# Dynamic Business Modeling for Sustainability:

## - Exploring a System Dynamics Perspective to Integrate Social Lifecycle Sustainability Assessment-


**Authors**:

**Jing Lin** | Ph.D. student @ Université Paris 1 Panthéon-Sorbonne & HTWG Constance

Prof. Dr. Clotilde Rohleder | *Market Oriented Management* | University of Applied Sciences Constance, Germany

A. Prof. Dr. habil. Selmin Nurcan | *Centre de Recherche en Informatique* | *Sorbonne Business School (EMS)* | University Paris 1| Pantheon-Sorbonne, Paris France

Prof. Stephane Copin | *Sorbonne Business School (EMS)* | University Paris 1, Pantheon-Sorbonne, Paris France

**Presenter**:

Jing Lin | Global Integration Services Practice | Siemens Digital Industries Software | Munich Germany

Email: jinglin.nuernberg@yahoo.de


IARIA

UNIVERSITÉ PARIS 1
PANTHÉON SORBONNE

H T W G
Hochschule Konstanz
Technik, Wirtschaft und Gestaltung

# Presenter

SIEMENS
Ingenuity for life

Siemens Digital Industries Software
Global Integration Services Practice
Solution Architecture

## Education

2015~ Ph.D of Centre de Recherche en Informatique, Université Paris 1 Panthéon-Sorbonne & HTWG Constance

2000~2002 - Master of Business Administration (MBA) of the University Stuttgart | Germany

1994~1997 - Master of Arts – MA, Economics
Sichuan University | Chengdu | China

1990~1994 - Bachelor of Engineering – BE, Mechanical Engineering
Sichuan University | Chengdu | China

## Employment History

2019~ Solution Architect – *Global Integration Services Practice* - Siemens Digital Industries Software
2017~2019 - Solution Architect –*Product Lifecycle Management (PLM)* - Siemens Healthineers
2010~2017 - Senior Consultant– *Product Lifecycle Management (PLM)* - Siemens Digital Industries Software
2007~ 2010 - Business Consultant– *Product Lifecycle Management* - TATA Technologies (former INCAT GmbH)
2006~ 2007 – Maternity and parental leave
2002~ 2006 – Research Engineer in automotive (Tier 1 ~ 2)

## Professional Profile & Expertise

Jing Lin has expertise in PLM Solution Architecture, is a Solution architect at Siemens AG (among them 9 years with Siemens Industry Software, 2 years the Siemens Healthineers).
She brings more than 14 years of experience in high level consultancy, implementing and supporting with a deep knowledge of Engineering in the Automotive, Aerospace & Defense, Medical sectors by applying advanced Information Technology, such as CAD/BOM and Multi CAD design Integration, and Change Management, Material and Substance Compliance management, Agile methods, Design thinking.
She has also experience in enterprise application interface like PLM Product -Teamcenter Integration for SAP or Enterprise Architectures (including architecture and implementation).
In her pre-Siemens PLM time, she had experience in automation of Manufacturing and Production processes (without PLM Product like Teamcenter), which included Factory planning and production management, Takt-time measuring and optimization, workflow & operation definition.

# Topic of Research

- System Dynamics modeling
- Applying system dynamics on health caring & therapie
- LCA integration into PLM
- Information visibility on ordering dynamics in a supply chain

# Content

# I. Introduction

# I. Introduction

***Sustainability issues in the smartphone lifecycle***

*System Boundaries*

*Stakeholder - influence matrix*

SBM: Sustainable Bussiness Model

[X]: Focus of my Research

## LifeCycle Sustainable Issues along Smartphone Lifecycle

| *Life cycle phases and sustainability issues ▶* | Resource extraction and processing | | | Design and manufacturing | | | | Distribution and network provision | | Usage | | | End-of-life | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *SBM patterns ▼* | Illicit operations / conflict minerals | Poor working conditions | Environmental degradation | Energy/resource intensive manufacturing | Poor working conditions | Exposure to toxic substances | Poor product design choices | Transport emissions | Fast replacement business model | Short lifetime | Electricity consumption | Stockpiling of functional devices | Stockpiling of defect devices | Illicitly imported electronic waste | Informal recycling | Poor working conditions | Toxic substances / lost materials |
| SUSTAINABLE RESOURCE COMPANY | X | X | X | | | | | | | | | | | | X | X | |
| SUSTAINABLE MANUFACTURER | | | | X | X | X | X | X | X | X | X | X | X | X | X | | X |
| SUFFICIENCY-ADVOCATING NETWORK PROVIDER | | | | | | | | X | X | X | X | | | | | | |
| USAGE-EXTENDING DISTRIBUTOR | | | | | | | | X | | X | X | X | X | X | X | | X |
| REFURBISHING & REPAIR GAP-EXPLOITER | | | | | | | | | | X | X | X | | | | | |
| REFURBISHING & WEEE SERVICE PROVIDER | | | | | | | | | | X | X | X | X | X | X | | X |
| WEEE SERVICE PROVIDER | | | | | | | | | | | | | X | X | X | X | X |

