POLITECNICO
MILANO 1863

Making IT Green

Awareness-Driven Service Design and Management

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October 13, 2022

WHO AM I?

Assistant Professor at **Politecnico di Milano** in Italy and **Visiting Researcher** at **Umeå University** in Sweden

I research new strategies to improve the efficiency of **data centers** and **clouds** by applying techniques derived from the **Artificial Intelligence** and **Machine Learning** fields.

I am very interested in **adaptation** and **self-adaptation** to discover how a complex system can heal itself when some problems occur.

MY TOPICS

GREEN IS

Energy-efficiency aware Information Systems. Detect undesired situations and select proper repair action using an adaptive decision system.

IS MONITORING

Enable monitorability of applications. Discover hidden relations between monitoring data. Build prediction models. Apply techniques to reduce the volume of monitoring data.

DaaS IN FOG

Move computation and/or data nearer to the users to improve Data Utility (QoS and Data Quality). Support the selection of the most suitable data source and manage data and computation movement for SLA satisfaction.

BIG DATA QUALITY

Context-aware assessment of data quality for Big Data. Definition of new metrics and new techniques for assessing data quality with Big Data and limited time.

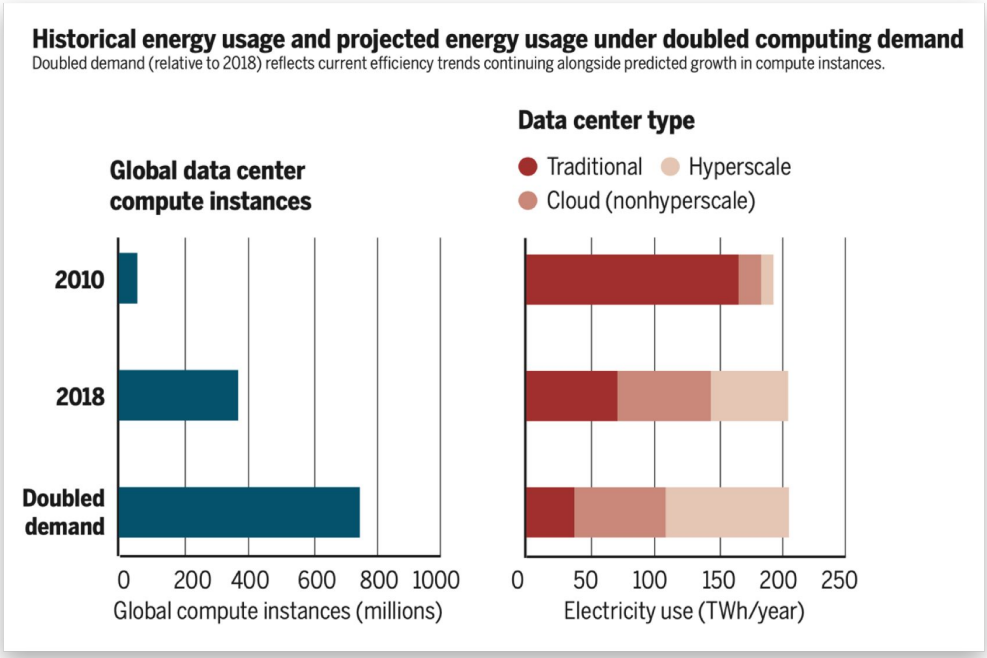
PROCESSES IN IoT

Discover the relation between business process execution and data generated by IoT sensors. Improve the cooperation between business processes.

SERVERLESS IN FOG

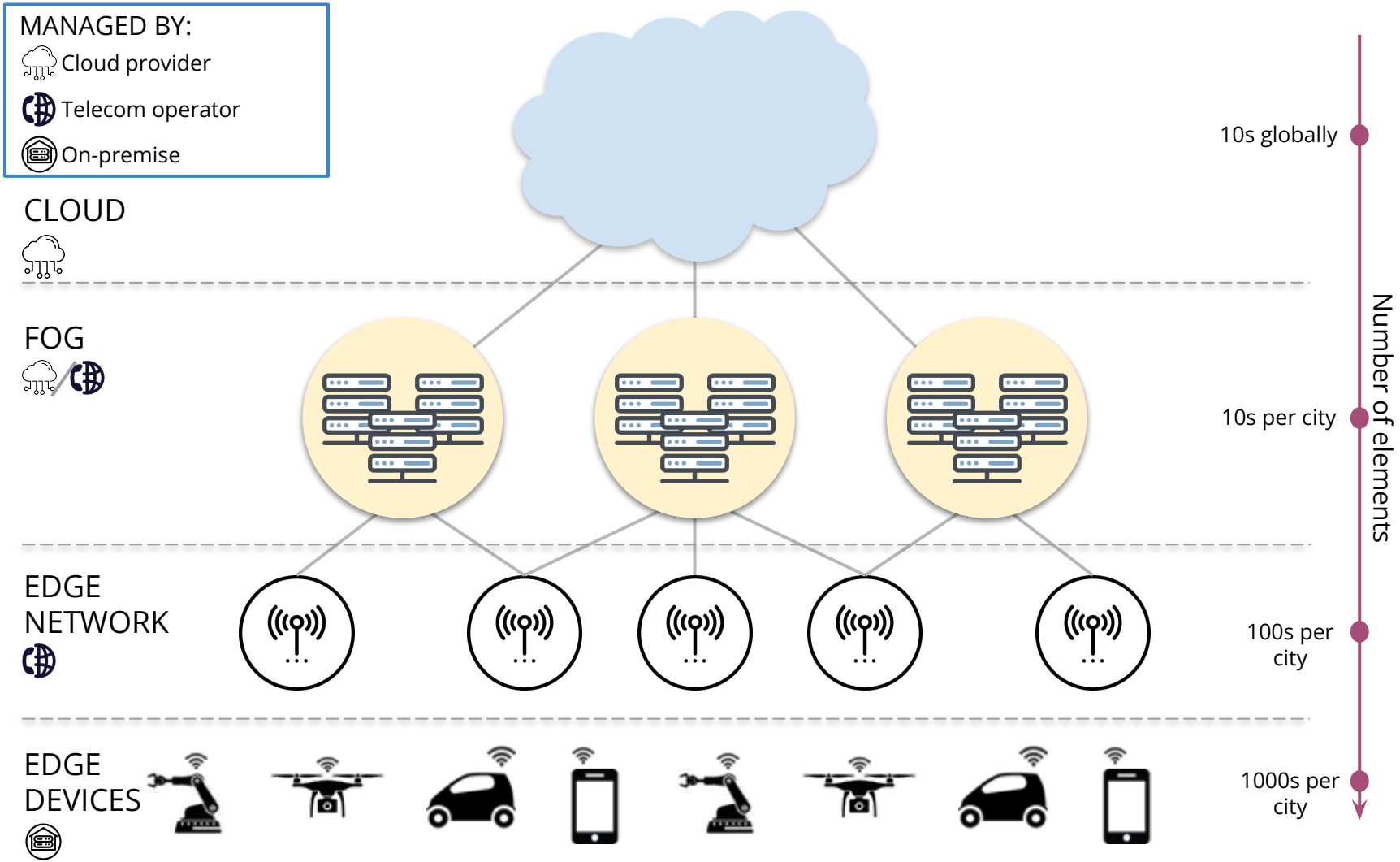
Improving energy efficiency and quality of service of serverless applications and FaaS scenarios in heterogeneous fog environments.

