

Politecnico di Torino

# Development of a key performance indicator framework for battery swap system

## **Supervisors:**

Dott.sa Giulia Bruno

Prof. Franco Lombardi

Dott. Alberto Faveto

Candidate:

Aysan Jarvand

# Agenda

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# Thesis Purpose

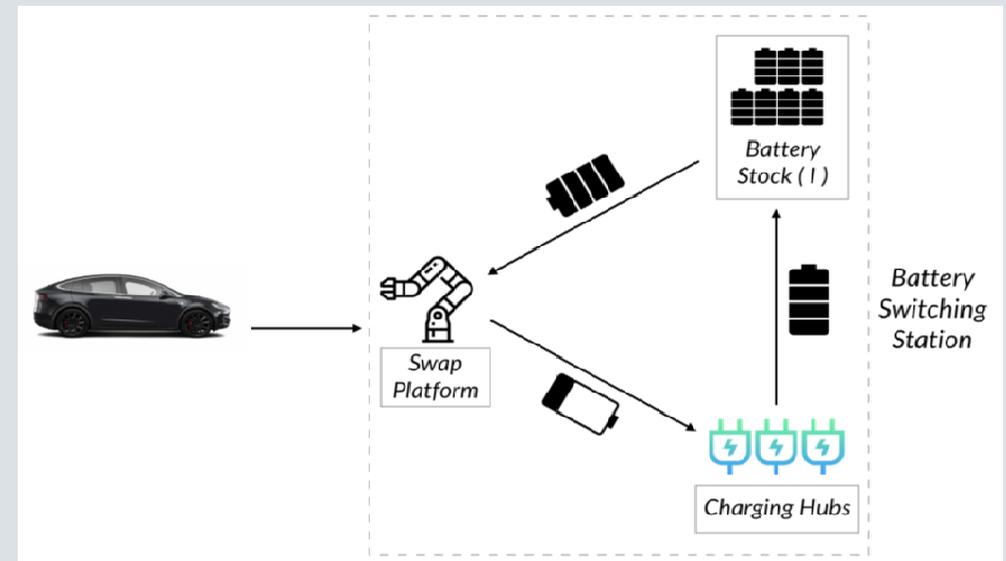
The purpose of the thesis is to develop a key performance indicators framework for battery swap system

By reviewing 214 papers , extracted 23 KPIs

Categorized in two groups, Economic and social

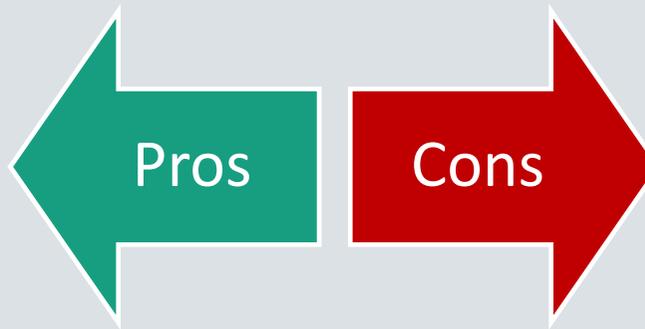
# Background

A Battery Swap Station (BSS) is essentially a station in which the discharged battery of an Electric vehicle, in particular a battery electric vehicle (BEV), can be swapped with a fully charged one.