# I. Introduction

***Stakeholder -influence***

*ESG metrics and stakeholder impacts*

| Class | Category | Example Subcategories | Employees | Community | Suppliers | Customers | Shareholders |
|---|---|---|---|---|---|---|---|
| Environment | Carbon and Climate | • Energy and fuel efficiency<br>• GHG emissions<br>• Technology and opportunity (investments) | | ✔ | ✔ | | ✔ |
| | Natural Resources | • Water (use and pollution)<br>• Land, forests, biodiversity (use and pollution)<br>• Sustainable sourcing | | ✔ | ✔ | | ✔ |
| | Waste and Toxicity | • Hazardous and non-hazardous waste<br>• Emissions and spills<br>• Electronic waste<br>• Packaging material | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Management of Environmental Risk | • Disaster planning, response and resiliency<br>• LEED design and certification | ✔ | ✔ | ✔ | ✔ | ✔ |
| Social | Human Rights | • Ethical sourcing<br>• Supply chain standards | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Labor, Health, and Safety | • Fair wages, benefits, training and development<br>• Labor standards, job stability, and mobility<br>• Employee engagement | ✔ | ✔ | ✔ | | ✔ |
| | Diversity and Inclusion | • Equal opportunity and participation | ✔ | ✔ | ✔ | | ✔ |
| | Product Safety, Quality, and Brand | • Customer satisfaction<br>• Affordability and accessibility | ✔ | ✔ | | ✔ | ✔ |
| | Community Engagement / Partnerships | • Volunteer hours<br>• Workforce/community demographic parity<br>• Alliances with key organizations, councils, and institutions<br>• Corporate philanthropy | ✔ | ✔ | | | ✔ |
| Governance | Board Composition | • Minority representation<br>• Gender equality | ✔ | ✔ | | ✔ | ✔ |
| | Ethics and Compliance | • Anti-corruption<br>• Cybersecurity and data privacy<br>• Oversight and accountability<br>• Management policies, systems, and disclosure (transparency)<br>• Political contributions/lobbying | ✔ | ✔ | ✔ | ✔ | ✔ |
| | General Corporate Governance | • Executive compensation<br>• Board leadership/structure<br>• Share structure (multiple classes, board election) | ✔ | | | | ✔ |
| | Risk Management and Mitigation | • Code of conduct<br>• Sensitivity analysis and stress testing | ✔ | ✔ | | ✔ | ✔ |

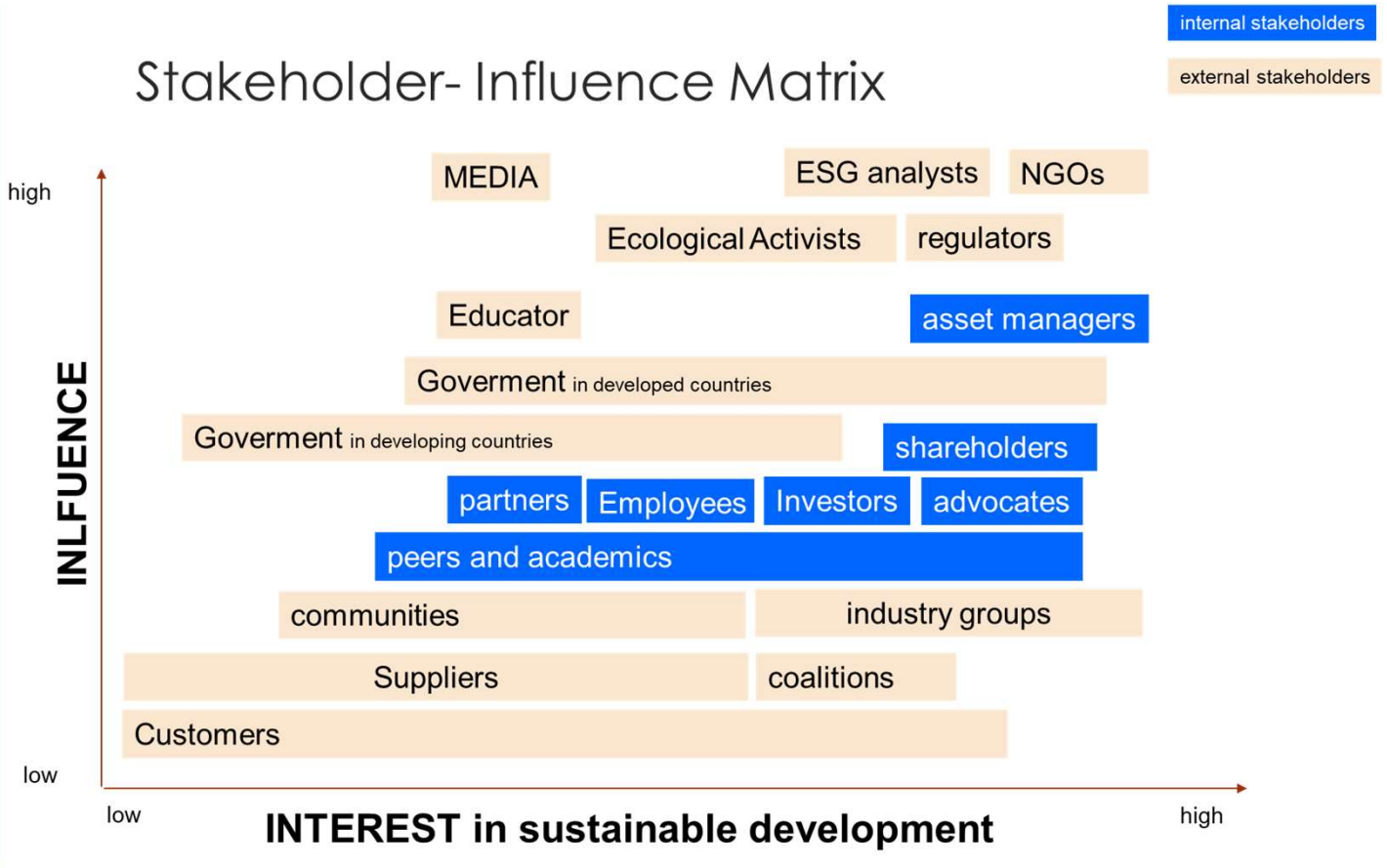
Source: https://corpgov.law.harvard.edu/2020/09/14/the-stakeholder-model-and-esg/

