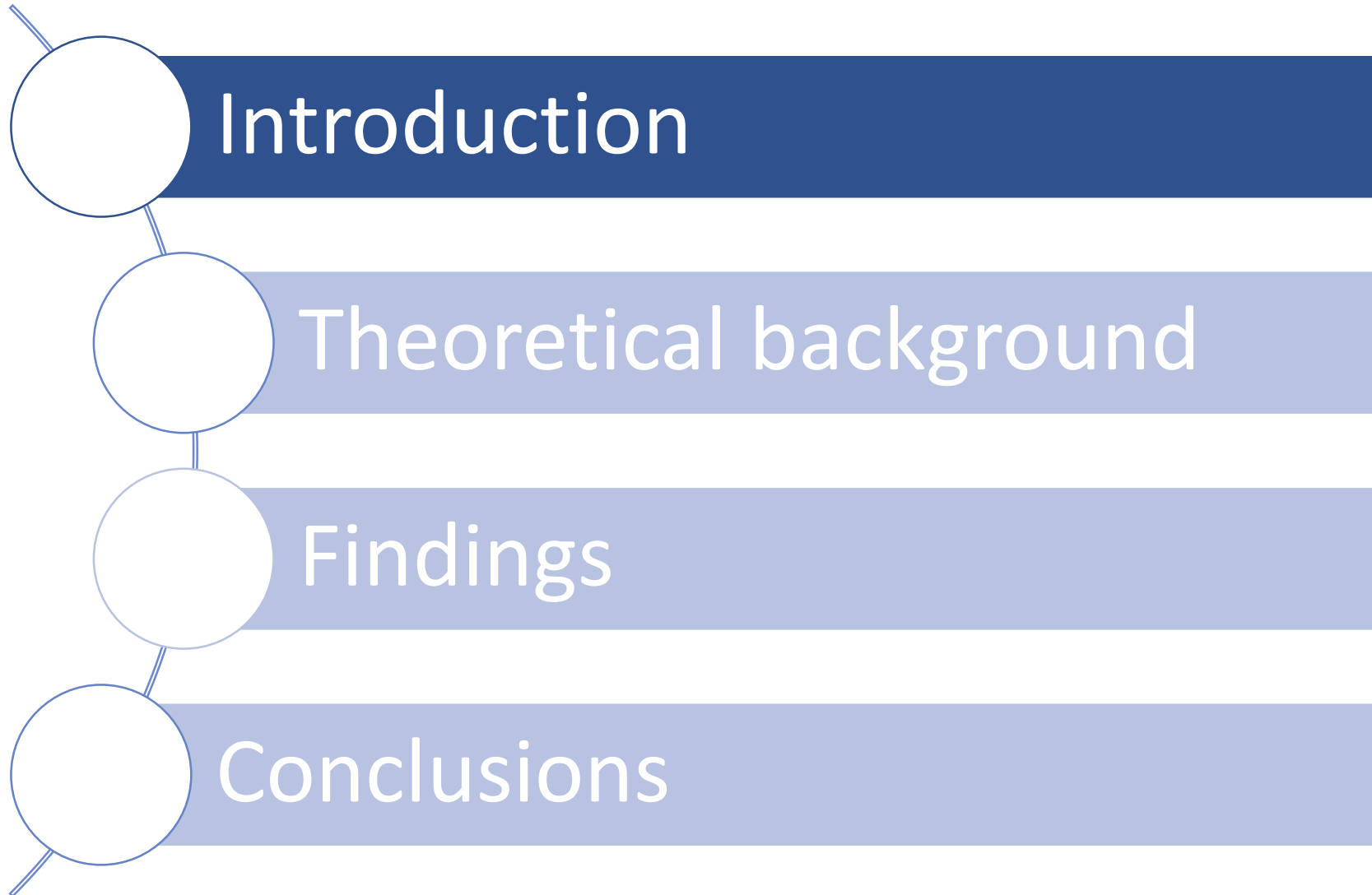


What is behind mirroring hypothesis? Dynamics between modularity and integration: case from BMW i

Yurong Chen , Carole Donada



Introduction

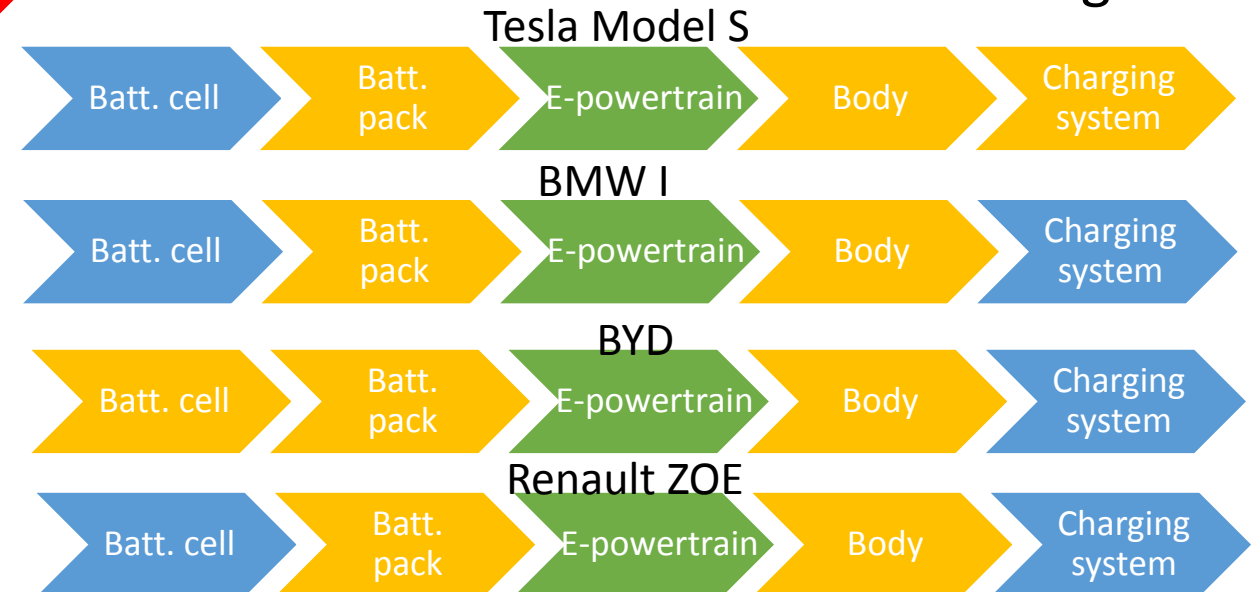
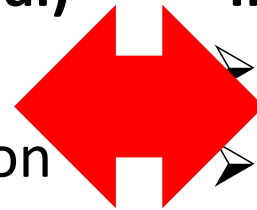
BATTERY ELECTRIC VEHICLE