CONTEXT



"Data centers are energy-intensive enterprises, estimated to account for around ***1% of worldwide electricity use*** *[and] have clear implications for global energy demand. By 2018,* ***global data center workloads and compute instances had increased more than sixfold*** *[compared to 2010]. The* ***next doubling of global data center compute instances*** *may occur within the next 3 to 4 years"*

Eric Masanet et. al., Recalibrating global data center energy-use estimates. Science, 2020.


MANAGED BY:
Cloud provider
Telecom operator
On-premise
CLOUD
FOG
EDGE NETWORK
EDGE DEVICES
10s globally
10s per city
100s per city
1000s per city
Number of elements

GOAL engage application designers in the path towards IT and IS sustainability

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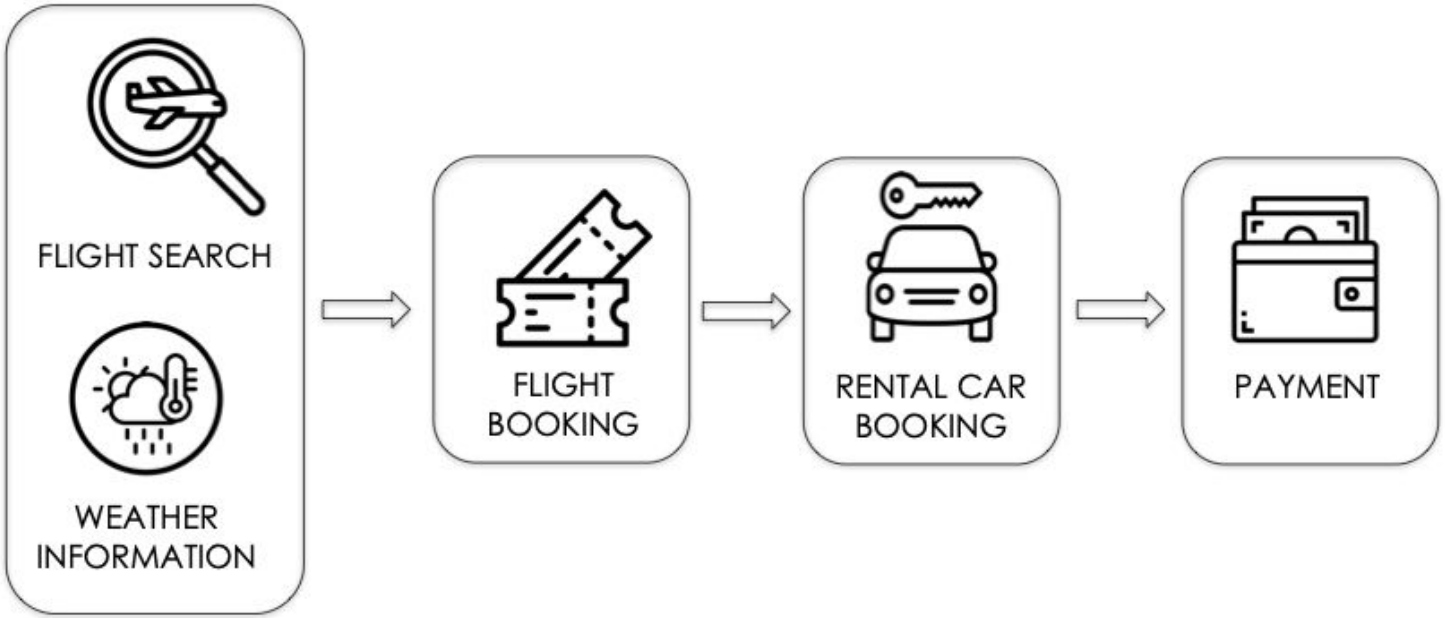
- Increasing sustainability-awareness
- Suggesting best practices
- Providing tools for sustainable-driven (re)design

CLOUD NATIVE APPLICATIONS



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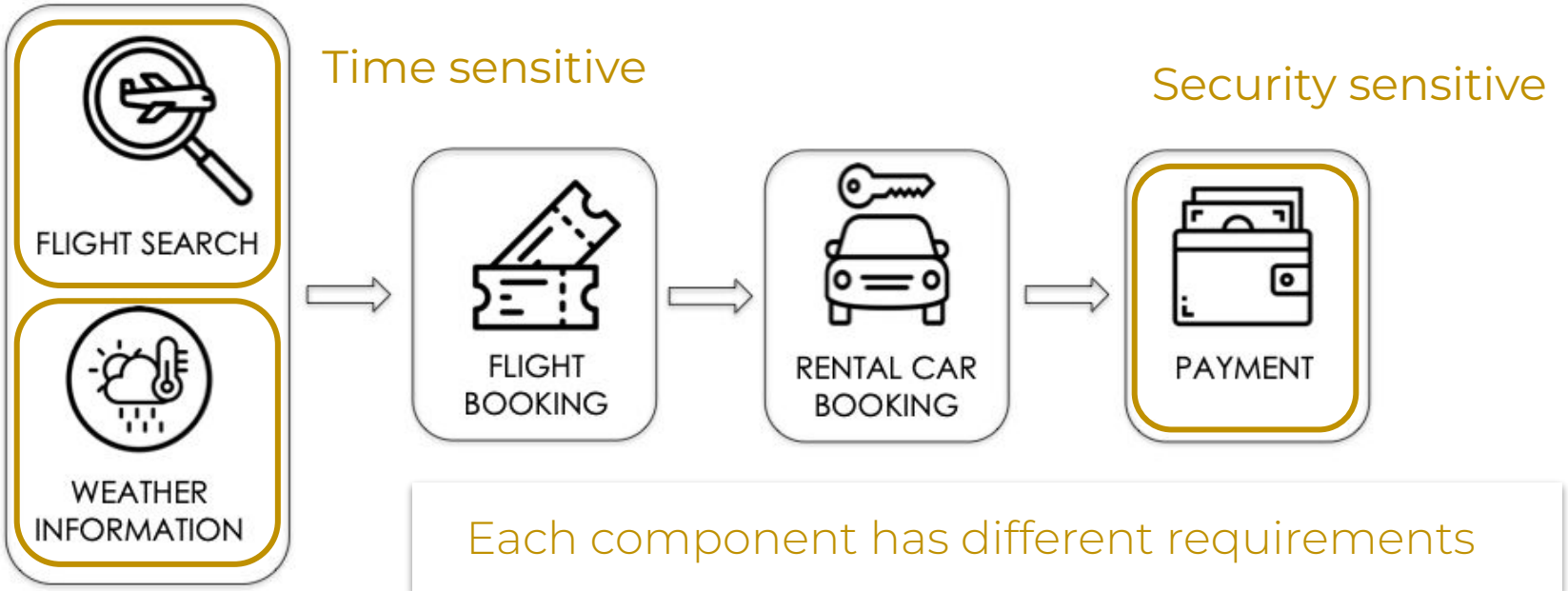

