PECE – POLI – USP
MBA – Tecnologia de Software

Aula 06
Mineração de Processos I

Prof. Dr. Rogério Rossi
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Roteiro

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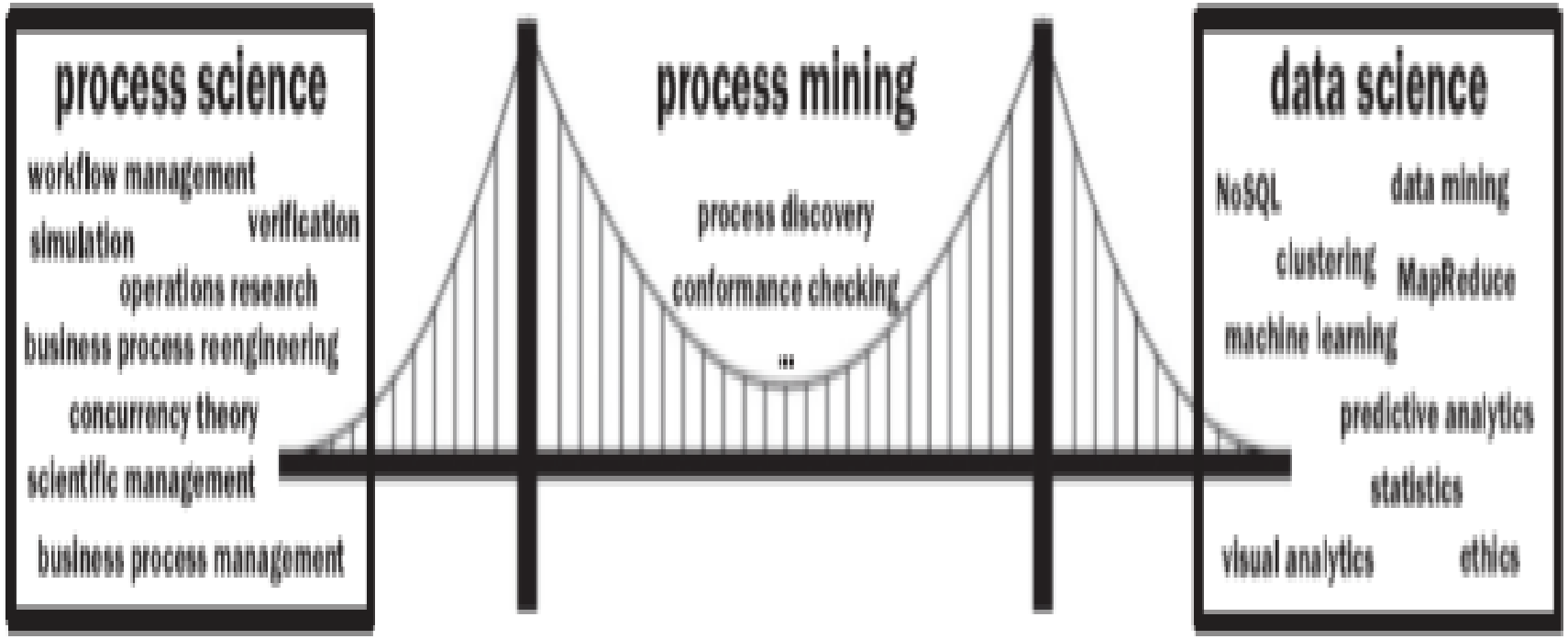
Process Science

- **Process science** refers to a broader discipline that combines **knowledge** from **information technology** and **knowledge** from **management sciences** to improve and run operational processes

- **Process science** aims at **process improvements** in terms of time, costs, quality, speed, flexibility, and reliability

Process Science



Process Science

- The adoption of **IT systems -** resulted in dramatic changes in the organization of work and enabled **new ways of doing business**
- **Innovations** in **computing and communication (ICT Systems)** are still the main drivers behind change in almost all **business processes**
- **Business processes** have become **more complex**, heavily rely on **information systems**, and may span multiple organizations

Process Mining Manifesto

- A **manifesto** is a "**public declaration of principles and intentions**" by a group of people
- The **Process Mining Manifesto** is written by members and supporters of the **IEEE Task Force** (2009)
- The goal of this **task force** is to promote the *research*, *development*, *education*, *implementation*, *evolution*, *and understanding* of **process mining**.

Process Mining Manifesto

- **Process mining** techniques are able to **extract knowledge** from **event logs** commonly available in today's **information systems**

- There are **two main drivers** for process mining interests

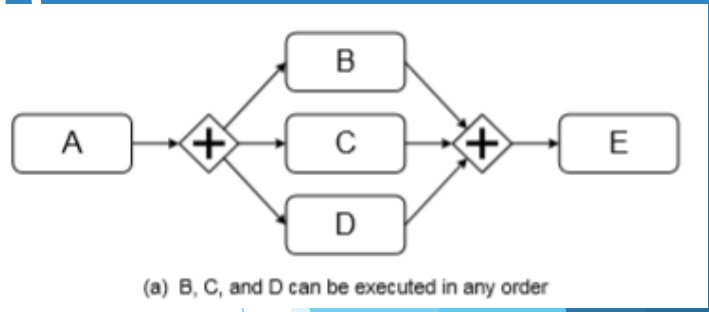
  1. **more and more events are being recorded**, thus, providing detailed information about the history of processes

  2. there is **a need to improve and support business processes** in competitive and rapidly changing environments

Process Mining Manifesto

- **Concrete objectives of the PM Manifesto** are:
  - **To make** end-users, developers, consultants, business managers, and researchers **aware** of the state-of-the-art in process mining
  - To **promote the use** of process mining techniques and tools and stimulate new applications
  - To **play a role** in standardization efforts for logging event data
  - To **organize** tutorials, special sessions, workshops, panels
  - To **publish** articles, books, videos, and special issues of journals

Process Mining Manifesto



(a) B, C, and D can be executed in any order

- **Process Mining – Guiding Principles (GP) –**

six GP was described to prevent users/analysts from making mistakes:

GP1 - Event Data should be treated as first-class citizens

GP2 – Log extraction should be driven by questions

GP3 – Concurrency, choice and other basic control-flow constructs should be supported