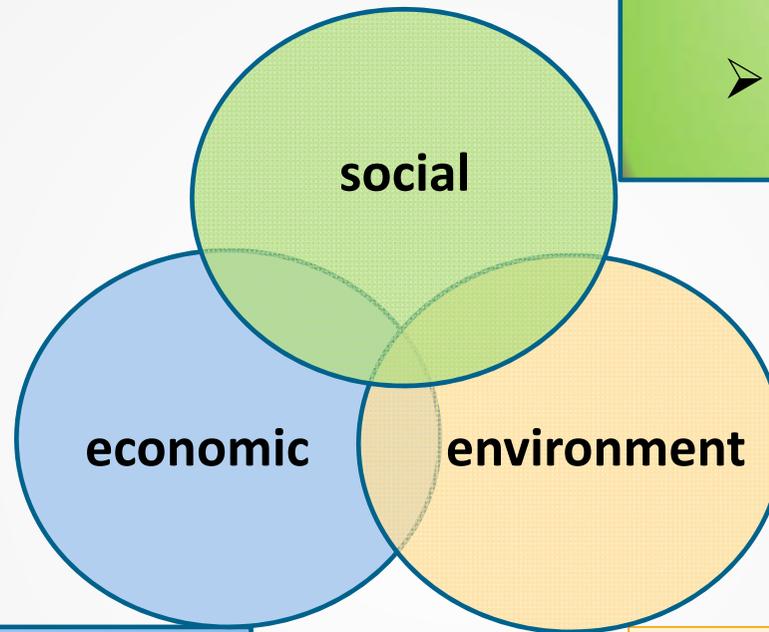
## Pros & cons of BSS

- Low EV cost, battery on lease
- Battery charging during off peak hours
- Short swapping time



- Battery ownership
- Reliability of rented battery pack
- Commercially viable business models

# Triple bottom line



- Improving the safety conditions
- Reducing the health risk

- Reduction in cost (operating, etc)
- Increasing productivity
- Optimizing operating parameters to maximize efficiency

- Reduction in energy consumption
- Reduction in wastage

# Anthony's Pyramid

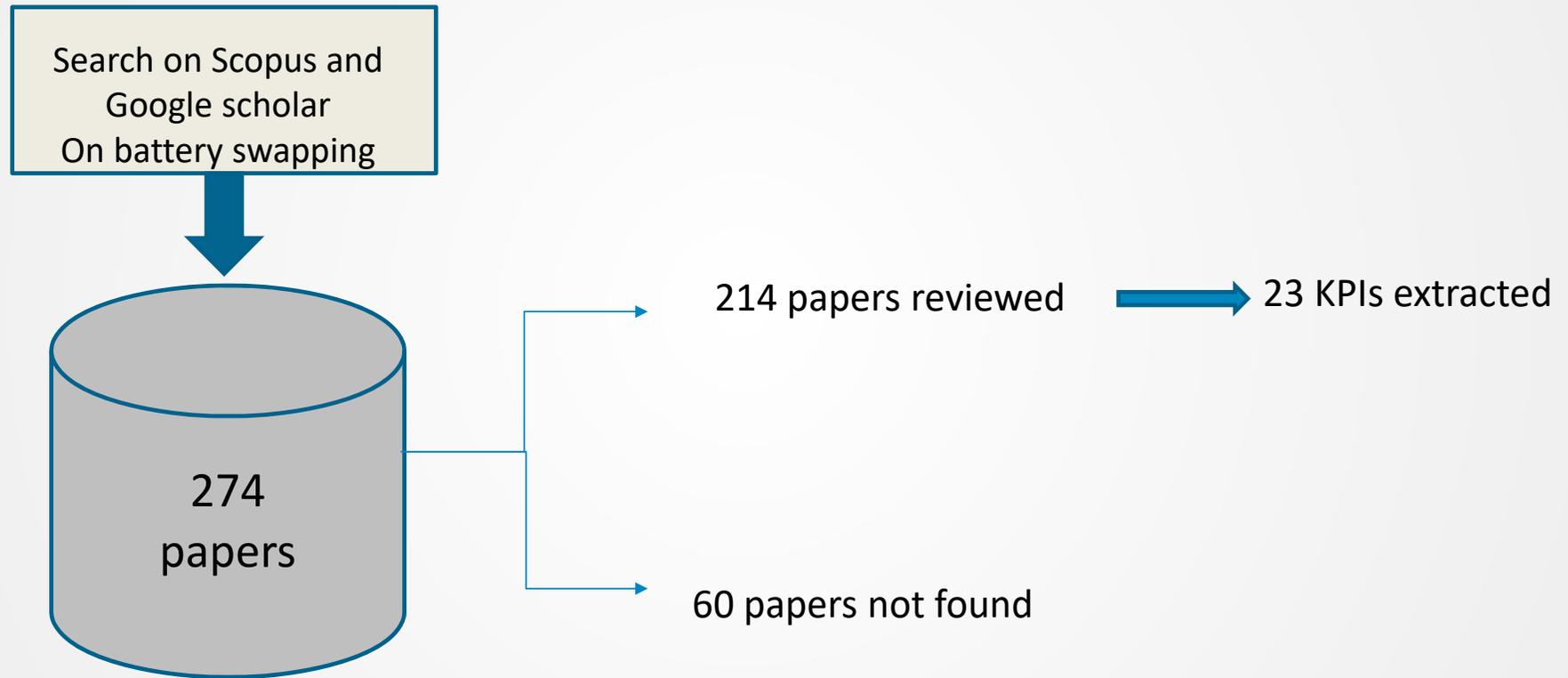


Strategic planning is the process of making decisions concerning the objectives of the organization