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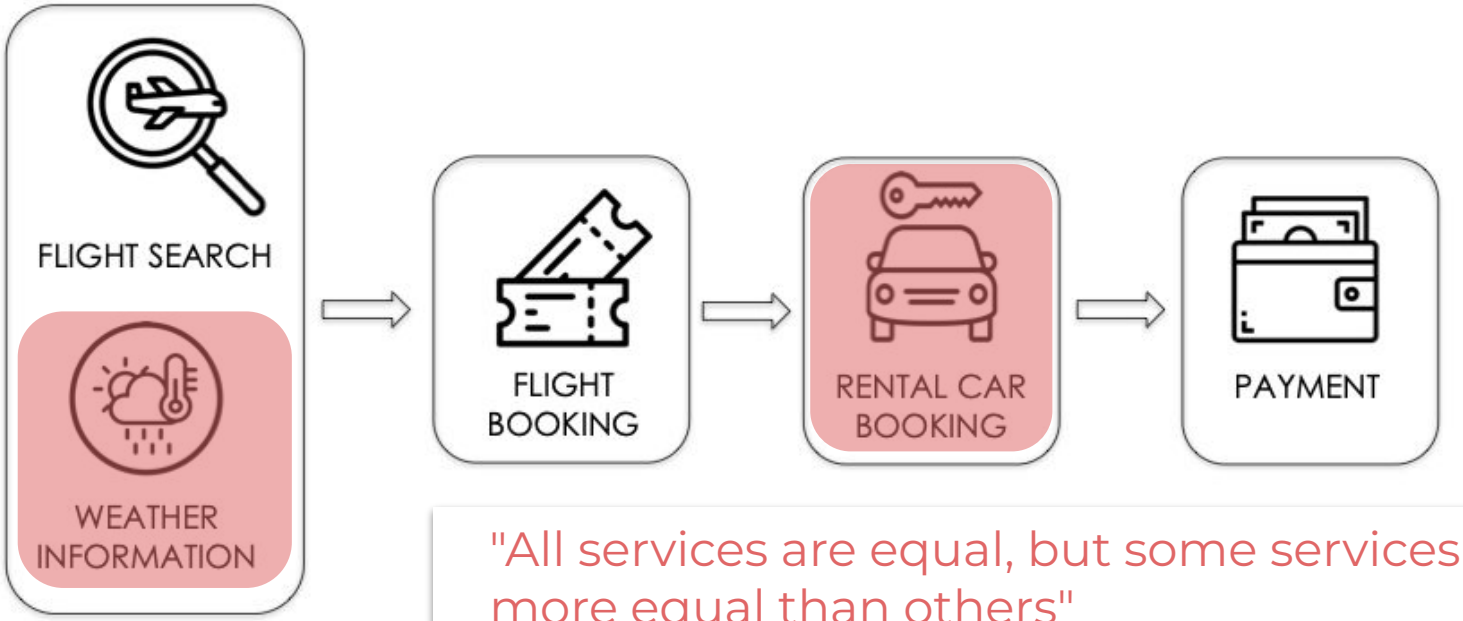
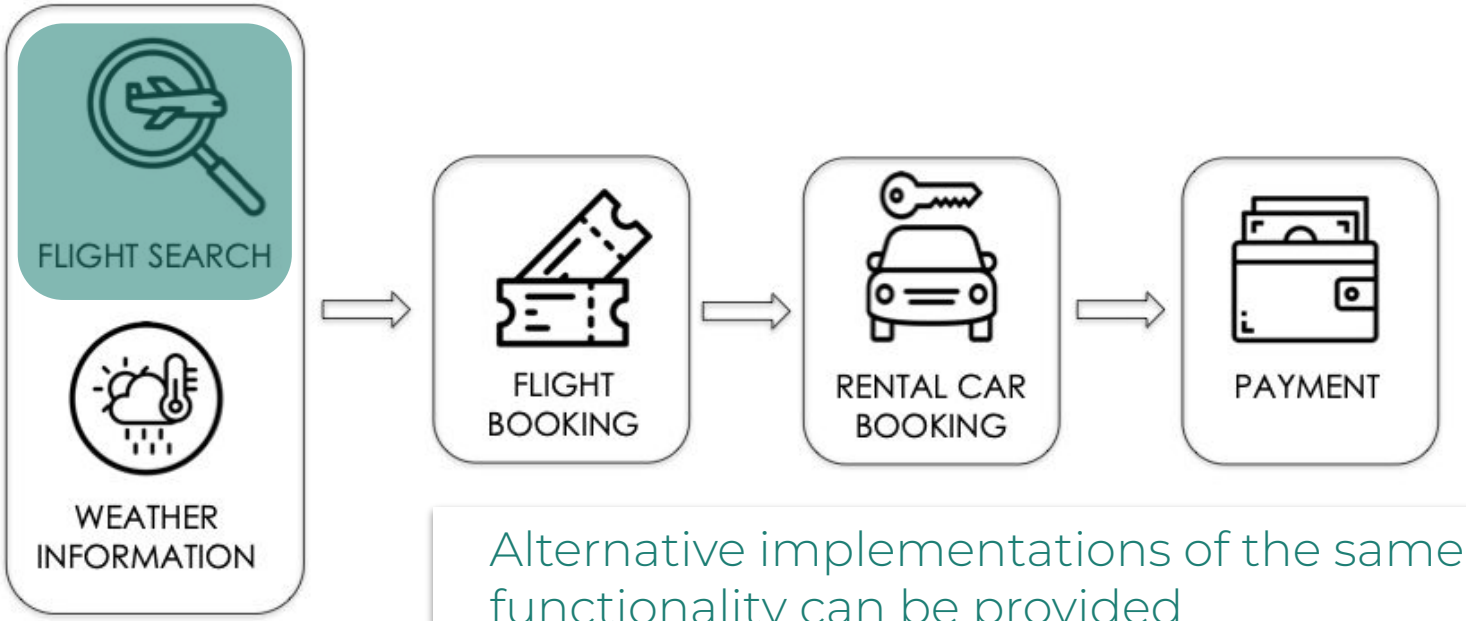