# I. Introduction

*Sustainability issues in the smartphone lifecycle*

*System Boundaries*

***Stakeholder - influence matrix***



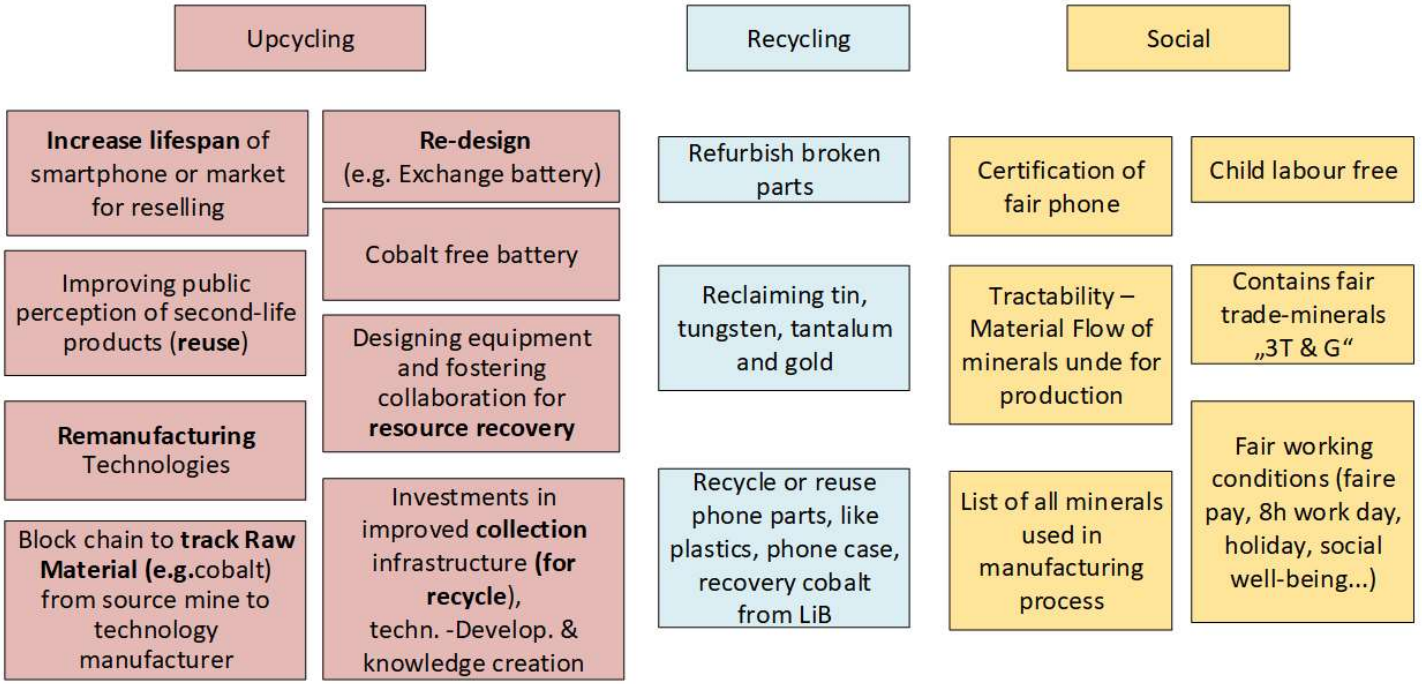
# I. Introduction

*Sustainability issues in the smartphone lifecycle*

***System Boundaries***

*Stakeholder - influence matrix*

## Systems Boundaries of thesis research



# II. System Dynamics Method and Software

# II. System Dynamics Method and Software

## The System Dynamics Approach

- System Dynamics is a computer-aided approach for strategy and policy design.
- The main goal is to help people **make better decisions when confronted with complex, dynamic systems**. The approach provides methods and tools to model and analyze dynamic systems. Model results can be used to communicate essential findings to help **everyone understand the system's behavior.**
- It uses **simulation modeling** based on feedback systems theory that complements systems thinking approaches. It applies to dynamic problems arising in complex social, managerial, economic, or ecological systems. System Dynamics can be applied to social, managerial, economic, ecological, and physiological systems.