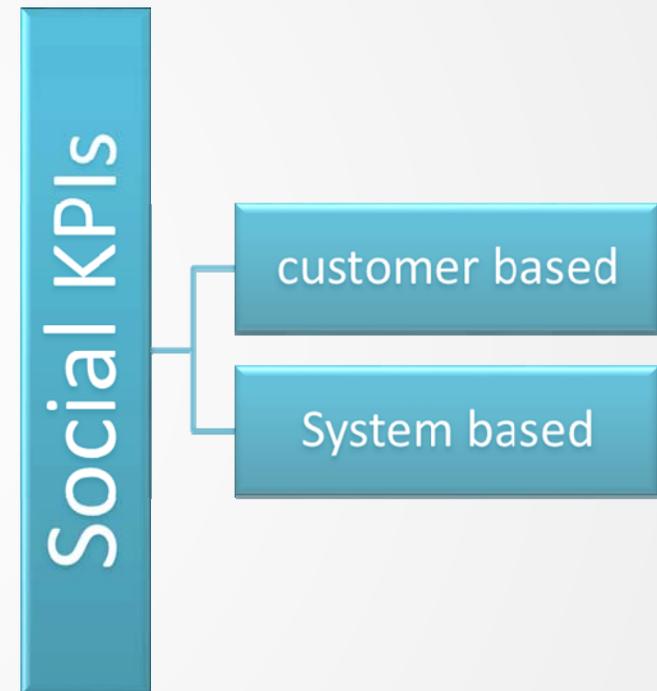
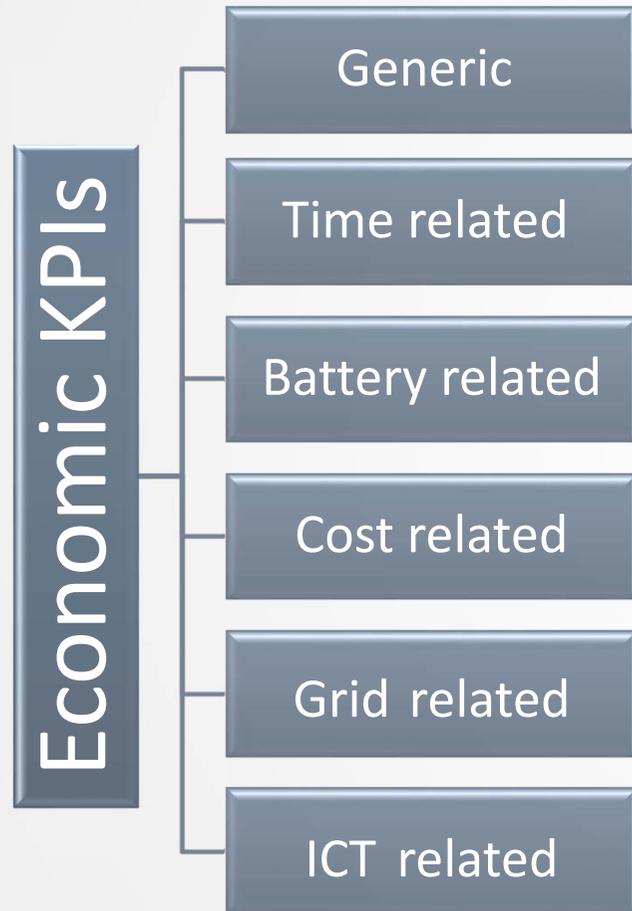
Identifying metrics for determining organizational performance and productivity.

routine decisions, That are made to achieve operational objectives.