Product design (modular or integral)

- OEMs - modular BEV
 - minimizing the cost: - rely on public charging from supplier, minimal change in their existing product...
- Debates in research
 - Modular BEV
 - Integral BEV: Fujimoto (2016), Chen et al. (2016)

Integration choice

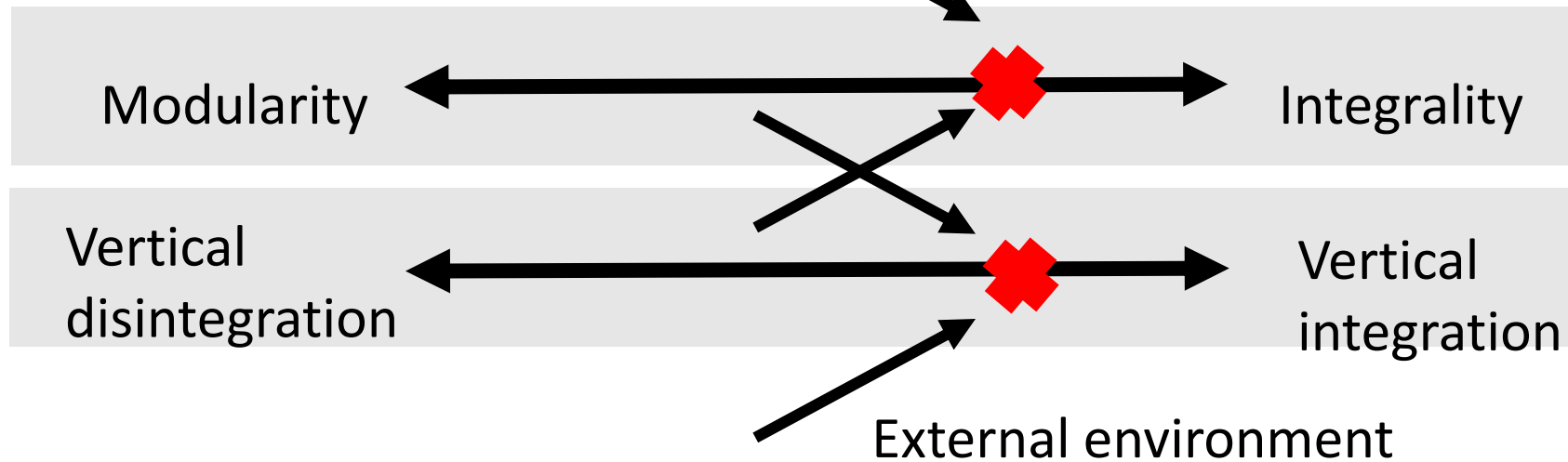
- Diversified integration choices
- Most active OEMs tend to choose integration