https://systemdynamics.org/what-is-system-dynamics/

# II. System Dynamics Method and Software

iThink ® and STELLA®


Powersim Studio

VenSim®

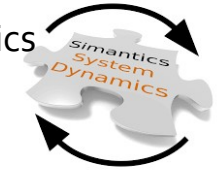

Simulink


StochSD

StatSim

WOLFRAM SYSTEM MODELER™

Simantics System Dynamics




OpenModelica

# III.
# Dynamic Business modeling Framework

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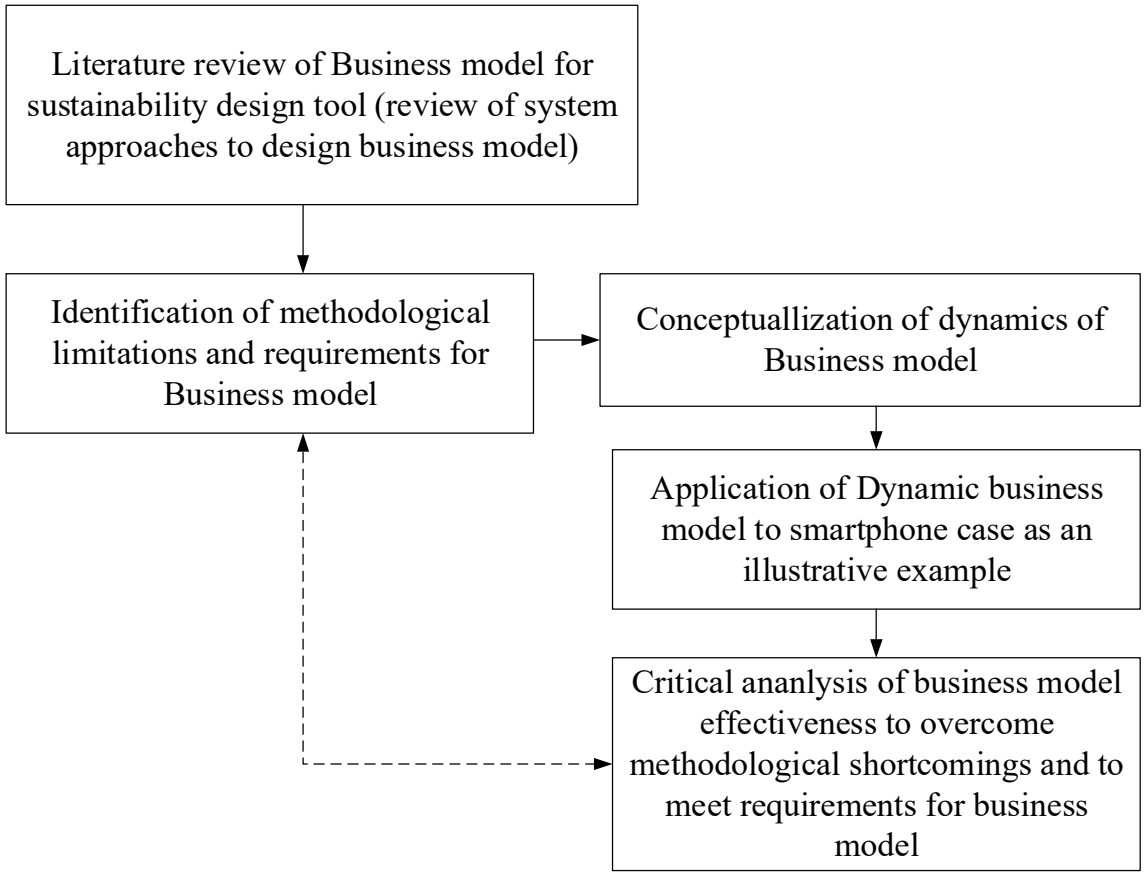
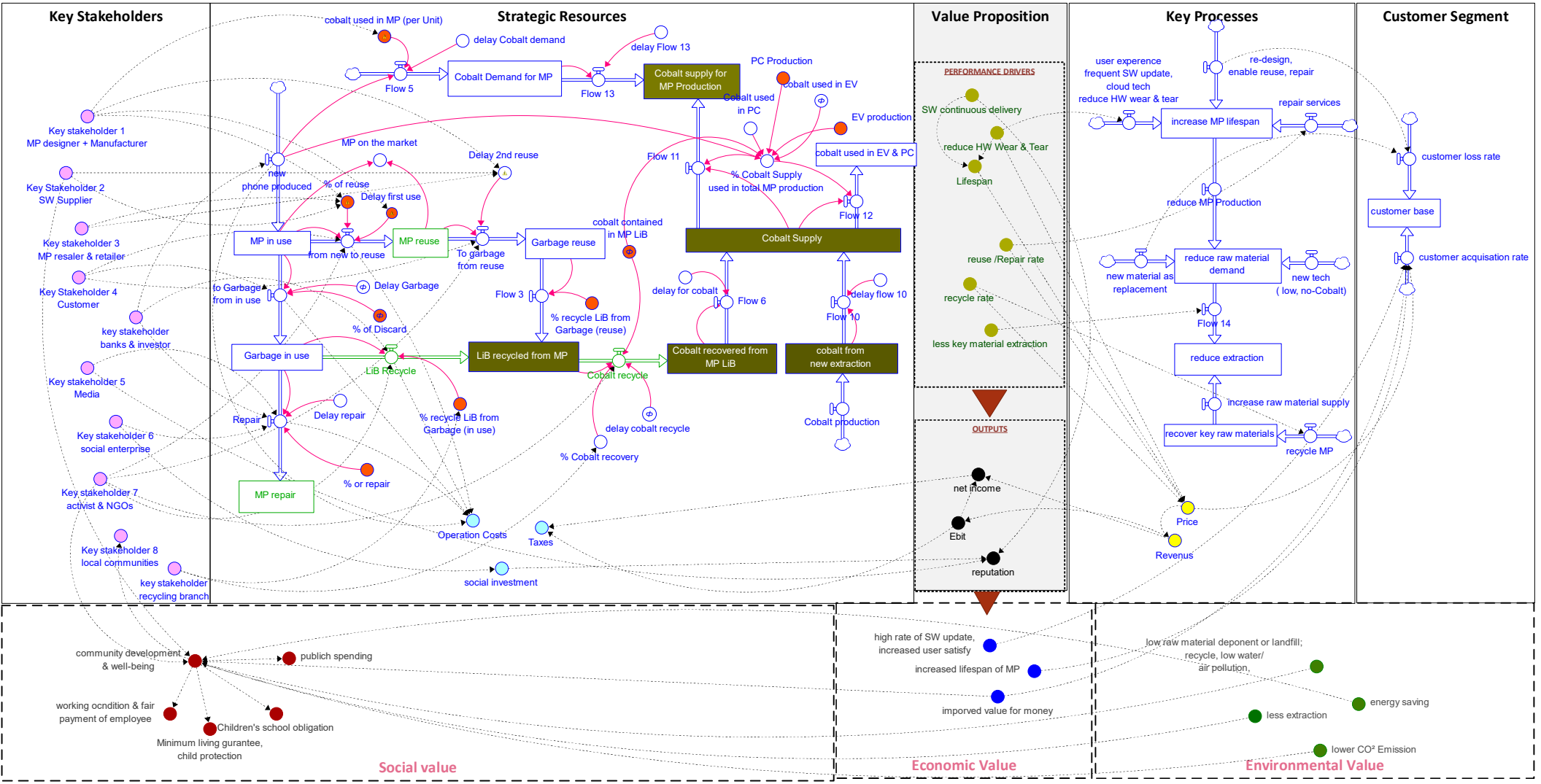
## Research Process Business Modeling for Sustainability




