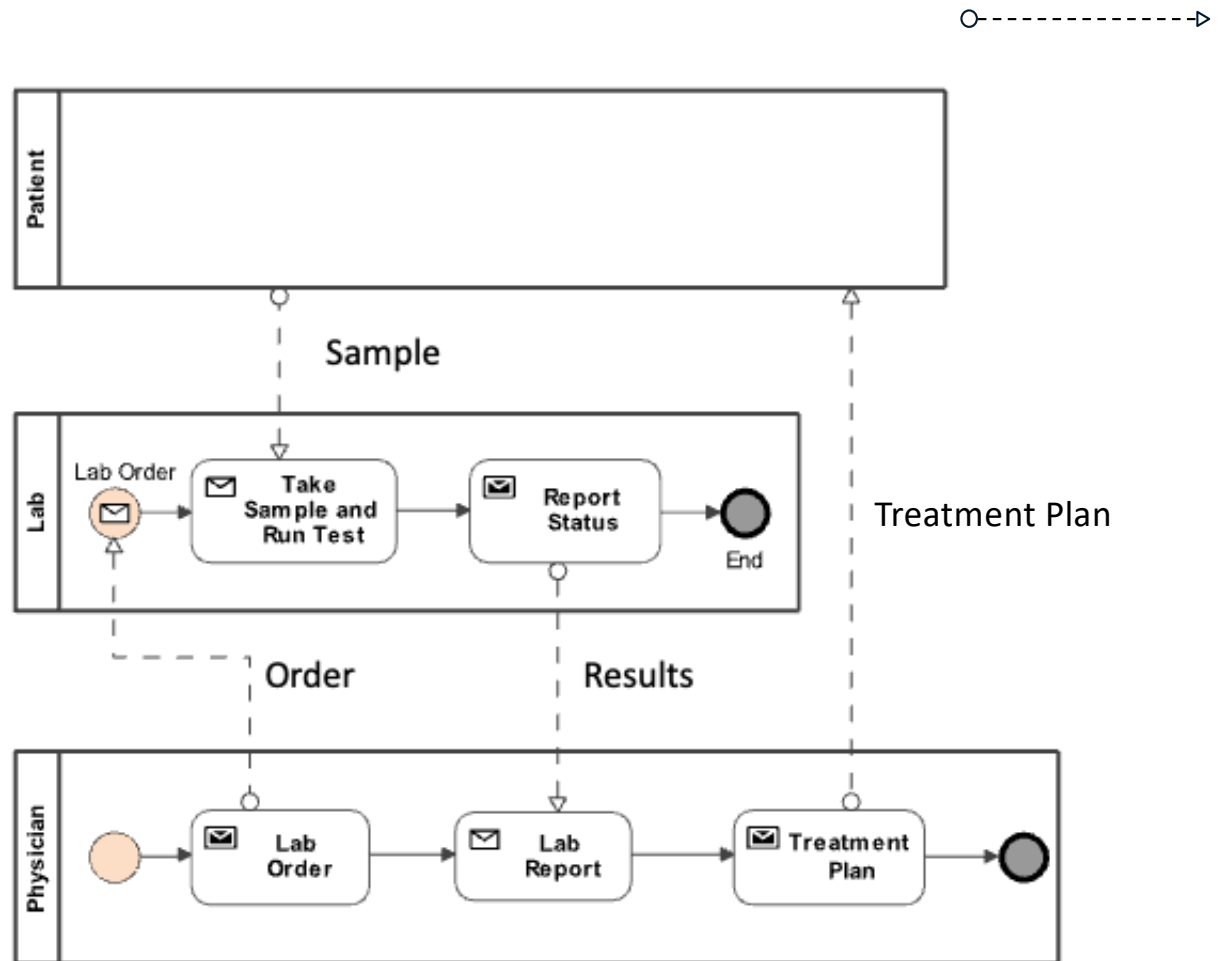
Pools provide a high-level view of how multiple participants interact and collaborate to execute the process.

In essence, a pool represents a swim lane in a BPMN diagram. Swim lanes are used to visually separate and categorize activities or tasks based on the participant responsible for their execution.

Each pool represents a specific participant or organizational entity involved in the business process. Participants can be individuals, departments, teams, organizations, or even external entities such as suppliers or customers.