Introduction

- Mirroring hypothesis of Tesla Model S

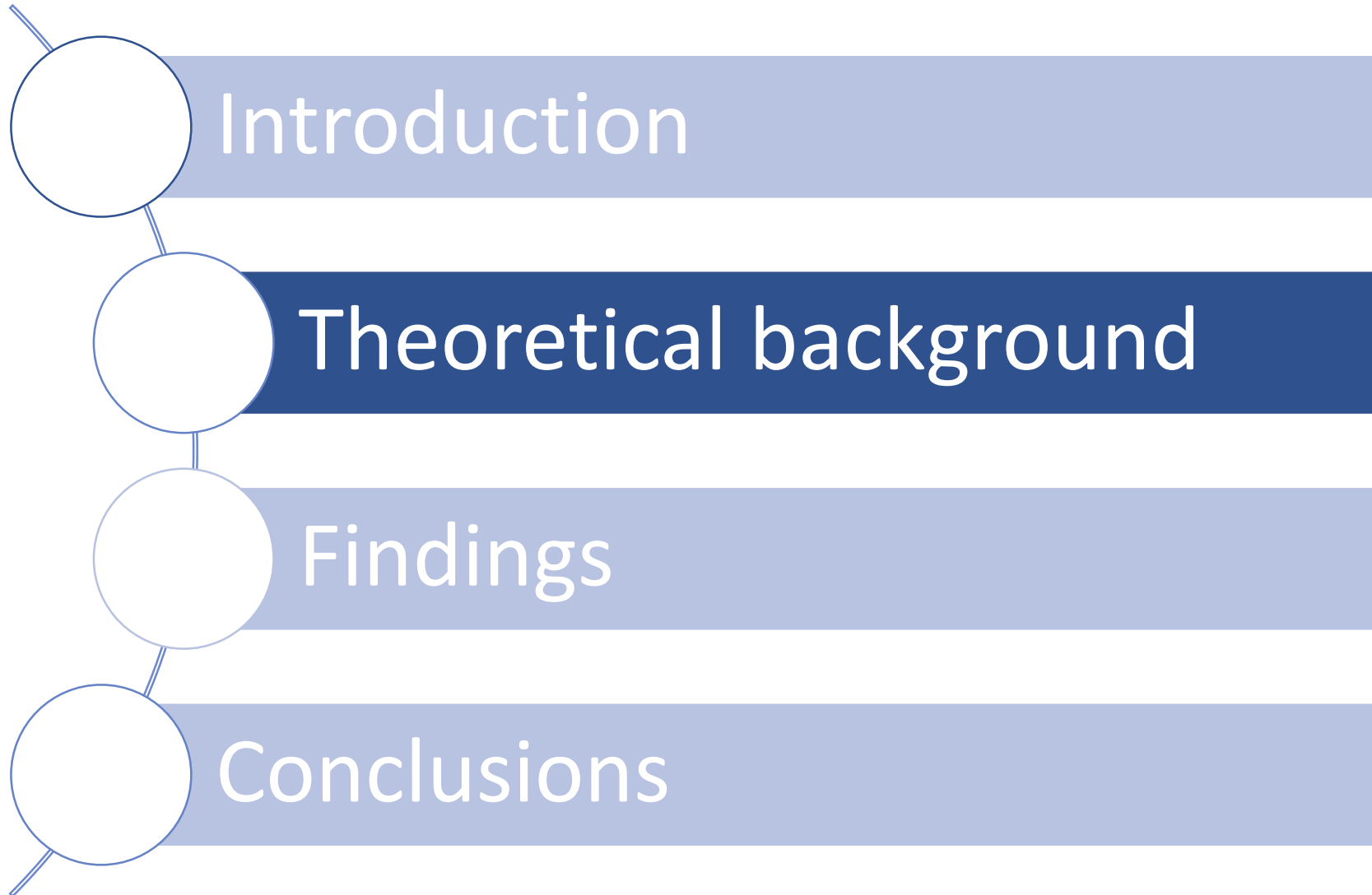
Differentiation strategy of Tesla
Commitment for “range anxiety reduction”



Introduction

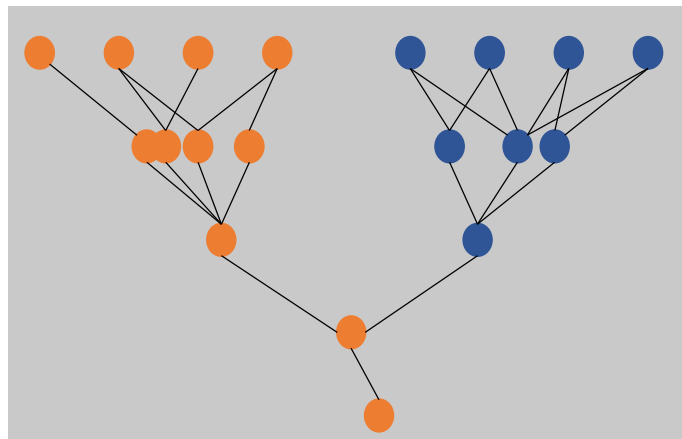
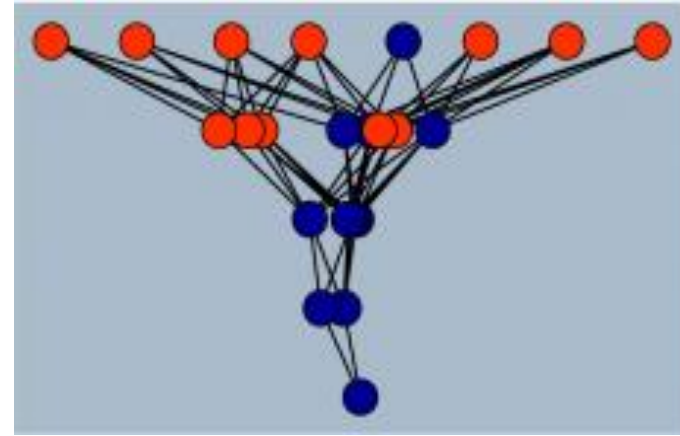
Research questions:

- Why contrary answers for modularity?
- Dynamics between modularity and integration?
- What is behind mirroring hypothesis?