Key Stakeholders
Strategic Resources
Value Proposition
Key Processes
Customer Segment
Key stakeholder 1
MP designer + Manufacturer
Key Stakeholder 2
SW Supplier
Key stakeholder 3
MP resaler & retailer
Key Stakeholder 4
Customer
key stakeholder
banks & investor
Key stakeholder 5
Media
Key stakeholder 6
social enterprise
Key stakeholder 7
activist & NGOs
Key stakeholder 8
local communities
key stakeholder
recycling branch
cobalt used in MP (per Unit)
delay Cobalt demand
delay Flow 13
Flow 5
Cobalt Demand for MP
Flow 13
Cobalt supply for
MP Production
PC Production
cobalt used in EV
Cobalt used
in PC
EV production
cobalt used in EV & PC
MP on the market
Delay 2nd reuse
Flow 11
new
phone produced
% of reuse
Delay first use
% Cobalt Supply
used in total MP production
Flow 12
MP in use
from new to reuse
MP reuse
To garbage
from reuse
Garbage reuse
cobalt contained
in MP LiB
Cobalt Supply
to Garbage
from in use
Delay Garbage
Flow 3
% recycle LiB from
Garbage (reuse)
delay for cobalt
Flow 6
delay flow 10
Flow 10
% of Discard
Garbage in use
LiB Recycle
LiB recycled from MP
Cobalt recycle
Cobalt recovered from
MP LiB
cobalt from
new extraction
Repair
Delay repair
% recycle LiB from
Garbage (in use)
delay cobalt recycle
Cobalt production
% Cobalt recovery
MP repair
% or repair
Operation Costs
Taxes
social investment
PERFORMANCE DRIVERS
SW continuous delivery
reduce HW Wear & Tear
Lifespan
reuse /Repair rate
recycle rate
less key material extraction
OUTPUTS
net income
Ebit
reputation
user experence
frequent SW update,
cloud tech
reduce HW wear & tear
re-design,
enable reuse, repair
repair services
increase MP lifespan
reduce MP Production
reduce raw material
demand
new material as
replacement
new tech
( low, no-Cobalt)
Flow 14
reduce extraction
increase raw material supply
recover key raw materials
recycle MP
Price
Revenus
customer loss rate
customer base
customer acquisation rate
community development
& well-being
publich spending
working ocndition & fair
payment of employee
Children's school obligation
Minimum living gurantee,
child protection
Social value
high rate of SW update,
increased user satisfy
increased lifespan of MP
imporved value for money
Economic Value
low raw material deponent or landfill;
recycle, low water/
air pollution
energy saving
less extraction
lower CO² Emission
Environmental Value

# III. Dynamic Business modeling Framework

## Theoretical Basis

**LCA**

**L**ife **C**ycle **A**ssessment tool can help determine impacts of products or systems over a range of **environmental** and **resource** issues.

**LCSA**

**L**ife **C**ycle **S**ustainability **A**ssessment refers to the evaluation of all **environmental**, **social** and **economic** impacts in decision-making processes towards more sustainable products throughout their life cycles.

**[E-LCA] + [S-LCA] +[LCC] = [LCSA]**

E-LCA: denotes the conventional **environmental lifecycle assessment**

S-LCA: represents the assessment of **positive and negative social impacts** along the product lifecycle

LCC (**Life Cycle Costing**), the assessment of **economic** impacts along product lifecycle, is necessary for an analysis, if cash flow is important.

# IV.
# Case Study with Smartphone

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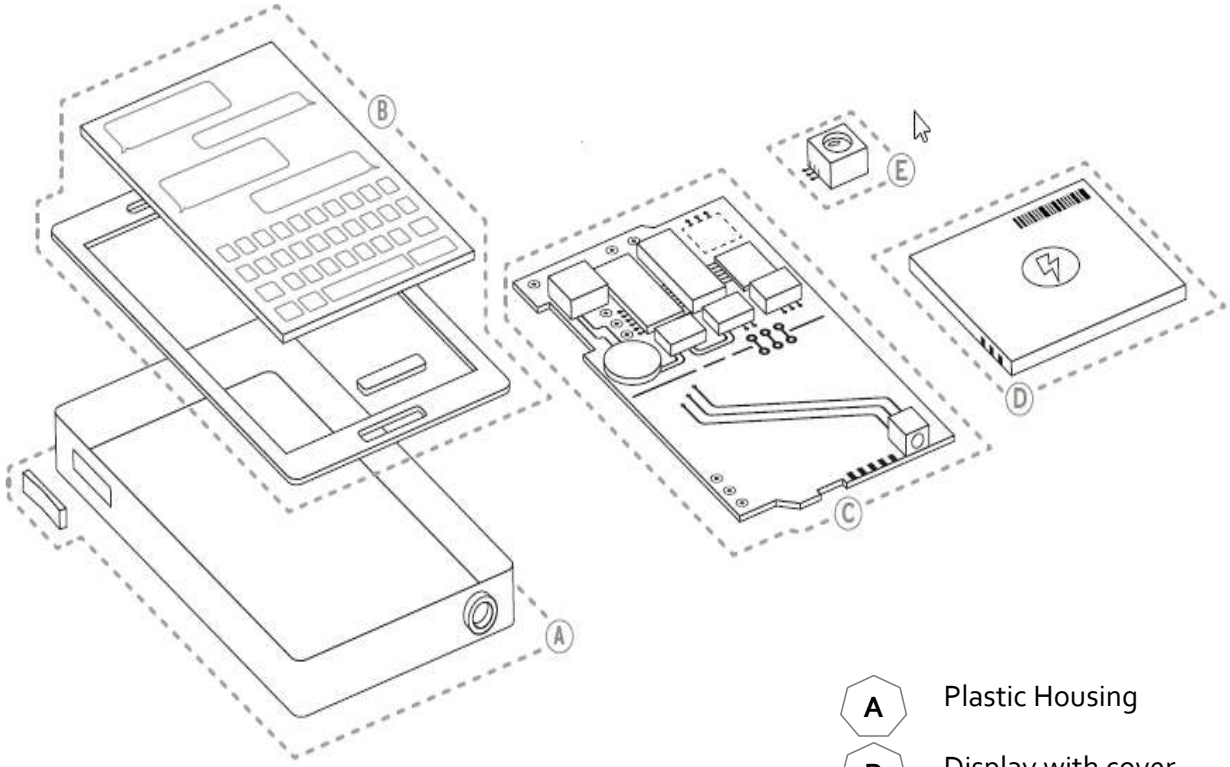
*Structure of one smart phone*