Inside each pool, there can be one or more lanes. Lanes are used to further divide the process into subcategories or functional areas, assigning specific tasks or activities to different subgroups within the participant

Single Pool: Represents an Entity in a Process

Organization 1

Single Pool with Two Lanes: Lanes Represent a Role Played in the Process

Organization 2

Role Lane 2

Role Lane 1

Customer

Manufacturer

Order

Confirmation

Shipment

Rejection

Parts Provisioning

Open Audition

Supplier

Bidder
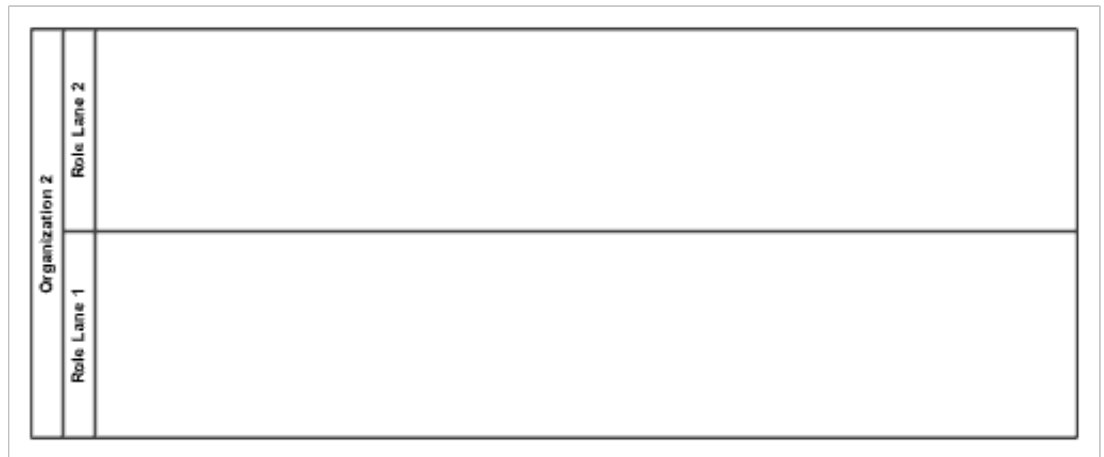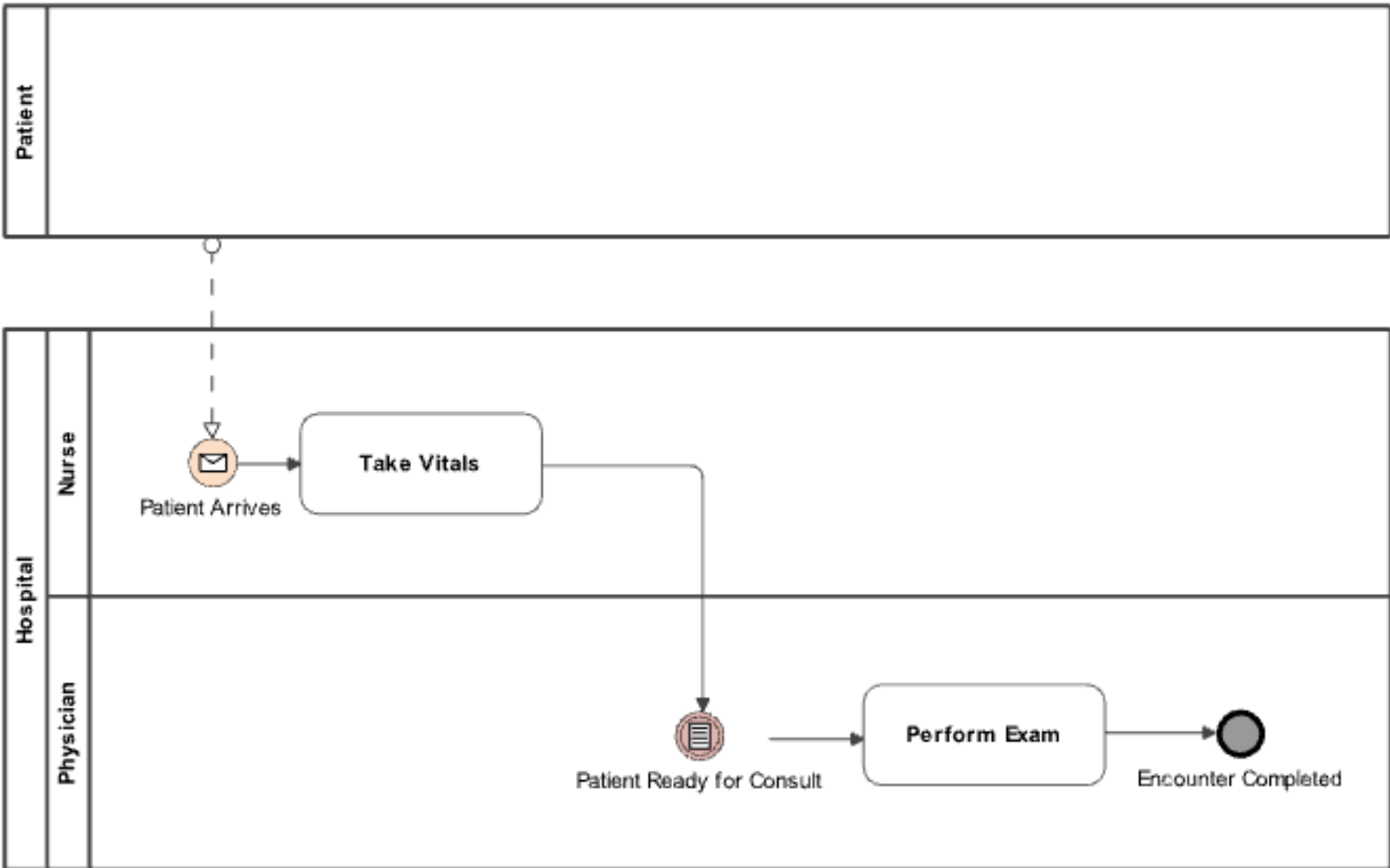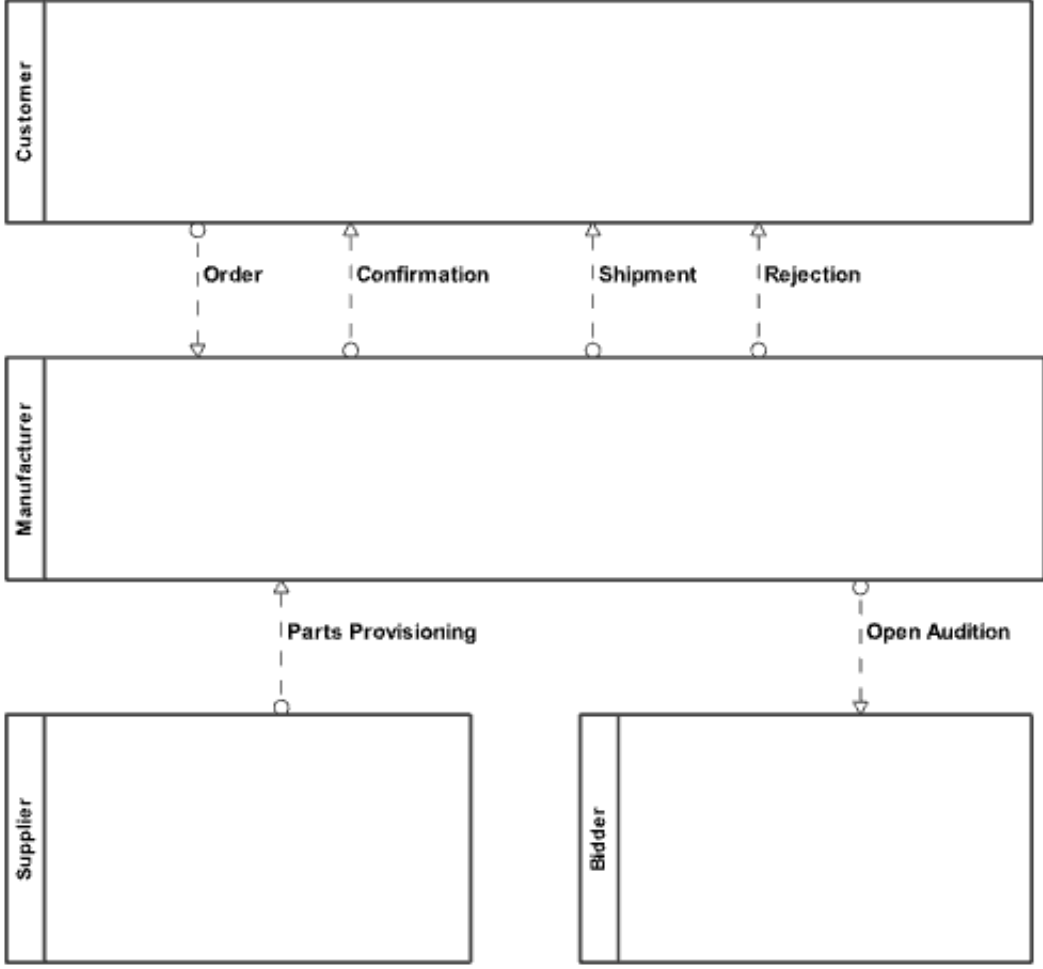
Artifacts