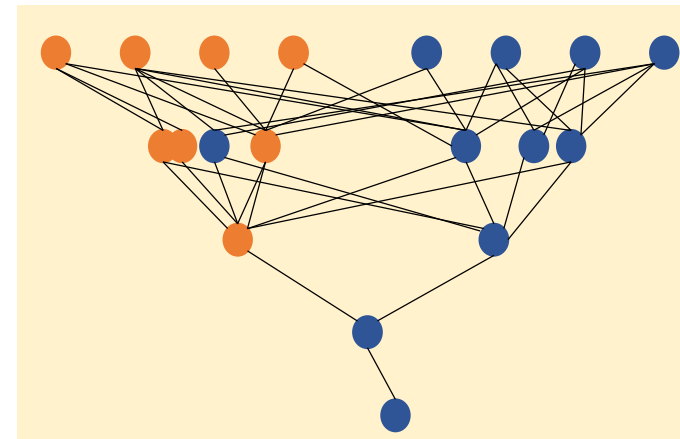


Theoretical background 1: modularity

Complex system

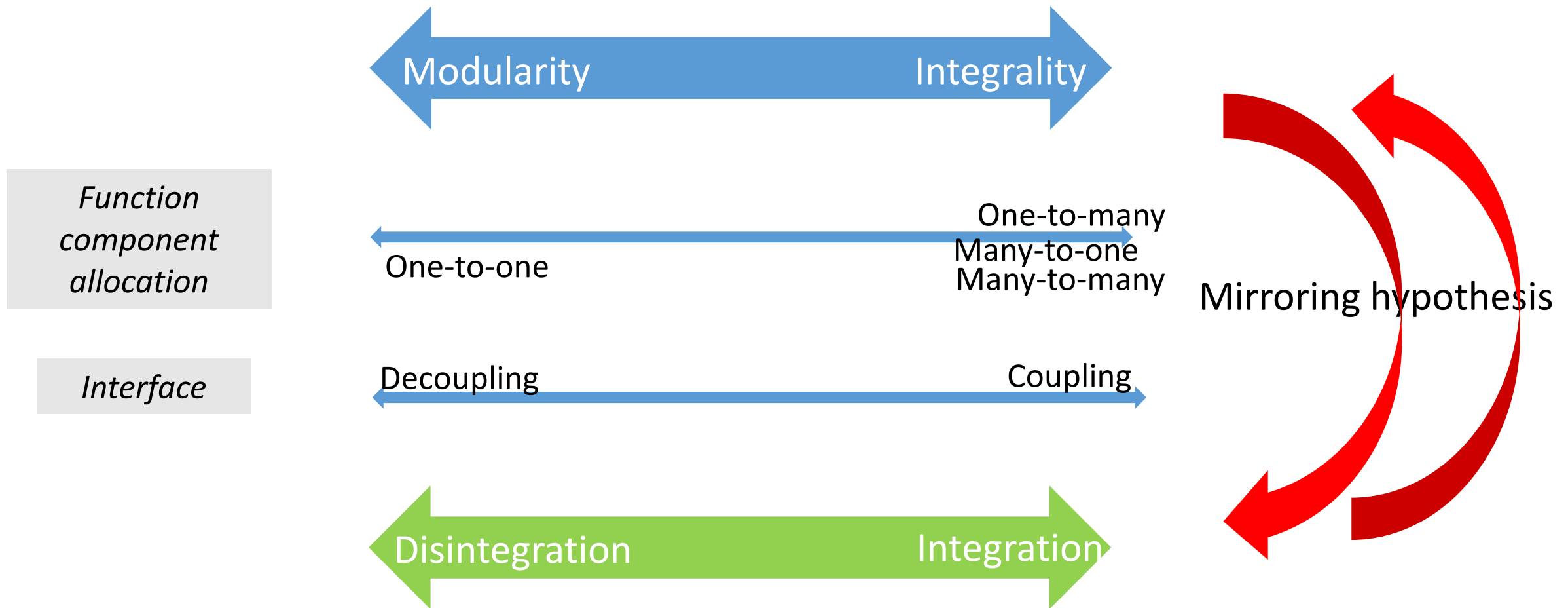


With modularity

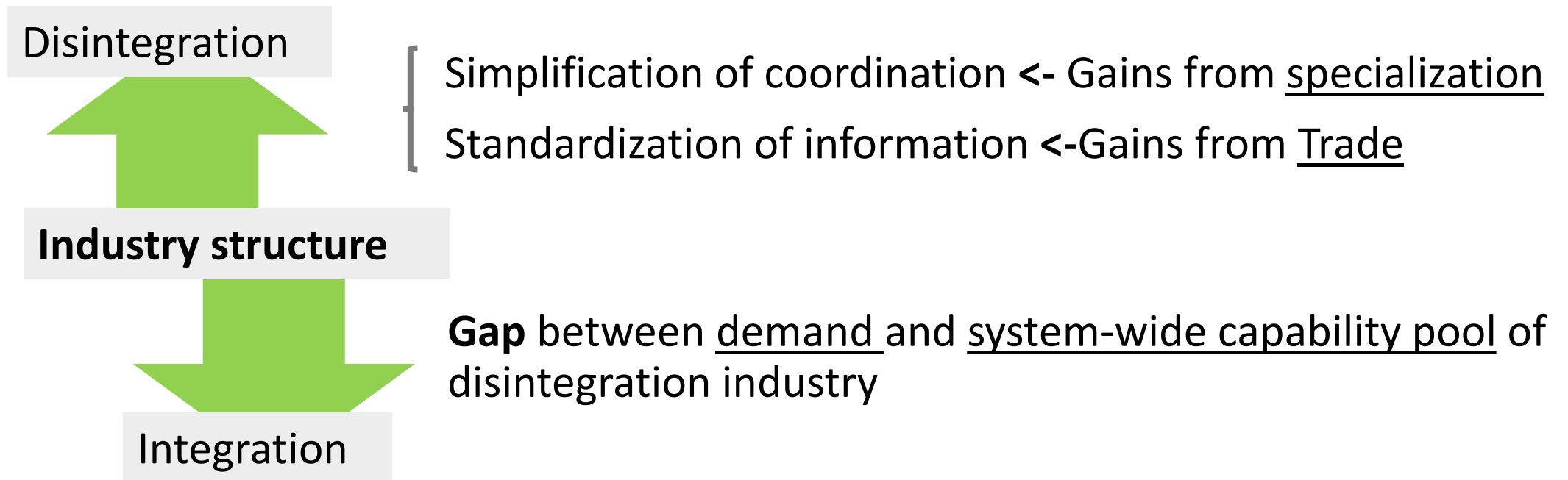


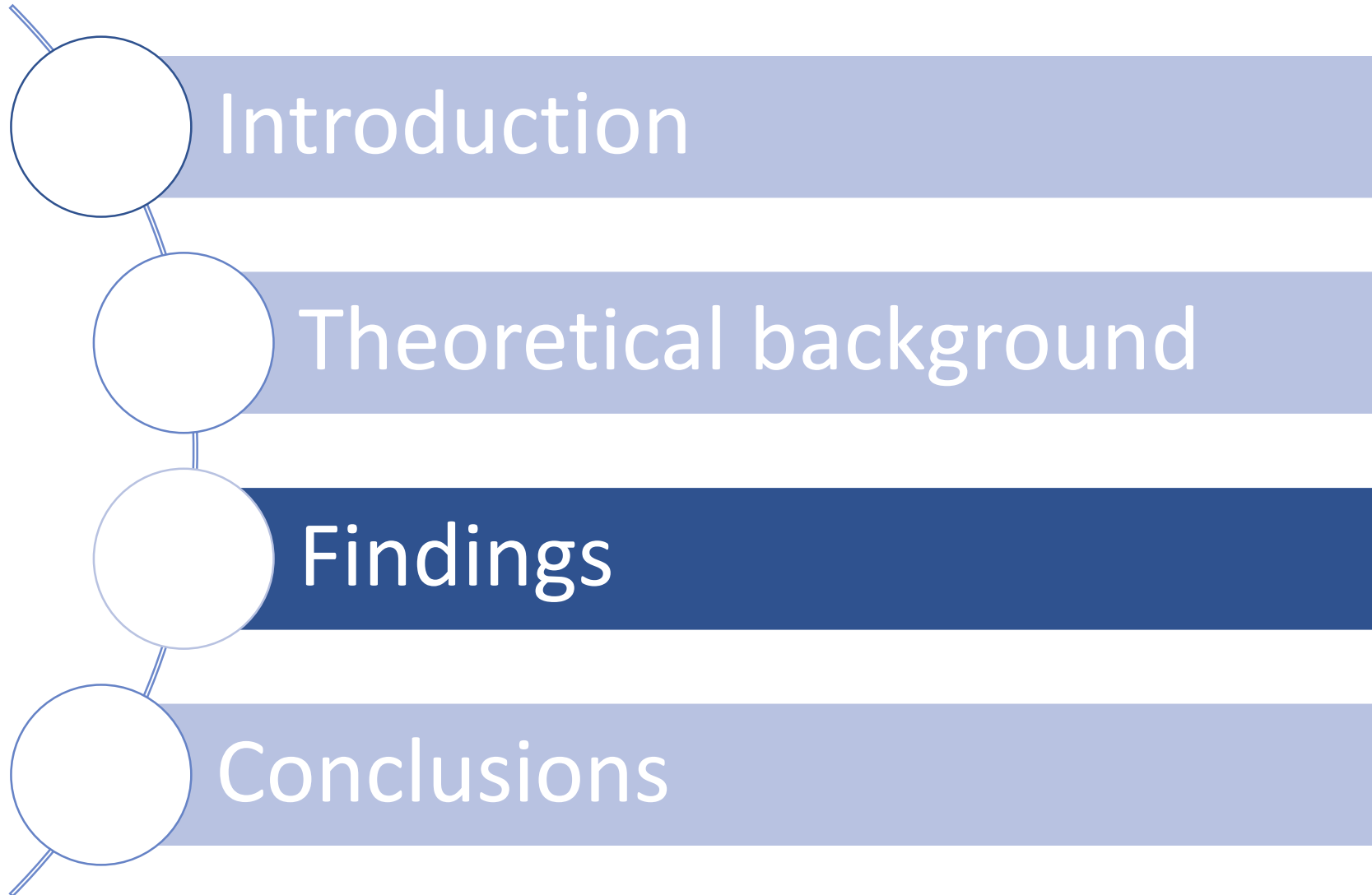
With integrality

Theoretical background 1: modularity

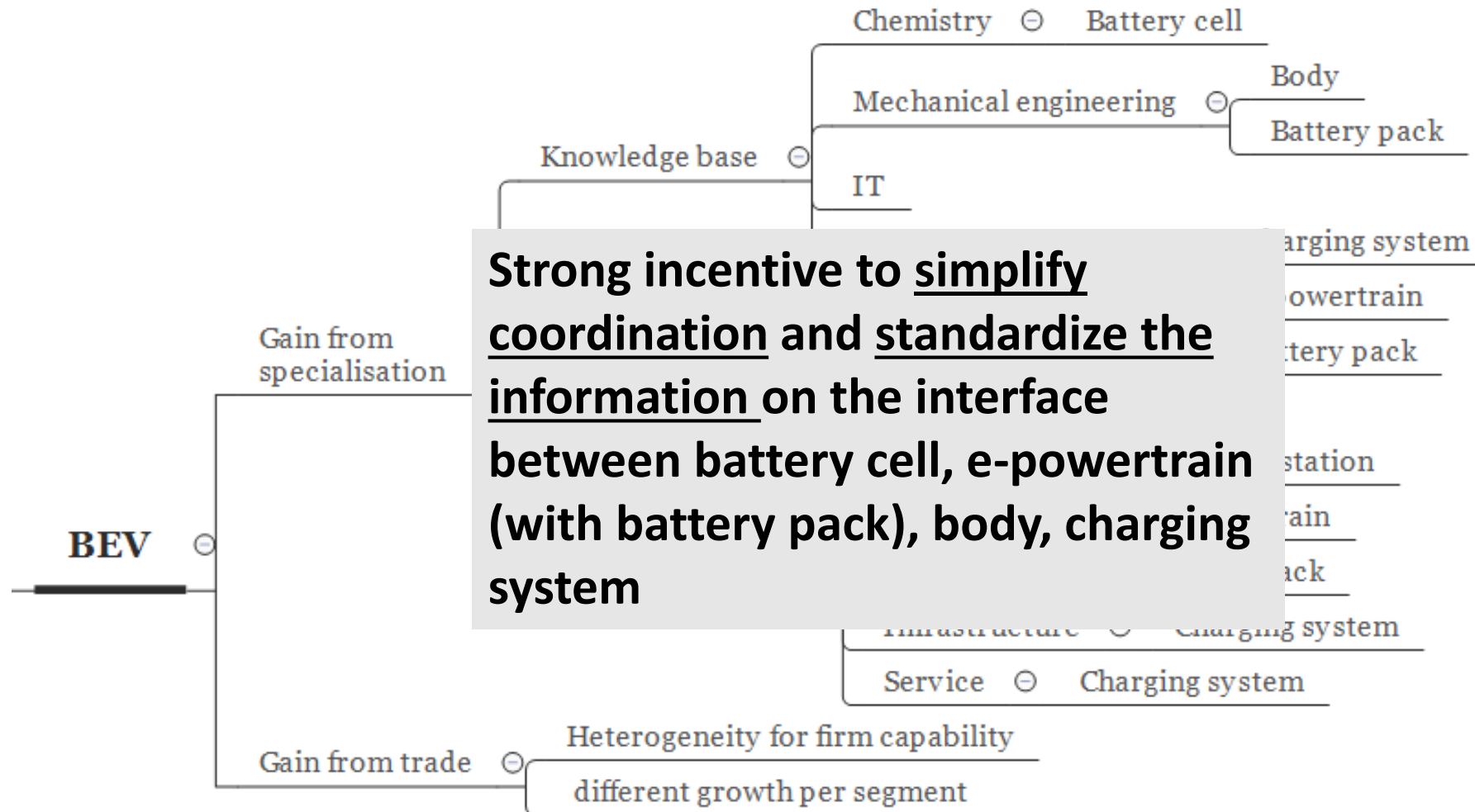