- A — Plastic Housing
- B — Display with cover
- C — PCB with electronic parts
- D — Battery
- E — Camera

# IV.
# Case Study

*Selecting of a case study*

- Smartphone's ubiquity and global cooperation involved
- Application of Conflict and Hazardous Materials in Smartphones – Co.
- Human rights abused (Child labor) might be hidden in the Smartphone's supply chain – material extraction
- Environmental impact extends through the Lifecycle of Smartphone

# Material Life Cycle of Smart Phone

7 Billion of People;
4,8 Billion smart phones end of 2019 (62,9%);
1,5 billion new smart phones will be produced per year;
36 smart phones will be producted per second, the production rate is higher than the human birth rate only 11% are recycled

- Mixed-signal chips (such as NFC): NXP in Netherlands.
- Accelerometer from Bosch Germany
- Gyroscope from Italy/France

- Design
- Development
- Marketing work
- Creation of software

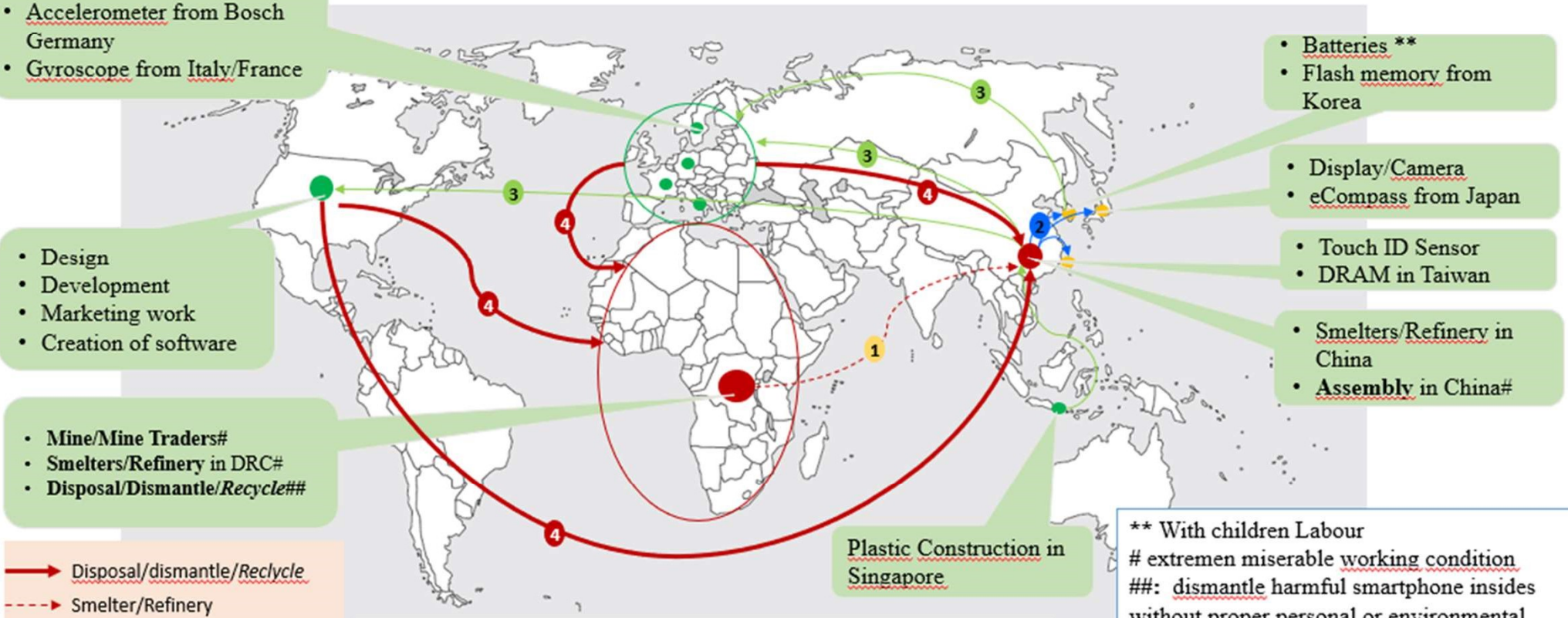
- **Mine/Mine Traders#**
- **Smelters/Refinery** in DRC#
- **Disposal/Dismantle/*Recycle*##**