Data Object: Represent information flowing through the process, showing how data is required or produced by activities. They provide a clear understanding of what data is consumed or generated within a specific task or process.

Annotation: Optional labeling to explain the type, format, or usage of the data.

Group: Visual mechanism used to categorize and document parts of a process diagram. It doesn't affect the flow or behavior of the process but adds clarity and understanding.

Connects data to activities (like tasks or events) and other artifacts. It illustrates how data flows into and out of process elements, showing how information is used or generated.
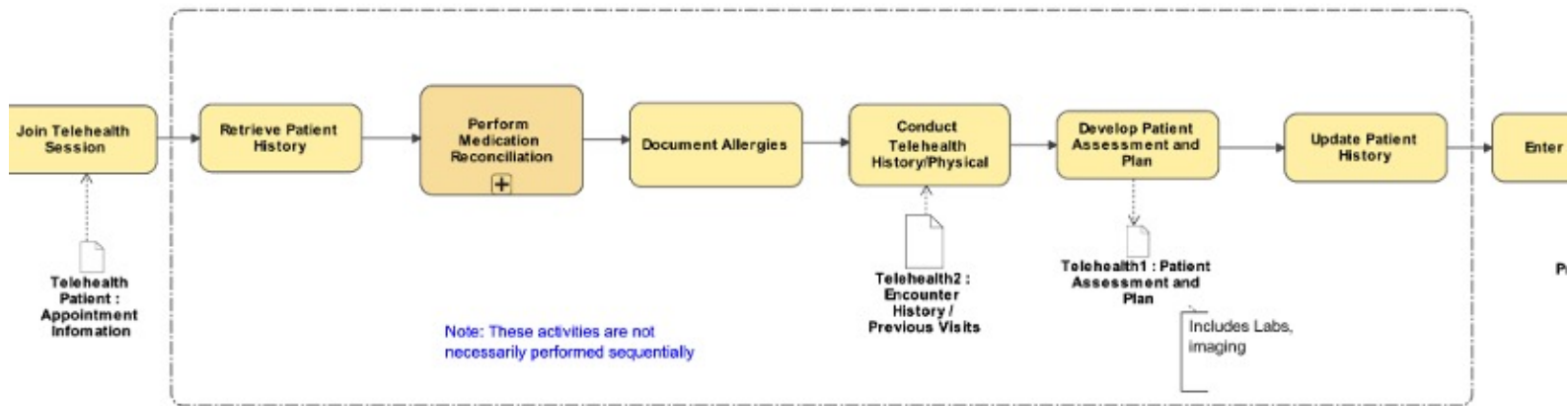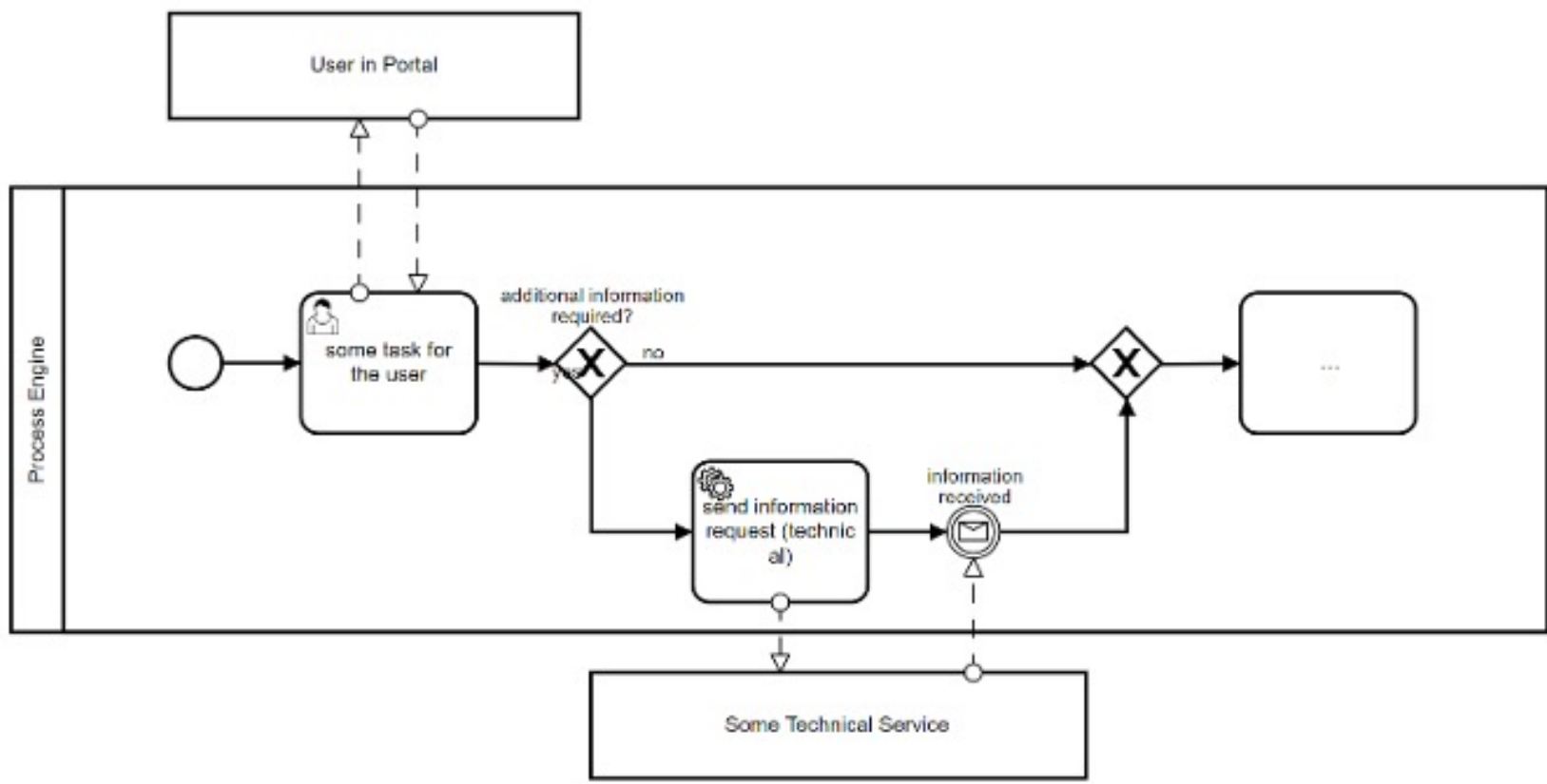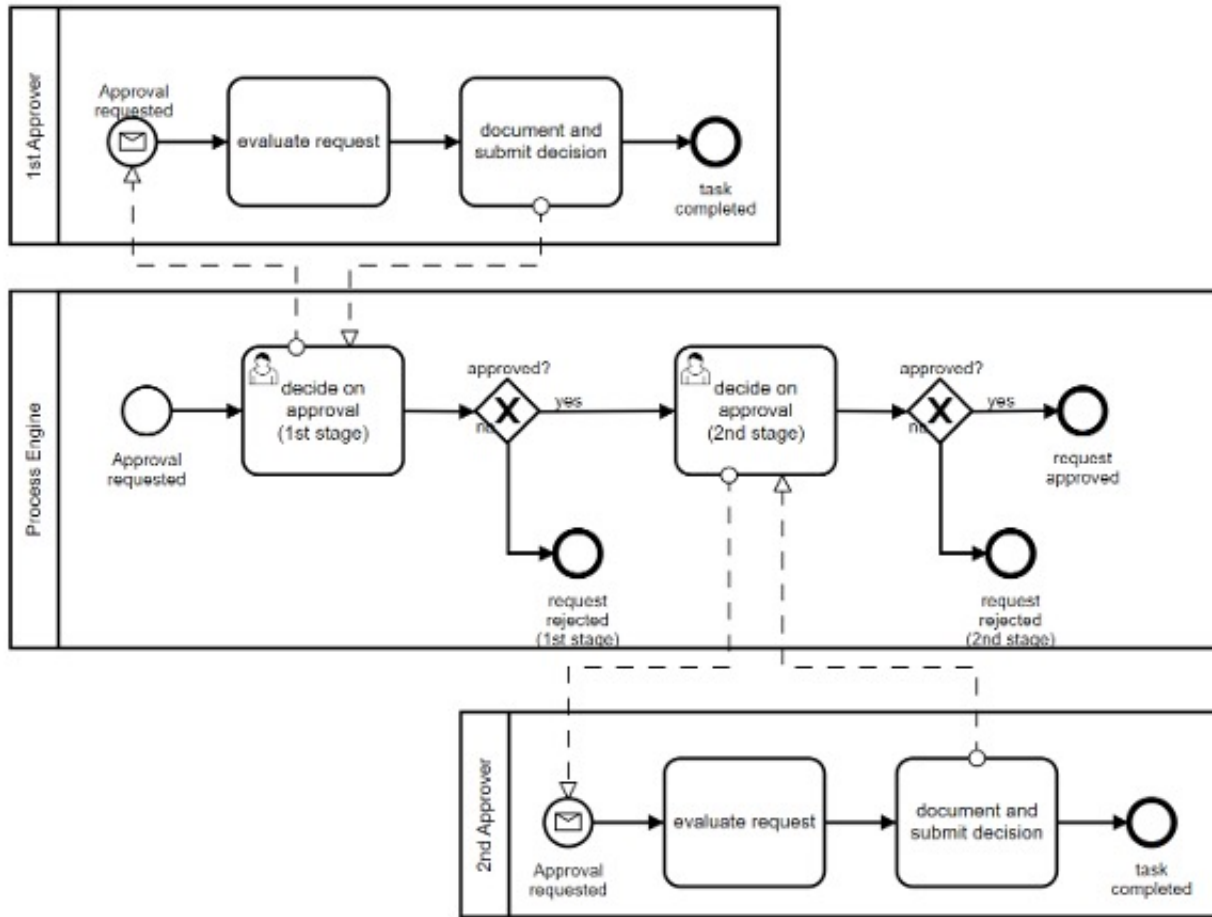
We want to model the following situation using BPMN 2.0. For a request (e.g., a payment) two approvals of two different people are needed. A Process Engine should ensure that both approvals are fulfilled before the request is approved. The manual steps that are performed by the two approvers should also be modeled in the BPMN diagram. The approval decision is performed using a portal with a Tasklist.