Theoretical background 2: integration v.s. disintegration





Motives for disintegration in EV industry

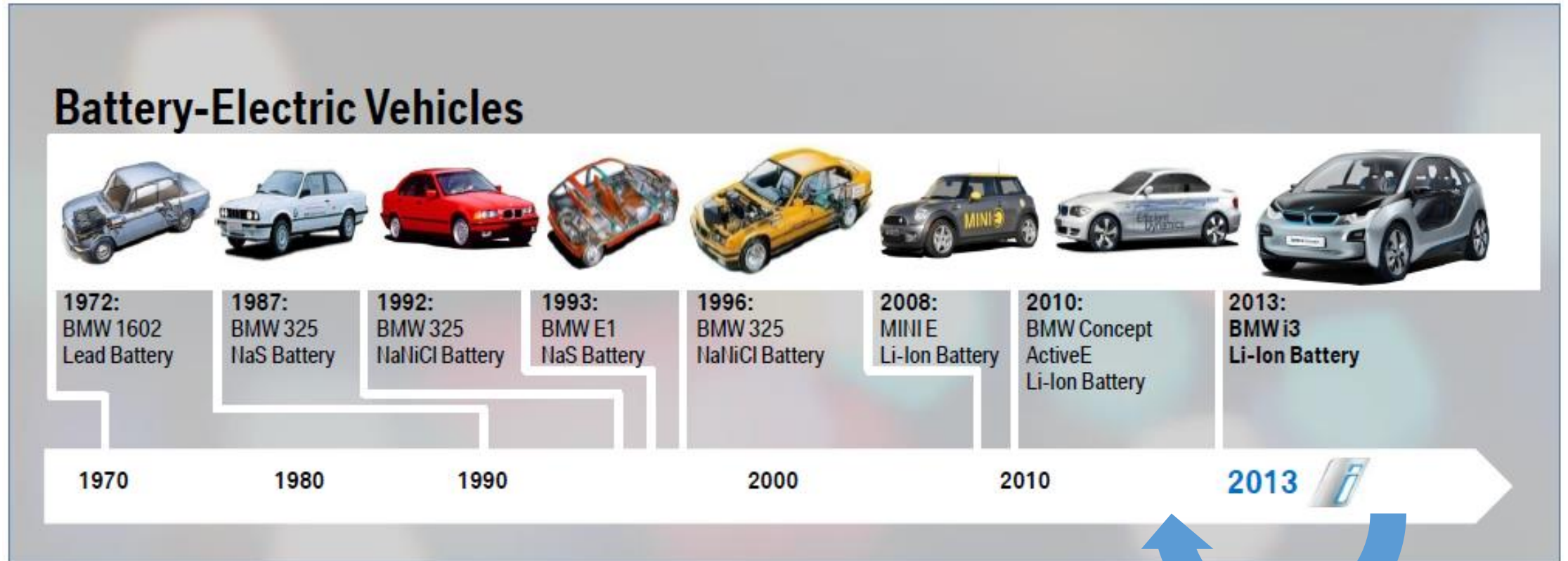


Motives for integration in BEV industry

		Demand			
		Systems	Firms	Low range anxiety	Low TCO
System-wide capability pool	dis-integration	body	Weight & Charging	Coordination	design& brand
		e-PT			Scale
		ba. pack		Scale	
		charging			Scale
	semi-integration 1	body + e-PT	Weight & Charging	Coordination	
		ba. pack			scale
semi-integration 2	body + e-PT + ba. pack	Weight	scale	Design, brand & Perf.	
	charging	Charging		safety	
Integration	body + e-PT + ba. pack	Weight & Charging	Coordination	Design, brand, perf. & safety	
	pack+ charging		scale		