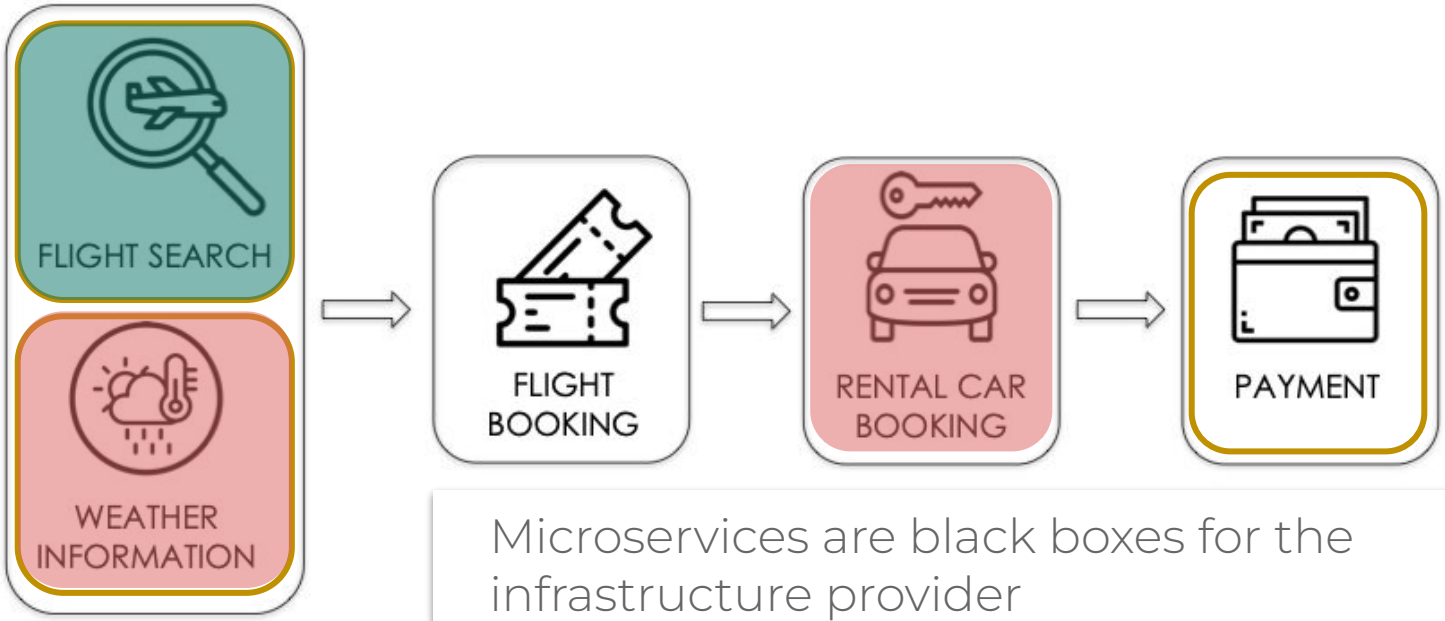
"All services are equal, but some services are more equal than others"

CLOUD NATIVE APPLICATIONS



Alternative implementations of the same functionality can be provided

CLOUD NATIVE APPLICATIONS

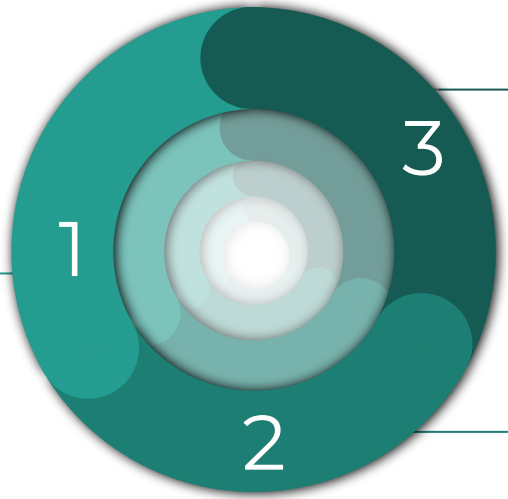


Microservices are black boxes for the infrastructure provider
All these features are hidden and don't adapt with the context of execution

SADP - Sustainable Application Design Process

SUSTAINABILITY AWARENESS

Microservice annotation with computational requirements, QoS constraints, and power consumption metadata



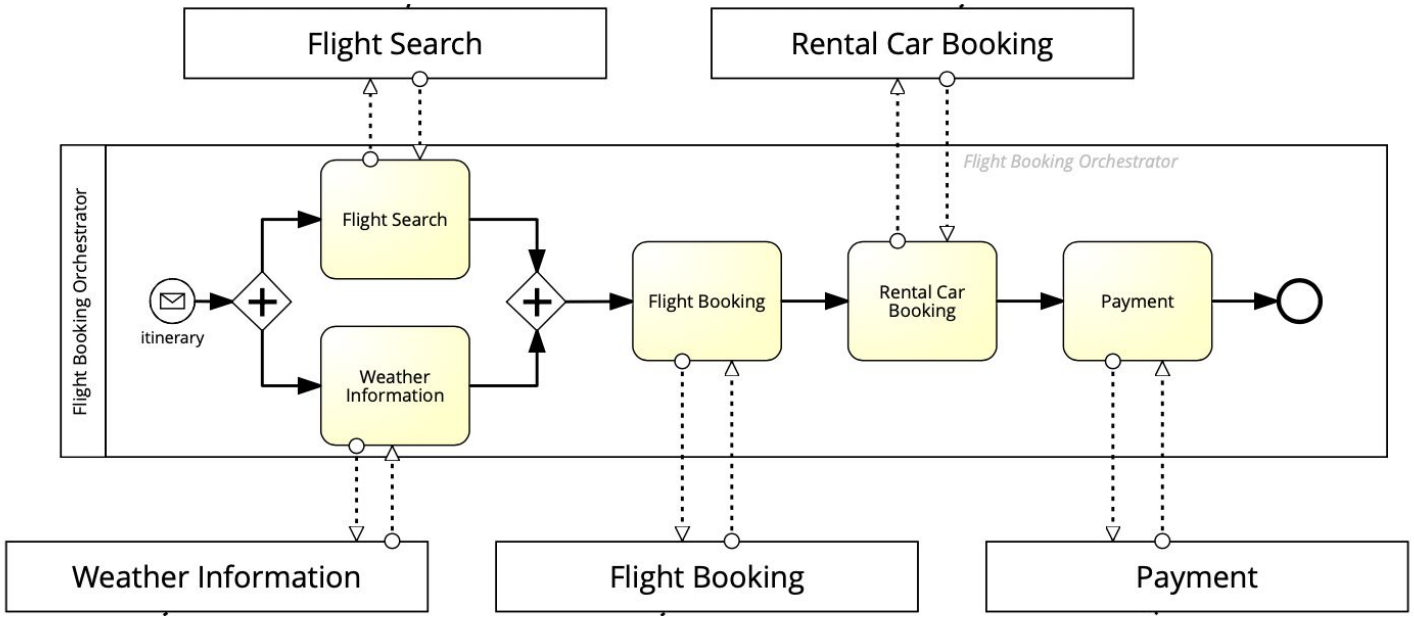
MICROSERVICE ENRICHMENT

Designers provide different execution modalities for the microservices composing the application

MICROSERVICE CLASSIFICATION

Application components are annotated with their relevance for the overall process