The Use Cases
The use cases for this pattern are numerous. Here are some examples:
•Payment Approval
•Invoice Approval
•Contract Approval
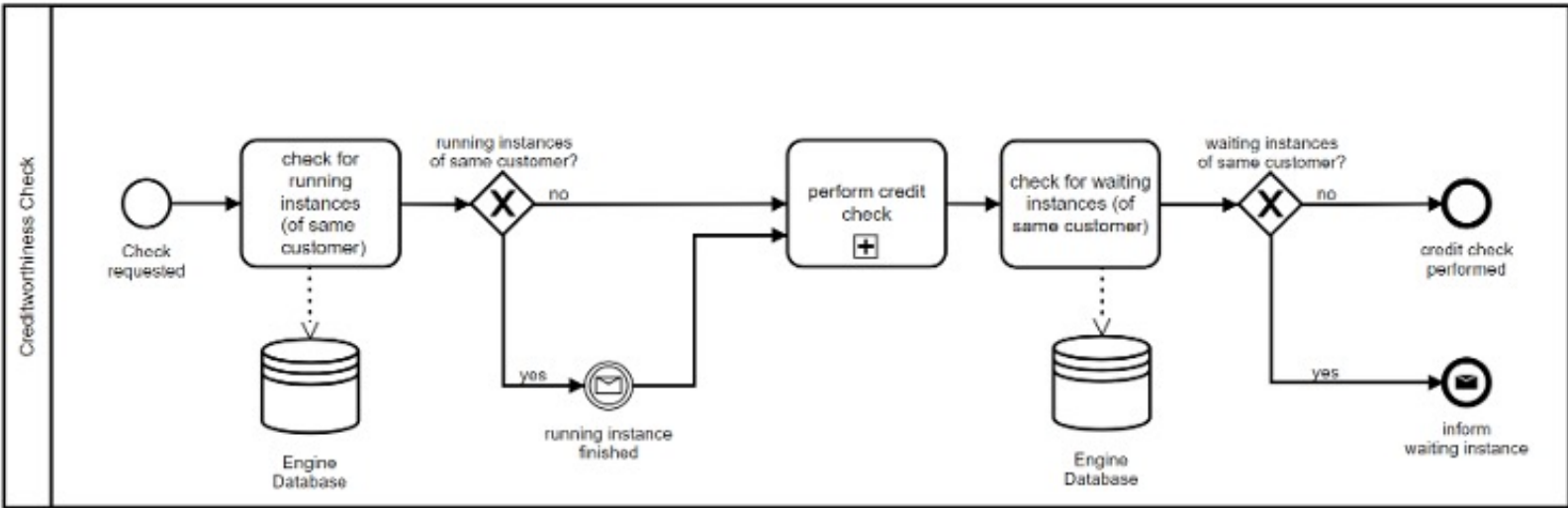
This solution is a bit more complex, since you need to determine the recipient (a single instance) of the message. That induces a second data request before the end of the instance. However, this is the correct way to solve the problem that occurs in the signal event solution.