GP4 – Events should be related to model elements

GP5 – Models should be treated as purposeful abstractions of reality

GP6 - Process Mining should be a **continuous process**

Process Mining Definition

- **Process mining** is a relatively young research discipline that sits between
  - **computational intelligence** and **data mining**
  - **process modeling** and **analysis**

- **Process mining** provides an important bridge between data mining and business process modeling and analysis
- The idea of **process mining** is to discover, monitor and improve real processes by extracting knowledge from event logs readily available in today's (information) systems

Process Mining Definition

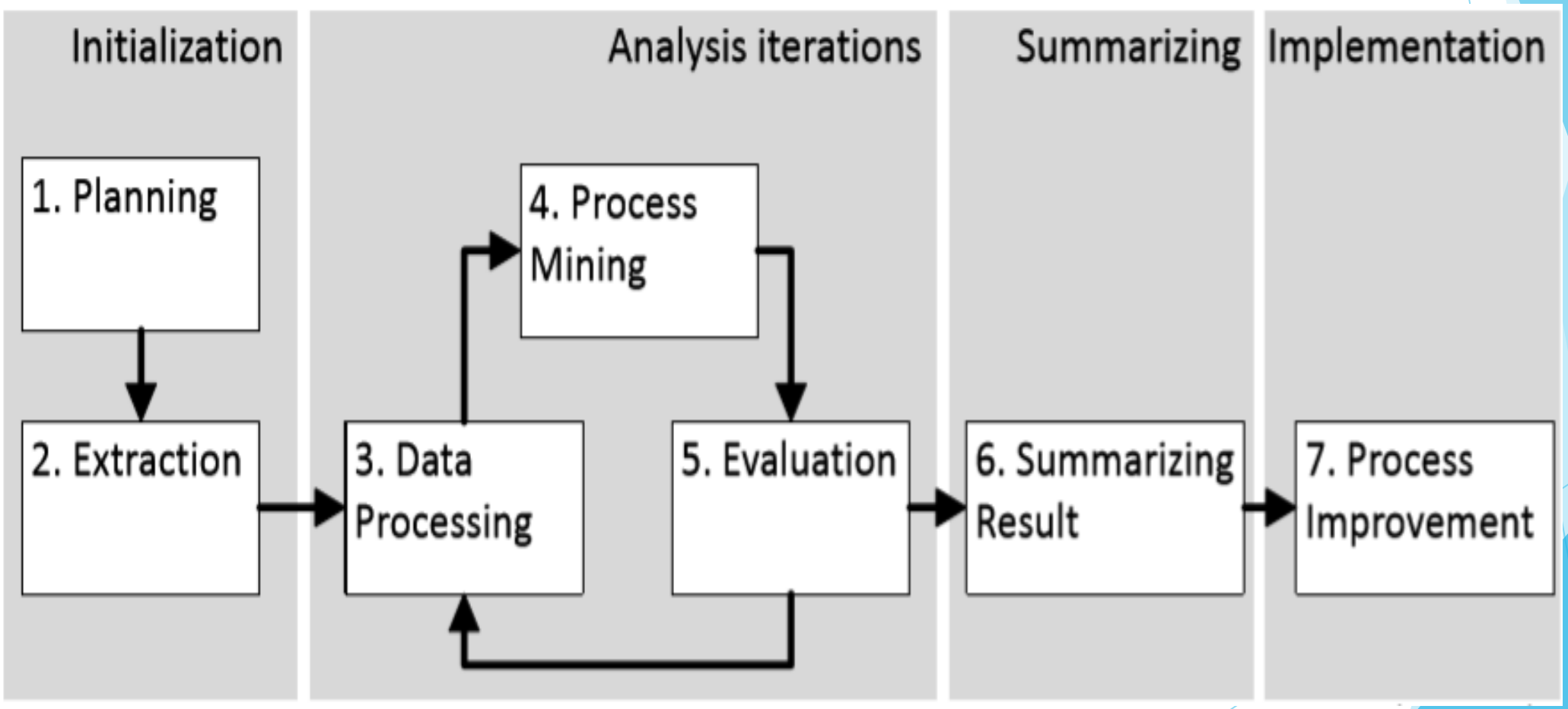
Process Mining (ou Mineração de Processos)

um **conjunto de técnicas** quem **extraem conhecimento de logs de eventos** armazenados em diversos sistemas de informações, afim de **descobrir modelos** que representam o **processo analisado**, verificar a **conformidade dos eventos em relação ao modelo descoberto**, e por fim ampliar e expandir o modelo descoberto tratando informações de gargalos, desempenho e recursos.

(Garcia *et al.*, 2019)