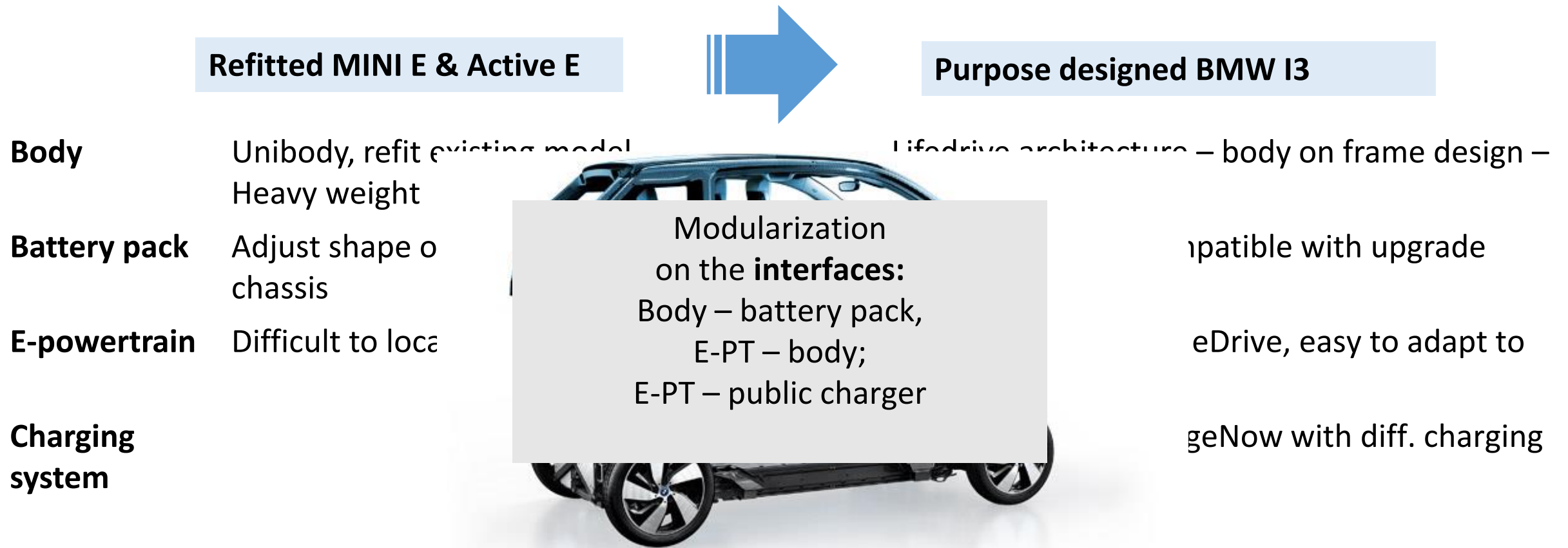
Low Range Anxiety -> Integration of charging (esp. fast charging) + ba. pack

Case of BMW i: the dynamics of modularity and integration



“BUILT FROM THE GROUND UP”

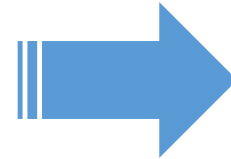
Case of BMW i: the dynamics of modularity and integration



Case of BMW i: the dynamics for modularity and integration

Purpose designed BMW i3

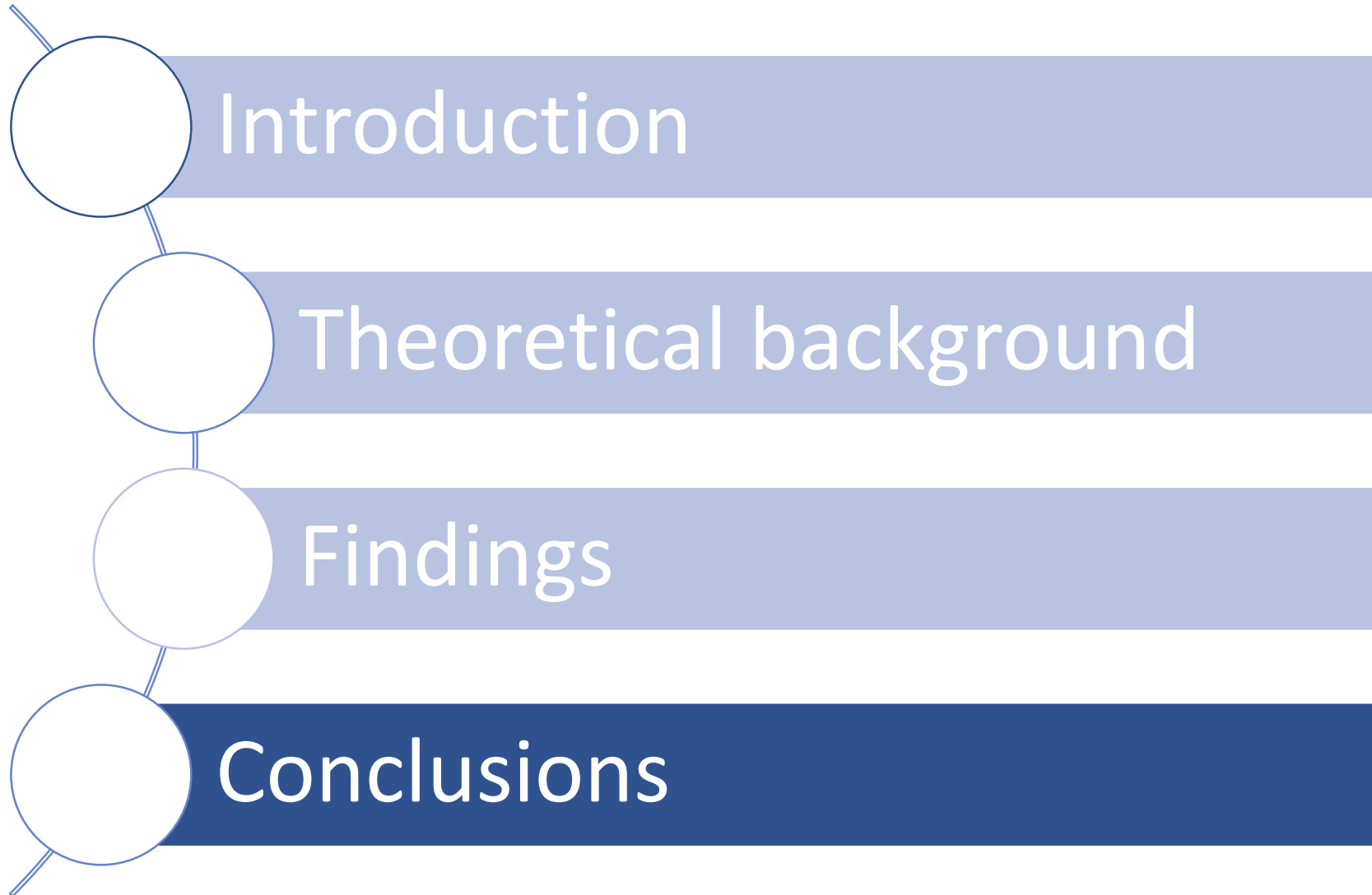
- Battery pack: 24 kWh - 160 km, with range extender 240km
- Public charging: ChargeNow with diff. charging stations providers
- **“a city car”** with less effort on range