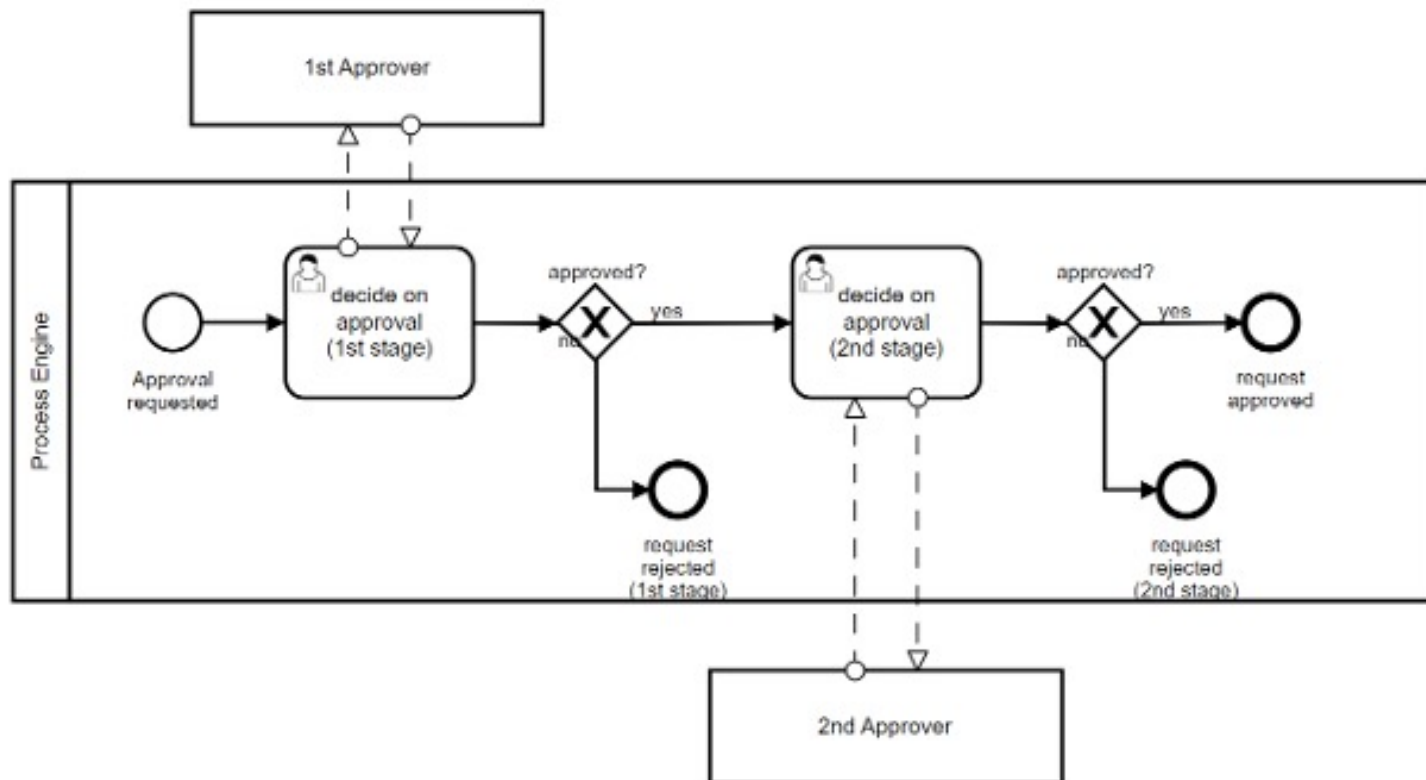
We will use the example of creating a bill. To create the bill, a discount needs
to be computed. The sum of the order and the customer type are the relevant
criteria to compute the discount.
This is a very simple example that will show us where to apply BPMN and
where not to.
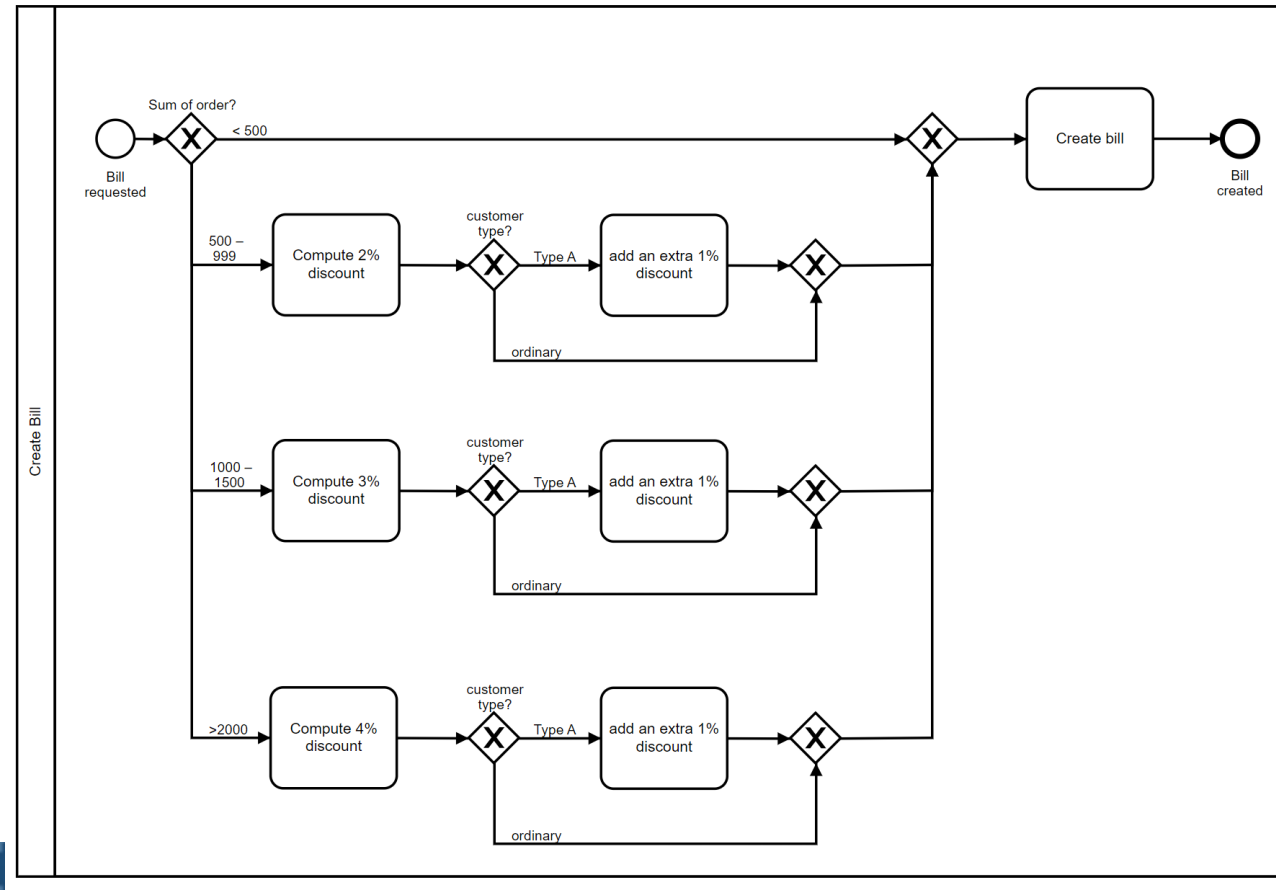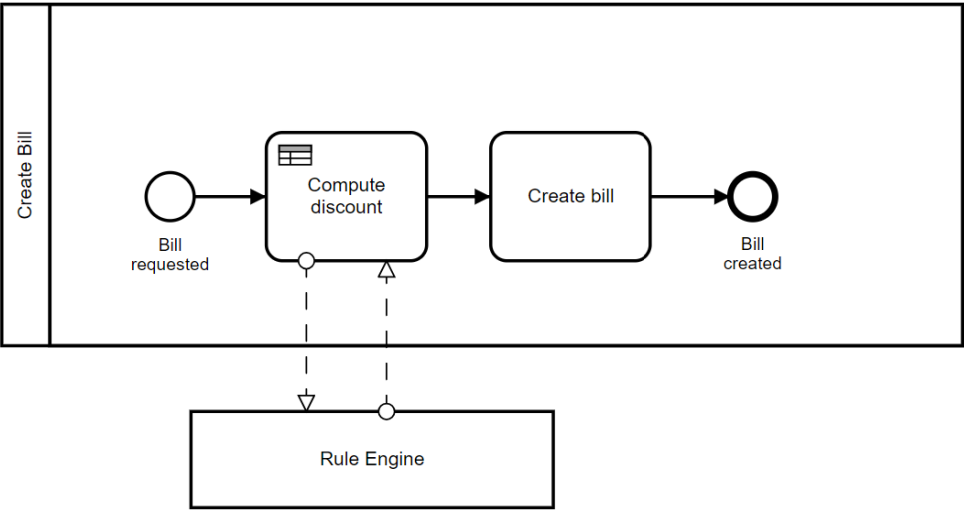
More Information about BPMN