Process Mining Definition

Process Mining activities

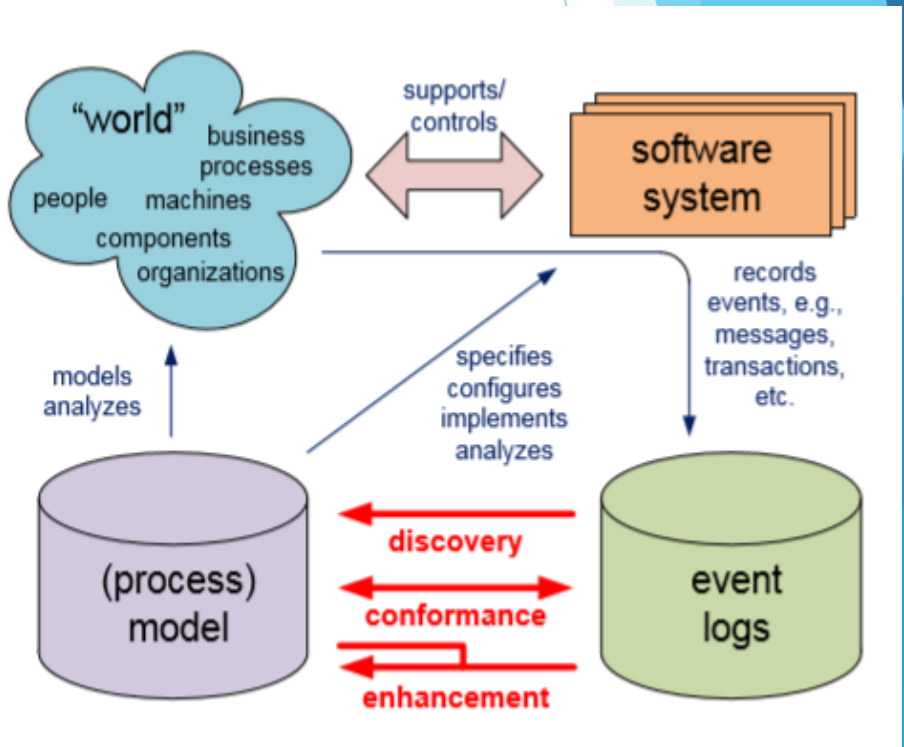


Process Mining Definition

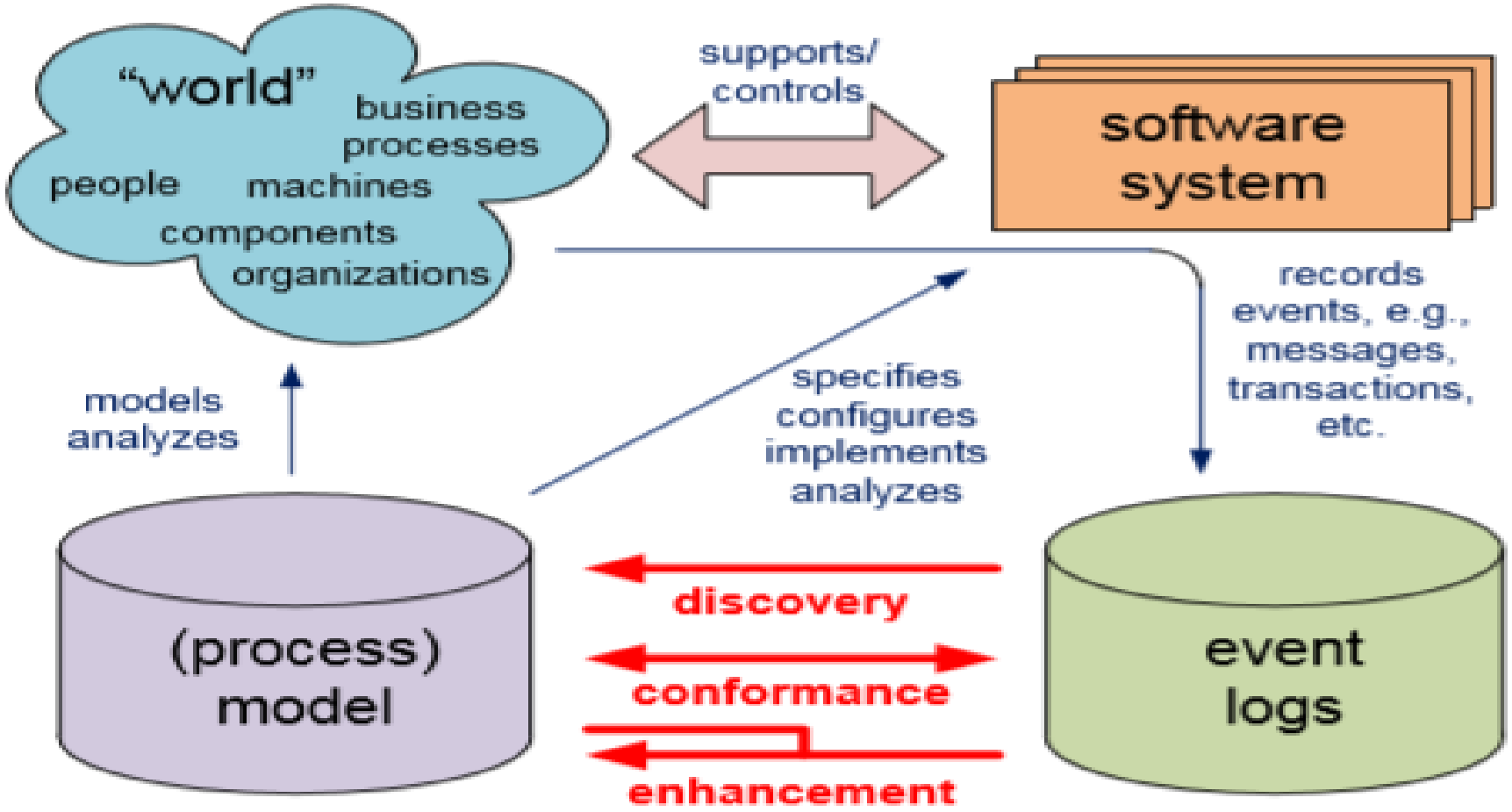
- **Process mining** includes
  - **DISCOVERY -** takes an event log and produces a process model without using any a-priori information
  - **CONFORMANCE -** monitoring

    deviations by comparing model and event log**.**

    Conformance checking can be used to check if reality, as recorded in the log, conforms to the model and vice versa
  - **ENHANCEMENT -** the idea is to extend or improve an existing process model using information about the actual process recorded in some event log.