# Paper selection procedure



## KPIs Clusters



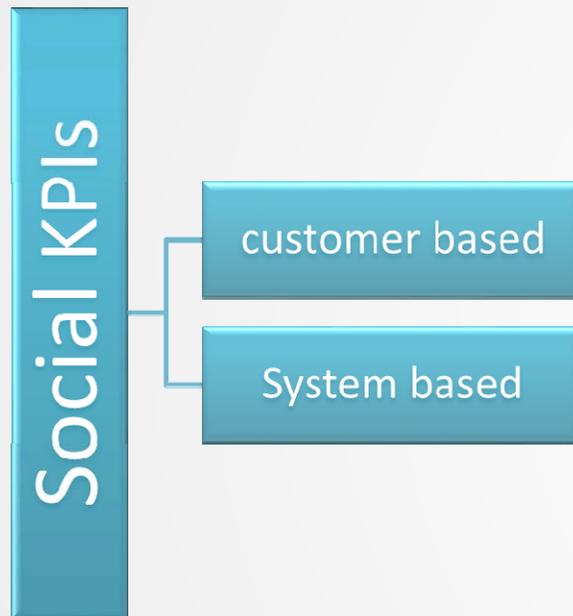
## Economic KPIs sub clusters

<b>Economic KPIs</b>	<b>KPIs</b>	
<b>Generic KPIs</b>	Throughput	tactical
<b>Time related KPIs</b>	Service time	tactical
	Cycle time	tactical
<b>Battery related</b>	Battery capacity	tactical
	Battery degradation	tactical
	Battery cost	strategy
	charging strategy	strategy
<b>ICT related</b>	IOT enabled energy management system	tactical

# Economic KPIs

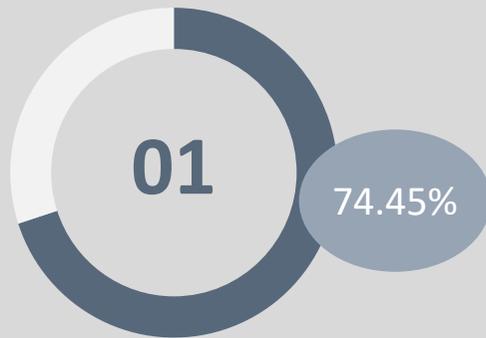
Economic KPIs	KPIs	
Cost related	Profitability	strategy
	Optimal location	strategy
	Operational cost	strategy
	Rental fees	strategy
	BSS size	operational
	BSS Capacity	operational
Grid related	Frequency regulation	tactical
	V2G service	tactical
	Reactive power control	tactical
	Impact on grid	tactical
	Daily demand	operational

# Social KPIs



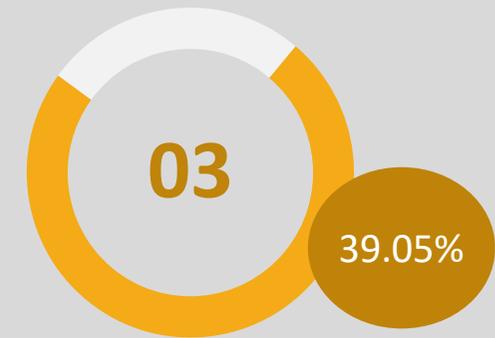
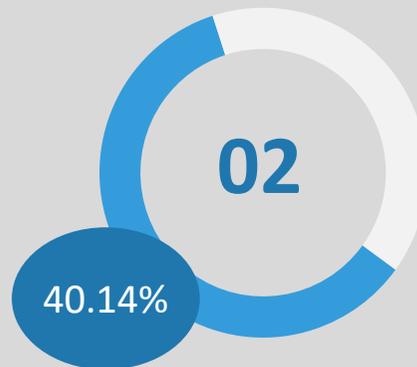
Social KPIs	KPIs	
<b>Customer based</b>	QoS /user satisfaction	strategy
	Incentives	strategy
<b>System based</b>	Mobility	strategy
	Reliability	strategy

# Results



Throughput has the Highest percentage among the KPIs

QoS or User satisfaction has the Second highest percentage as an important strategy factor that should be considered



Charging strategy has the third rank among KPIs

# Conclusions

- From 23 KPIs that have been extracted in total, 19 of them are economic KPIs.
- most of the economic indicators are grid and battery related specific performance indicators.
- No environmental key performance indicators was found

## Future work

stakeholders perspectives can be considered as a starting point for identifying relevant indicators.

stakeholders' interests and their importance for policy makers provides an important starting point for assessing and defining the major performance indicators.

**Thanks for your attention**