OMG's Business Process Model and Notation Specification

www.omg.org/spec/BPMN/2.0.2/PDF

Collaboration With Pools

Order DB

Store Order

: Order

Order Arrives

Retrieve Parts List

Check if Manf. Capacity & Parts Available

4 hours

: Parts (1..m)

Part Requisition (1..n)

Reset System

[Capacity & Parts Available]

[capacity ok, Parts Must be Ordered]

[Capacity is not Available]

: Order

A

Fulfill Order

process Fulfill Order

Send Order to Customer

Part

: Parts (1..m)

Update Parts List

Retrieve Order

Create Order Confirmation

Send Confirmation to Customer

Produce Assemblies

Create Invoice

Assemblies

Send Assemblies & Invoice to Customer

Order DB

: Order

Invoice

Order Folder

Order is Fulfilled

Send Rejection to Customer

Order is Cancelled

Retrieve Required Parts

process Retrieve Required Parts

Part Requisition (1..n)

Procure Part from Preferred Supplier

All Parts Available?

[No]

[Yes]

Part

Part Auction

Stop Auction   One Day

All Parts Obtained?

[Yes]

[No]

Determine if Part Will Be Available on Time

Update from Customer

Part Available?

[Yes]

[No]

Stop Auction

: Parts (1..m)

[Some Parts not Available]

[Procured Parts]

A