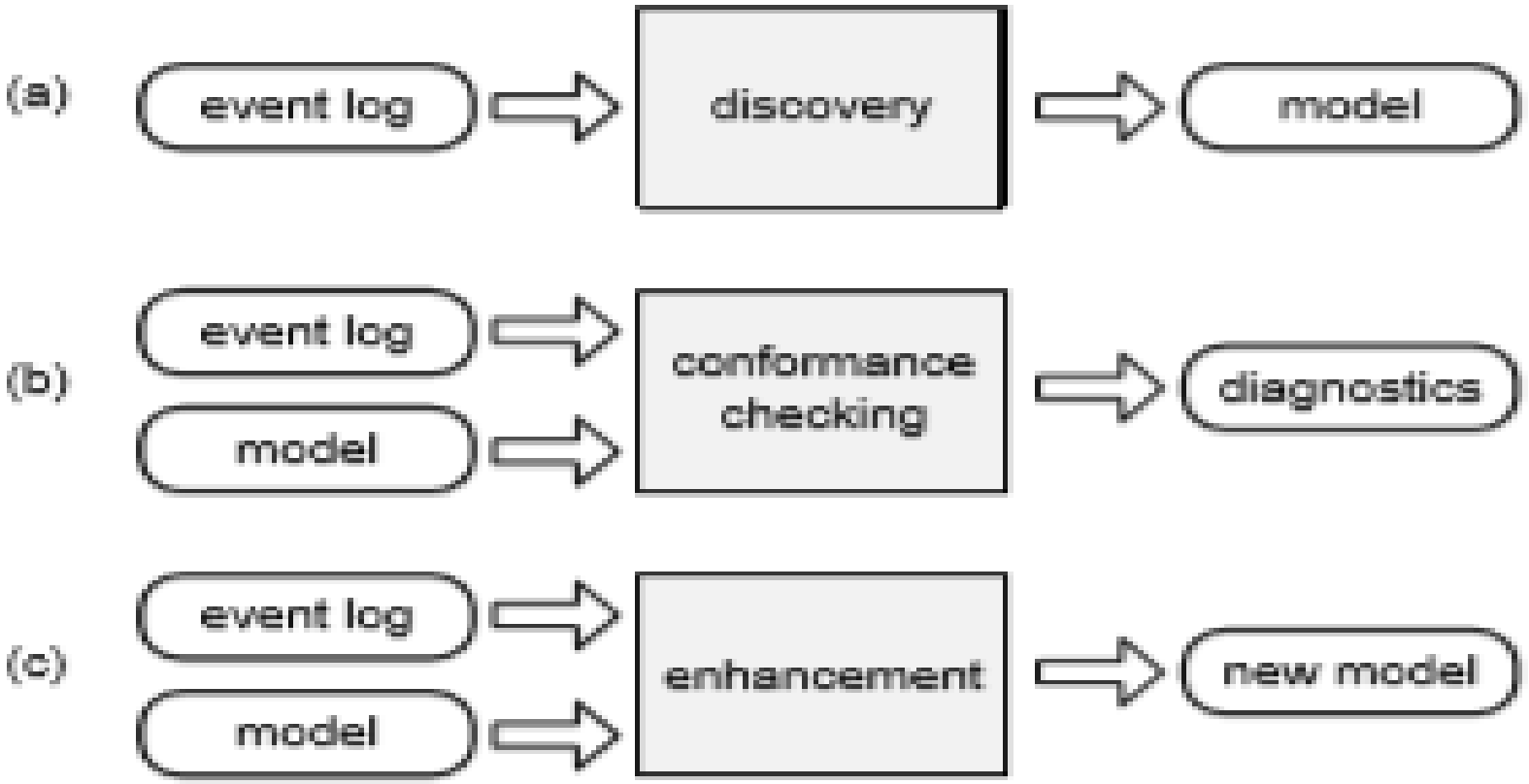


Process Mining Definition



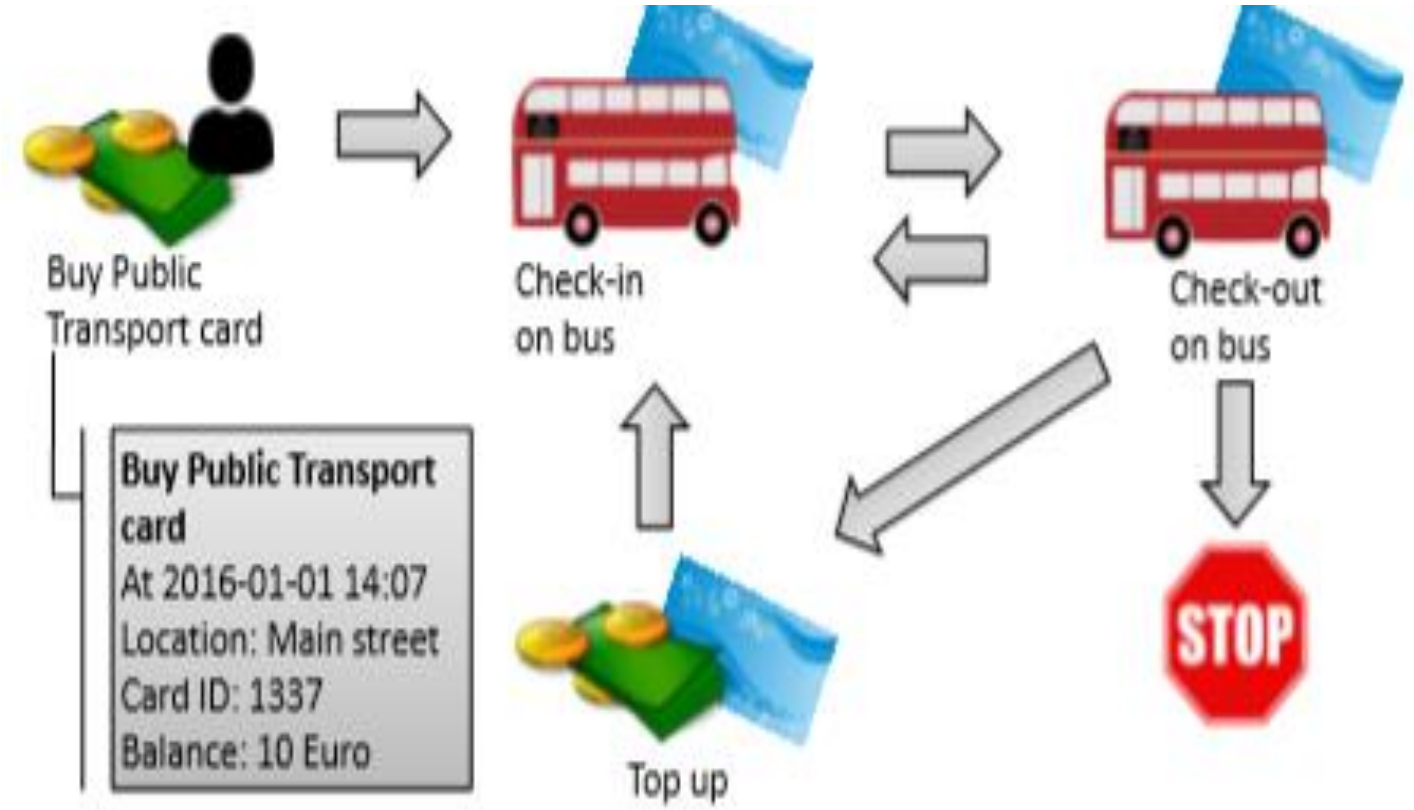
Process Mining Definition

Process Mining based on its inputs and outputs

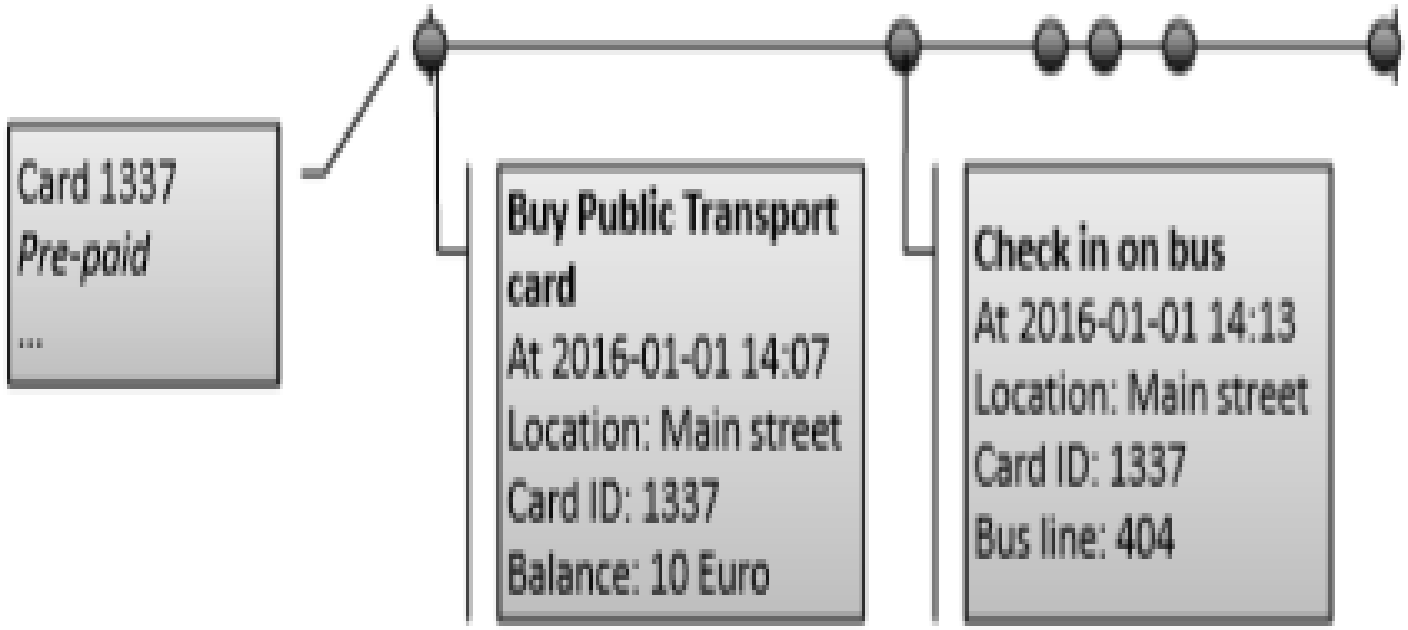


Process Mining & Event Logs

Process Mining & Event Logs



Process Mining & Event Logs



Process Mining & Event Logs

Card ID	Action	Timestamp	Location	Card Balance