SADP 1 - Sustainability Awareness



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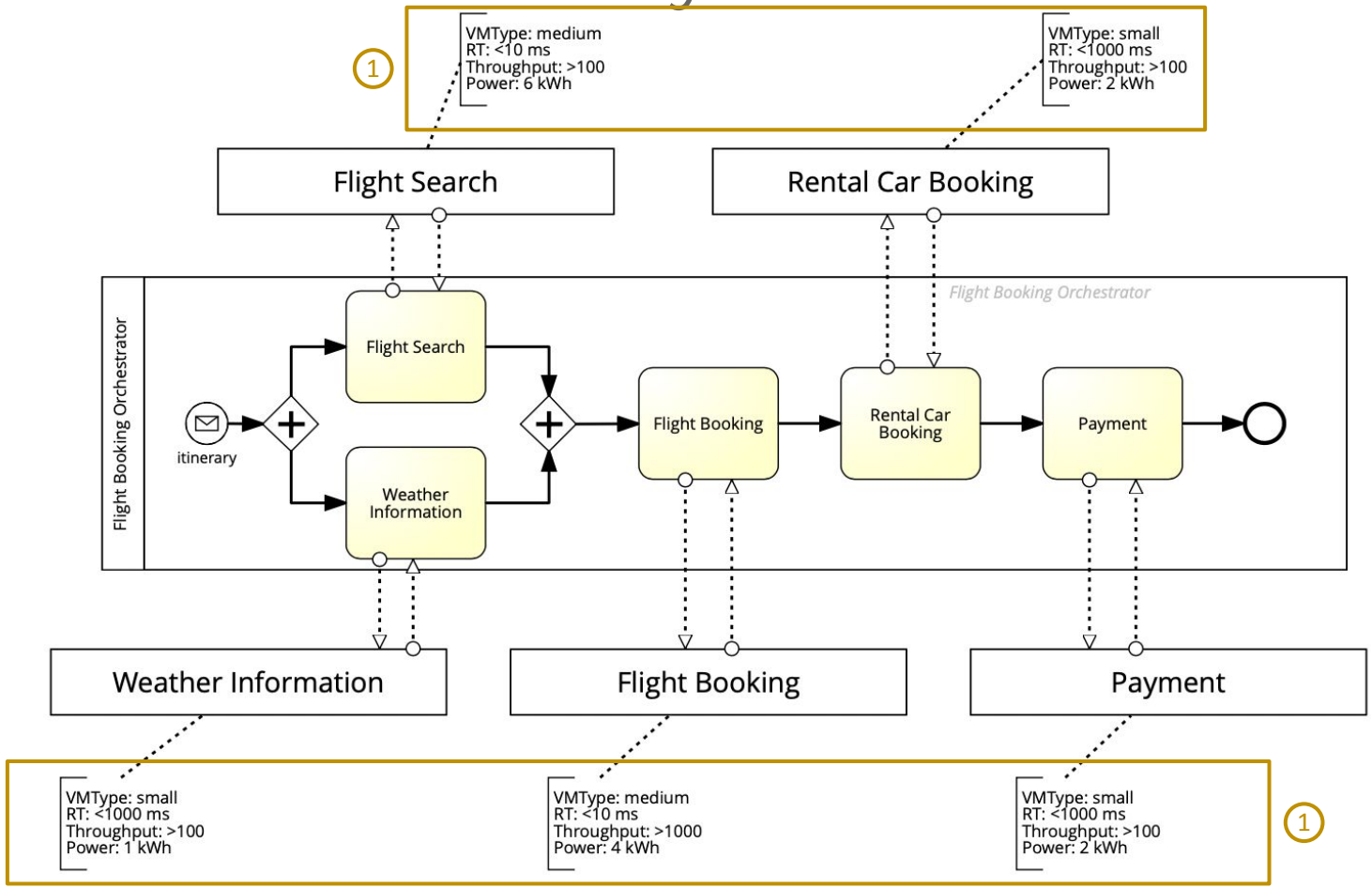
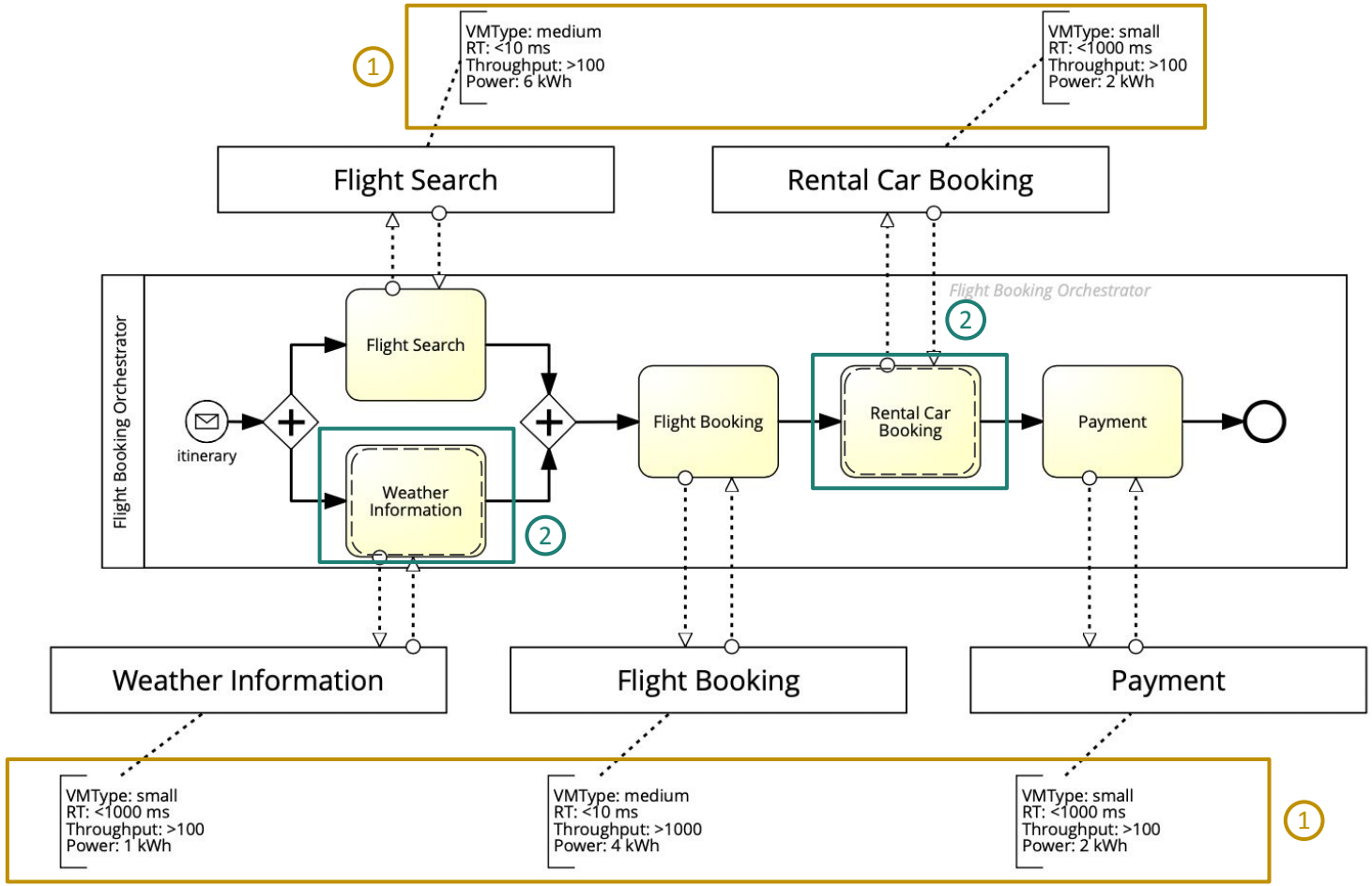
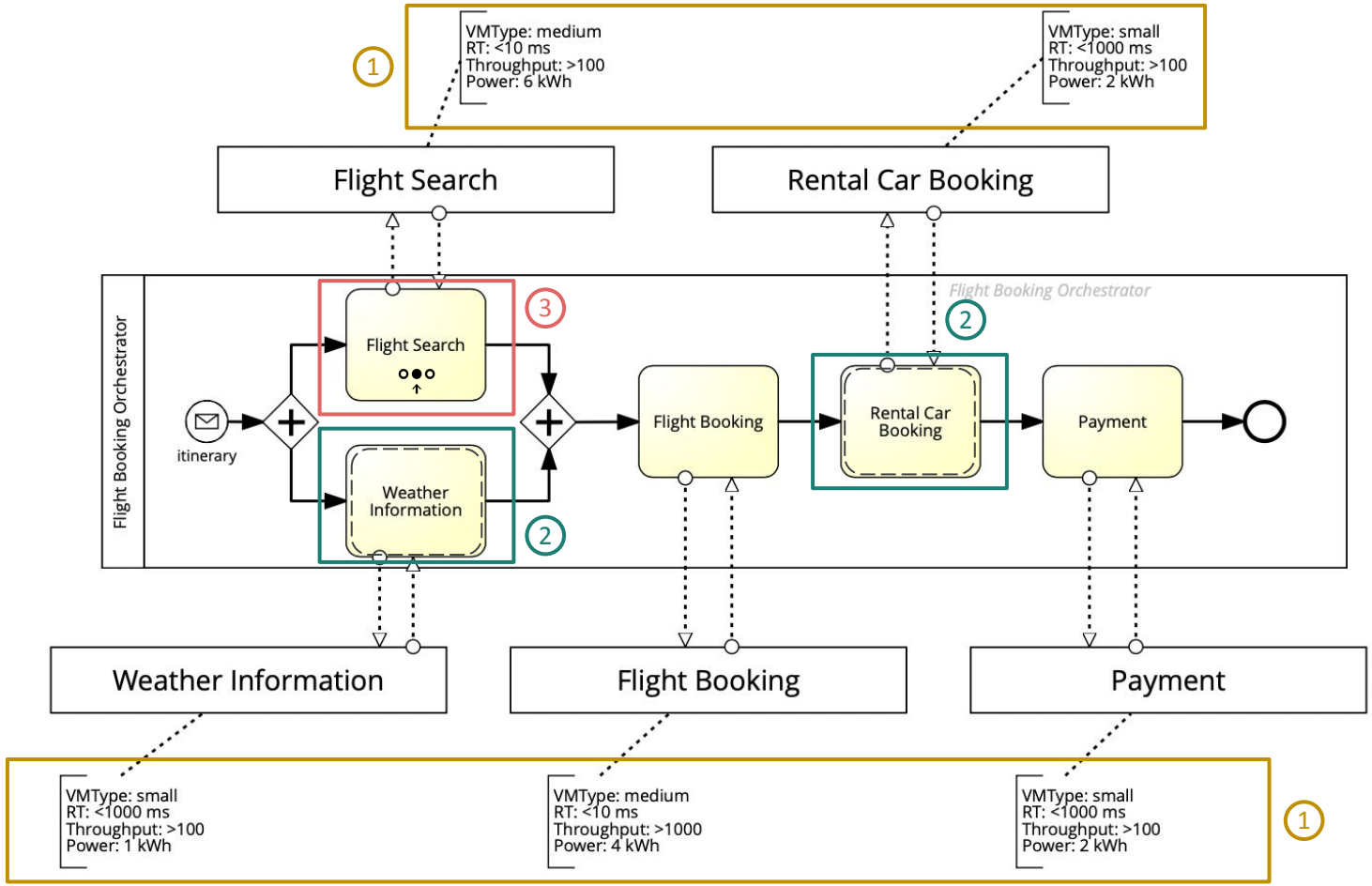