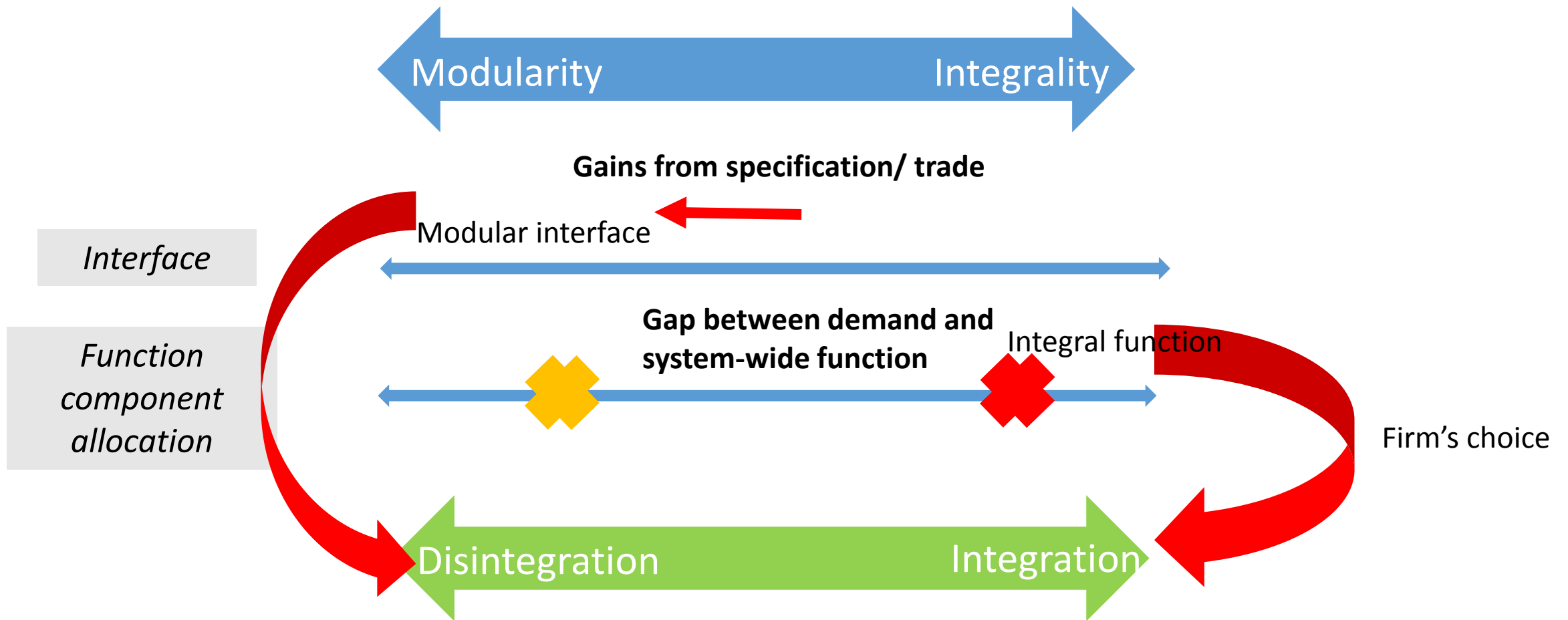
Activities in fast charging

- July 2014, BMW i DC fast charging station
 - 24 kW DC Combo fast charging developed with Bosch
 - with eVgo
 - with WV, Nissan to provide

Realization importance of range anxiety issues
Gap between demand and capability
pool of disintegrated system –
reintegration of fast charging



What is behind mirroring hypothesis?



Conclusion

- Integration v.s. disintegration in BEV:
 - Gains from specialization/ trade -> Strong incentive for modular interfaces between batter cell, e-PT (with battery pack), body, charging system
 - Gap between demand for low Range Anxiety and system wide capability pool -> integration of charging (esp. fast charging) + battery pack
 - The case of BMW I illustrate the process of modularization, and re-integration of fast charging
- Debates on modular or integral BEV:
 - Misunderstanding for modularity : interface + function component allocation
 - BEV tends to have modular interface, yet integral functional component allocation (e.g. over range anxiety)
 - Pursuit for high performance in functions may lead to integral interface as well
- The drivers and mechanics of mirroring hypothesis in firm level and industry level

Thank you for your attention!

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