1337	Buy Public Transport card	2016-01-01 14:07	Main Street	10
1337	Check in on bus	2016-01-01 14:13	Main Street	8
1337	Check out on bus	2016-01-01 14:42	Central Station	9.20
9927	Check in at station	2016-01-01 15:03	Airport Train Station	22
9927	Check out at station	2016-01-01 17:24	Central Station	16

Process Mining & Event Logs

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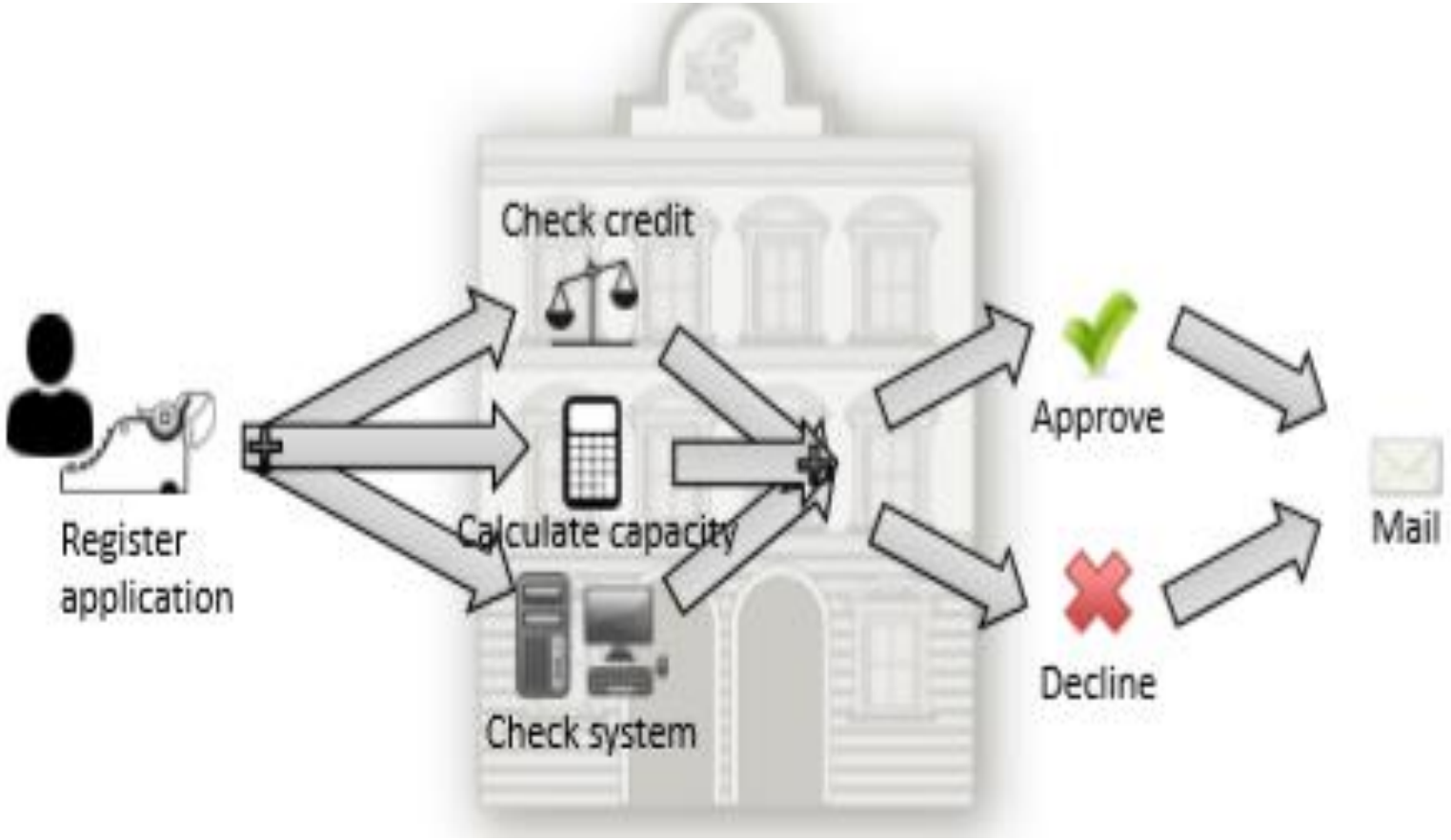
Trace