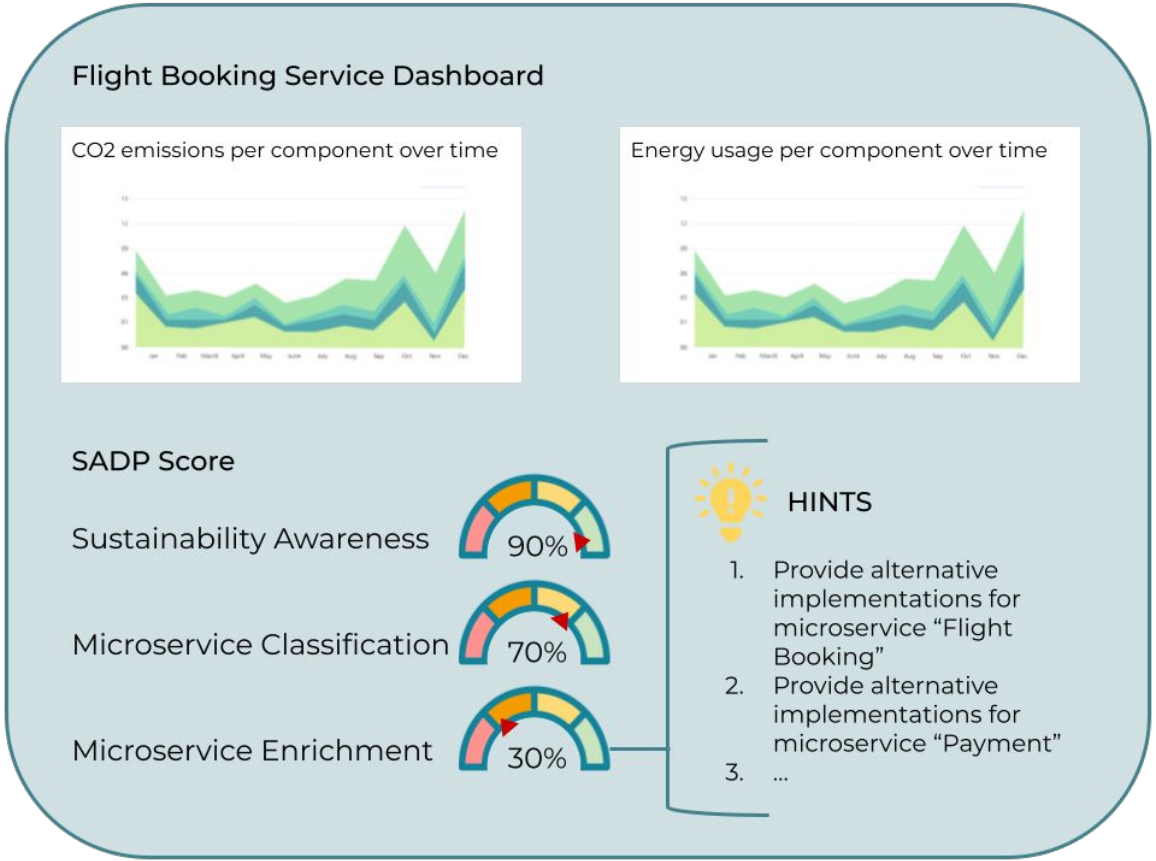
SADP 2 - Microservice Classification



SADP 3 - Microservice Enrichment



SADP - Increasing sustainability awareness



SADP - Sustainable Workflow Design

Exploiting the SADP features at execution time
Different execution modalities:

- NORMAL - typical execution
- BASIC - skips optional components

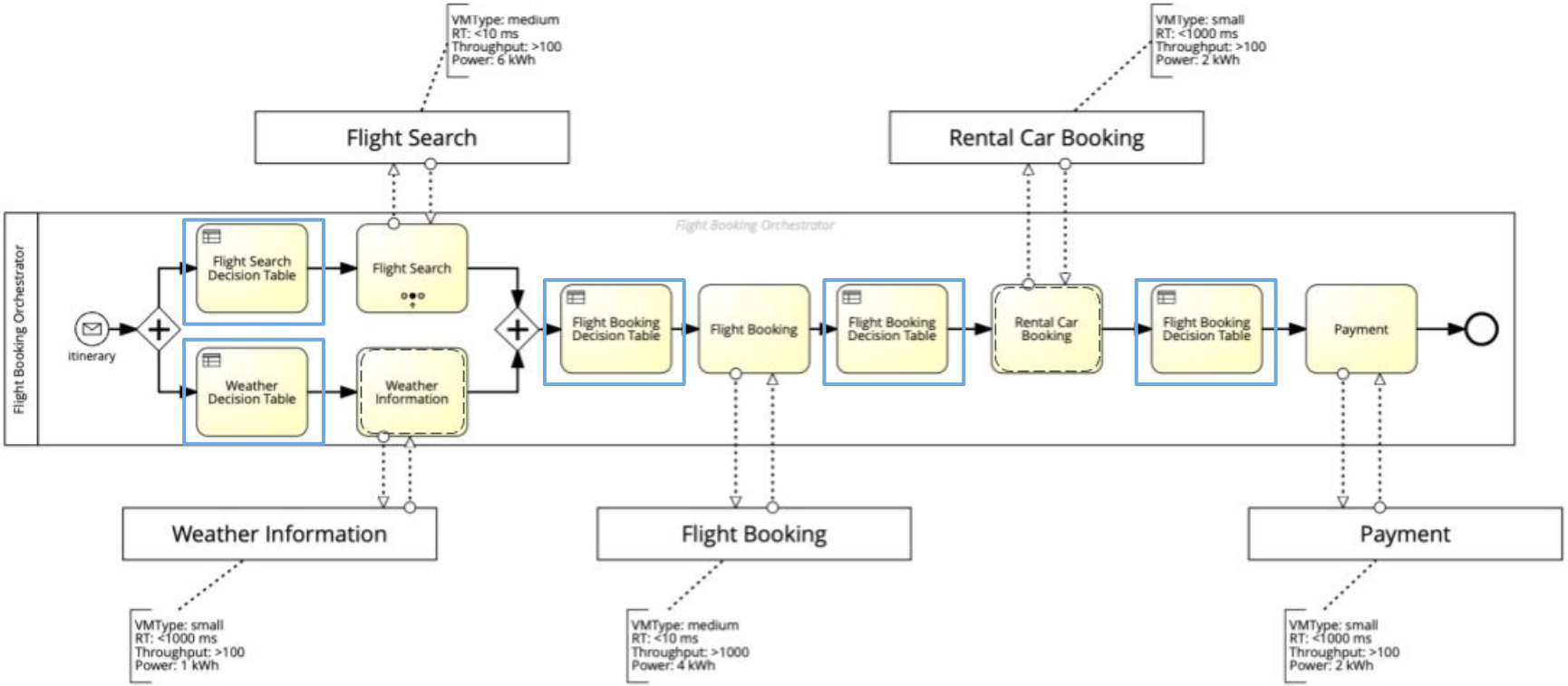
- HIGH PERFORMANCE - executes the performance enhanced version of a component if available
- LOW POWER - executes the low power version of a component if available

SADP - Sustainable Workflow Design

Different execution policies:

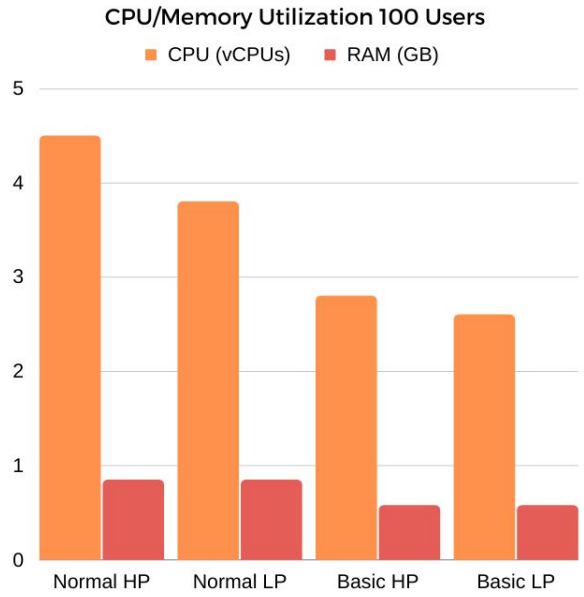
- ALL IN - same execution modality for all the components
- OPTIMISED SELECTION - best combination at the component level