Event Name

Event Timestamp

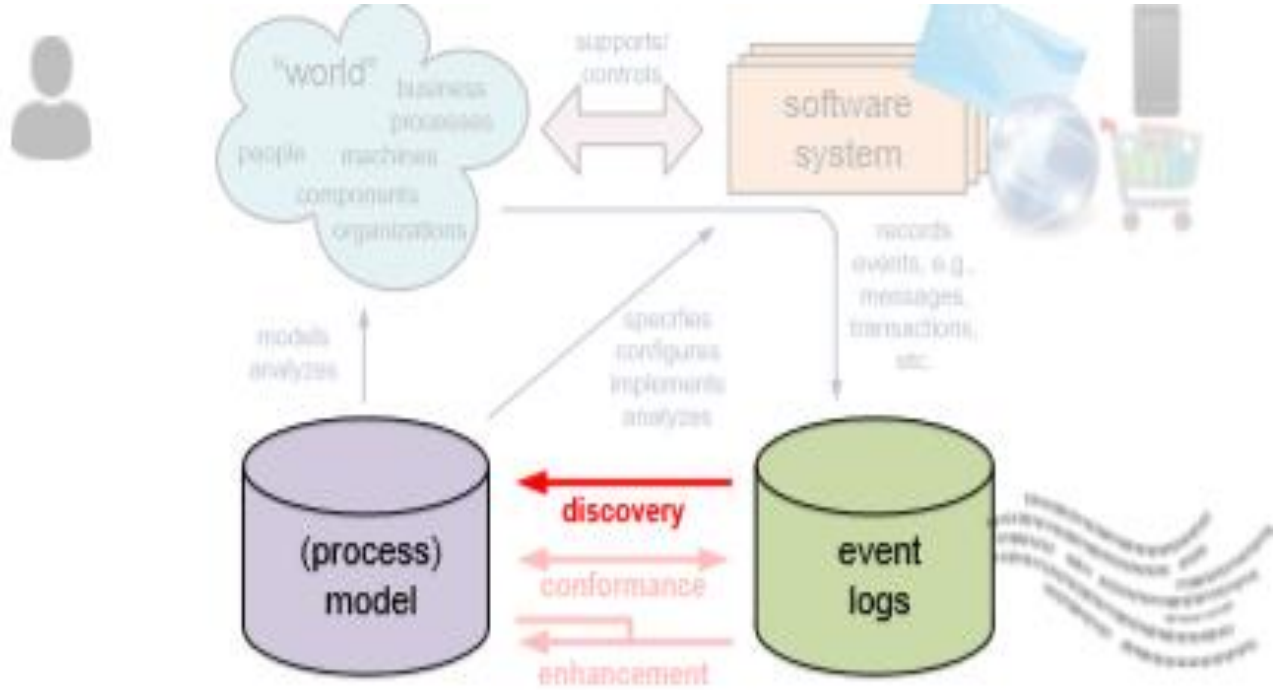
Event Extra Attributes

Process Mining & Event Logs

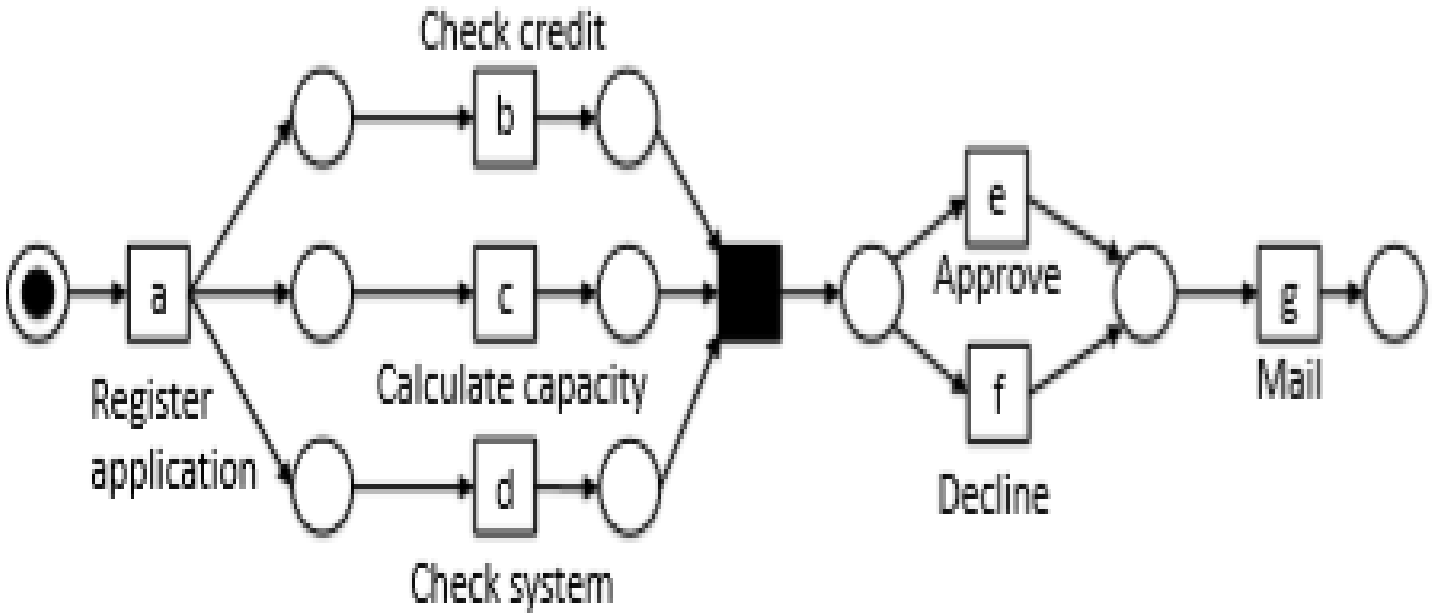


Process Mining & Event Logs

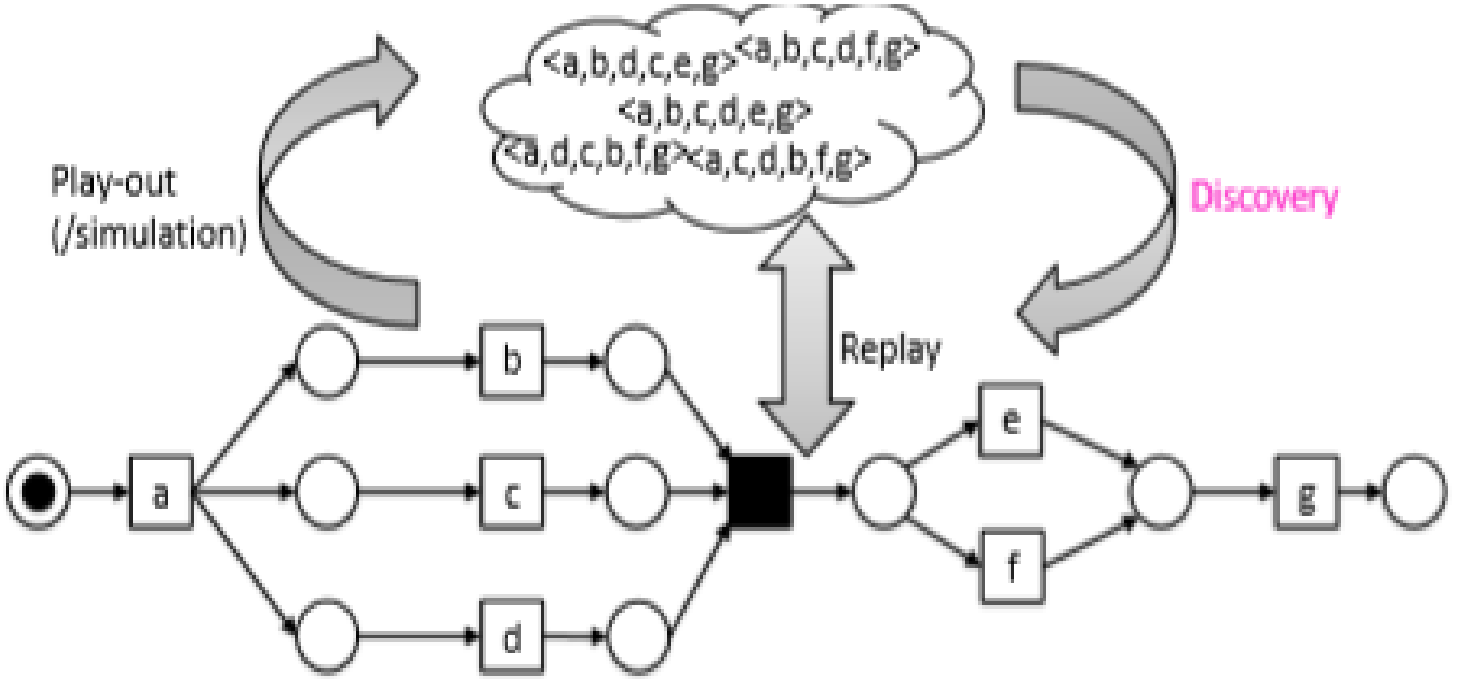
- Discovery



Process Mining & Event Logs



Process Mining & Event Logs



Process Mining & Event Logs

- Recognize patterns

Common patterns:

- Sequence
- Choice
- Parallelism
- Loops

<a,b,c,d,e,g>
<a,b,c,d,f,g>
<a,c,d,b,f,g>
<a,b,d,c,e,g>
<a,d,c,b,f,g>

1. Each trace has length 6
2. *a* is always first, and g last
3. *e* and *f* are alternating, and second last
4. *b*, *c* and *d* each occur once, in any order