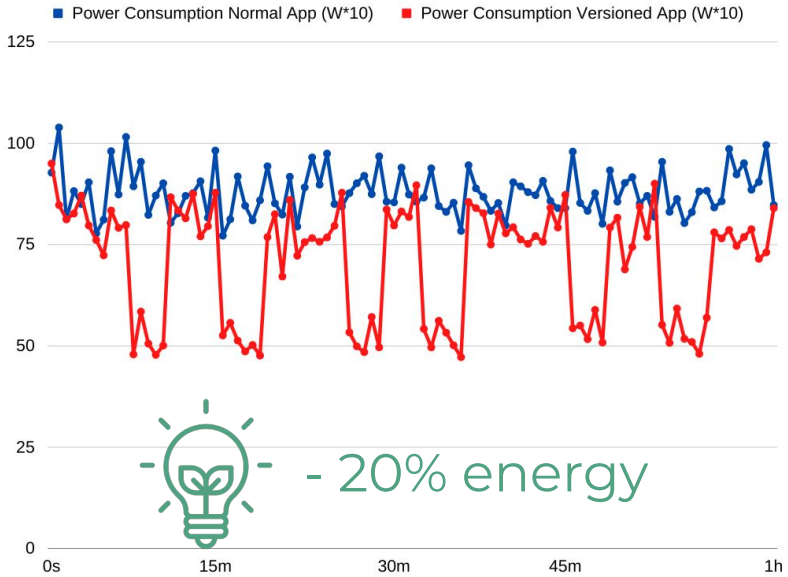
SADP - Sustainable Workflow Design



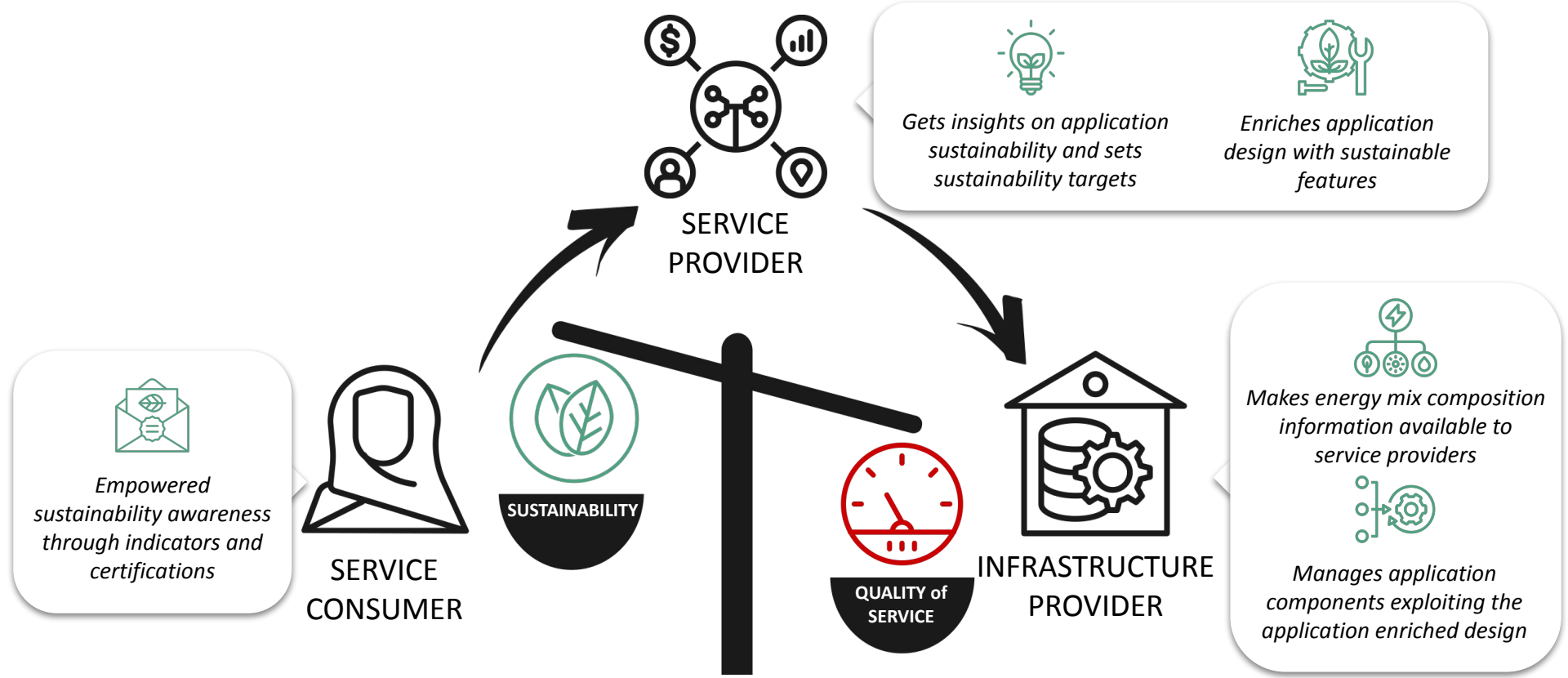
Enriching the process with Business Rules based on DMN

PRELIMINARY RESULTS





HOW CAN WE CHANGE IT?



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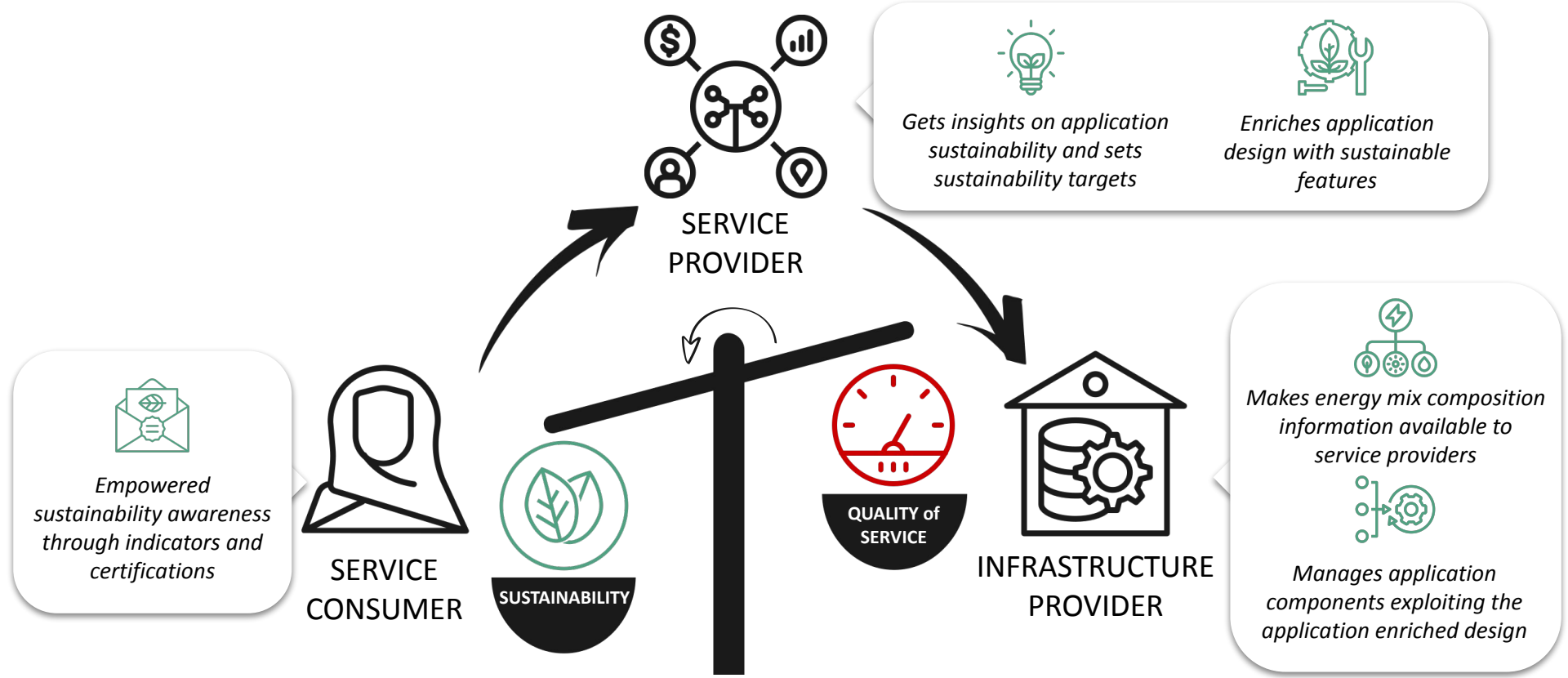

CONCLUSIONS

IS sustainability requires the involvement of all the stakeholders

A sustainability-aware design enables a **greener application management**

Preliminary results shown feasibility and energy reduction

The tradeoff between sustainability and QoE/revenue need to be explored

THANK YOU FOR YOUR ATTENTION

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