Process Mining & Process Engineering

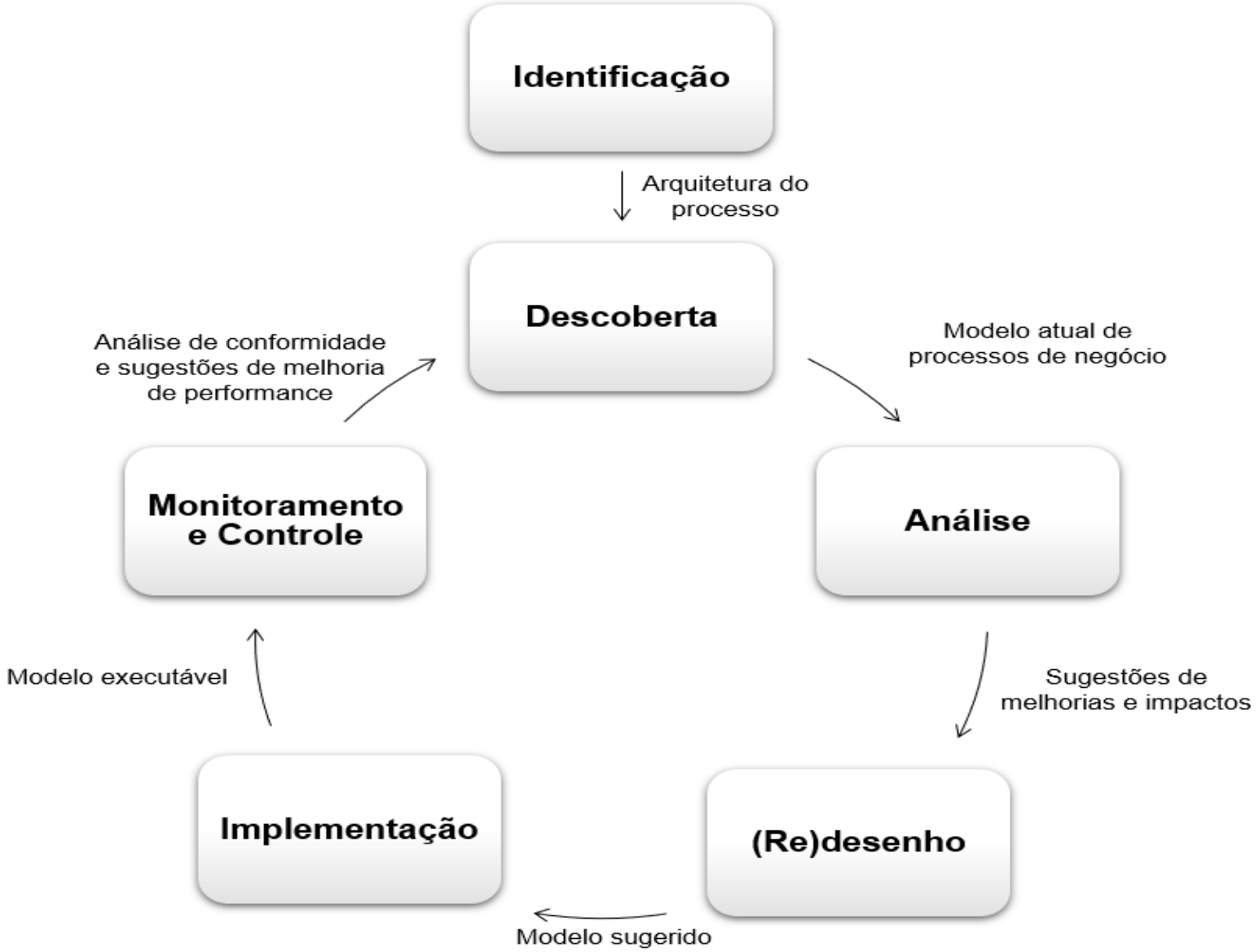
- Antes da **ascensão da mineração de processos**, o **engenheiro de processos** definia o **processo** baseado em **modelos pré-definidos** e também em suas **experiências**, e, então, os colaboradores de cada área deveriam **praticar o processo desenhado**.
- O **modelo do processo** sofre pouca influência das pessoas que **realmente o colocam em prática** e acabam **não atendendo** características específicas das organizações.

Process Mining & Process Engineering

Rubin et al. (2007), Van Der Aalst et al. (2011) e Lemos et al. (2011)

indicam que é possível utilizar **técnicas de mineração de processos** para auxiliar na **descoberta/identificação do modelo de processo** real sendo executado, e também detectar discrepâncias – que são **humanamente impossíveis** de serem detectadas manualmente, devido ao volume dos dados – entre os modelos e a execução dos processos.

Process Mining & Process Engineering



Process Mining & Event Logs

Exemplos de eventos gerados por sistemas baseados em software:

- saque de caixa eletrônico,
- um médico que ajusta uma máquina de raio x,
- um cidadão dando entrada em sua carteira de motorista,
- pagamento de imposto de renda e
- recebimento da passagem eletrônica de um viajante.

Como explorar os dados dos eventos para prover ideias de melhorias, identificar gargalos, antecipar problemas e agilizar processos?

Process Mining & Event Logs

Para a **mineração de processos** utiliza-se o **log de eventos**.

- As **técnicas de mineração de processos** assumem que é possível **registrar sequencialmente os eventos** de forma que cada evento se refira a uma atividade (um passo dentro de um processo) e está relacionado a um caso particular (uma instância de processo).
- Os **logs de eventos** podem conter informações adicionais, como por exemplo, o recurso (pessoa ou dispositivo) que está executando ou iniciando a atividade, a data e o horário do evento.

Process Mining - Types

Tipos de Mineração de Processos

- **Identificação (*discovery*)**
- **Conformidade (*conformance*)**
- **Otimização (*enhancement*)**

(Van Der Aalst *et al.*, 2011)

Process Mining - Types

Tipos de Mineração de Processos

Identificação (*discovery*)

- **gerar o modelo** a partir da **leitura do log de eventos**, sem utilizar informações adicionais
- Trata-se do tipo de mineração mais proeminente porque **as técnicas existentes são realmente capazes de descobrir processos reais** simplesmente baseados nos exemplos de execução dos logs

Process Mining - Types

Tipos de Mineração de Processos

Conformidade (***conformance***)

- Visa **verificar a conformidade do processo atual**, o **modelo formal** que está vigente **comparado com o modelo gerado** a partir dos logs de execução.
- Permite **verificar** se a **realidade encontrada nos logs de execução** está **em conformidade com o modelo desenhado**, e vice-versa.

Process Mining - Types

Tipos de Mineração de Processos

Otimização (*enhancement*)

- visa **melhorar o modelo formal** existente com base nas informações presentes nos logs de execução.
  - Utiliza-se a informação de data/horário do log de execução para apresentar gargalos, nível de serviço, tempo de processamento e frequência.