- Batteries **
- Flash memory from Korea

- Display/Camera
- eCompass from Japan

- Touch ID Sensor
- DRAM in Taiwan

- Smelters/Refinery in China
- **Assembly** in China#




** With children Labour
# extremen miserable working condition
##: dismantle harmful smartphone insides without proper personal or environmental protection
Recycle methods=Landfill & Incineration

# IV.
# Case Study

*Selecting of a case study*

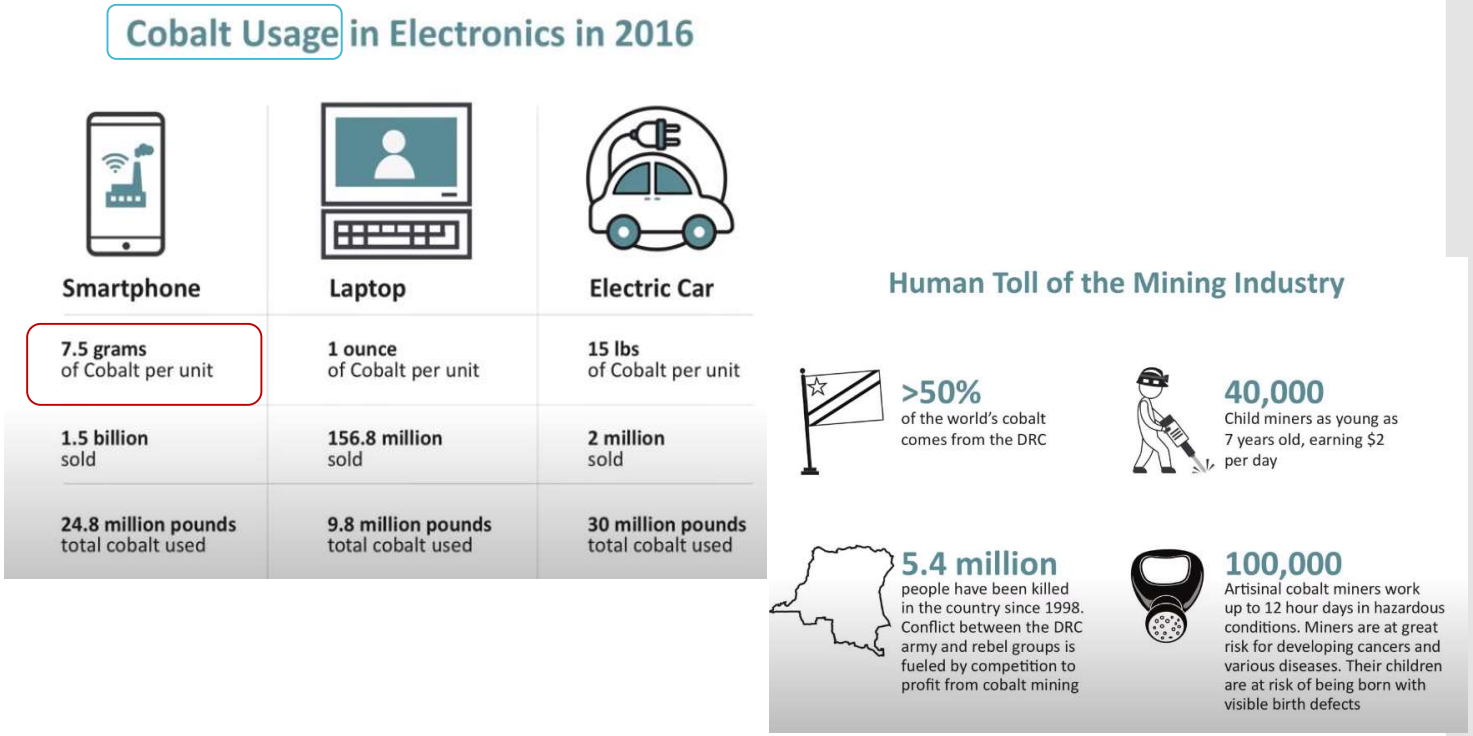

https://www.pinterest.de/pin/664351382508494466/

Conflicts minerals like: tin, tantalum, tungsten and Gold (3TG)

Co: Cobalt
Au: Gold
Ta: Tantalum
Sn: Tin
W: Tungsten

# IV.
# Case Study

*Selecting of a case study*




Source: The Atlantic, National Institute of Health, UNICEF, Amnesty International and Visual Capitalist as at Set. 2017

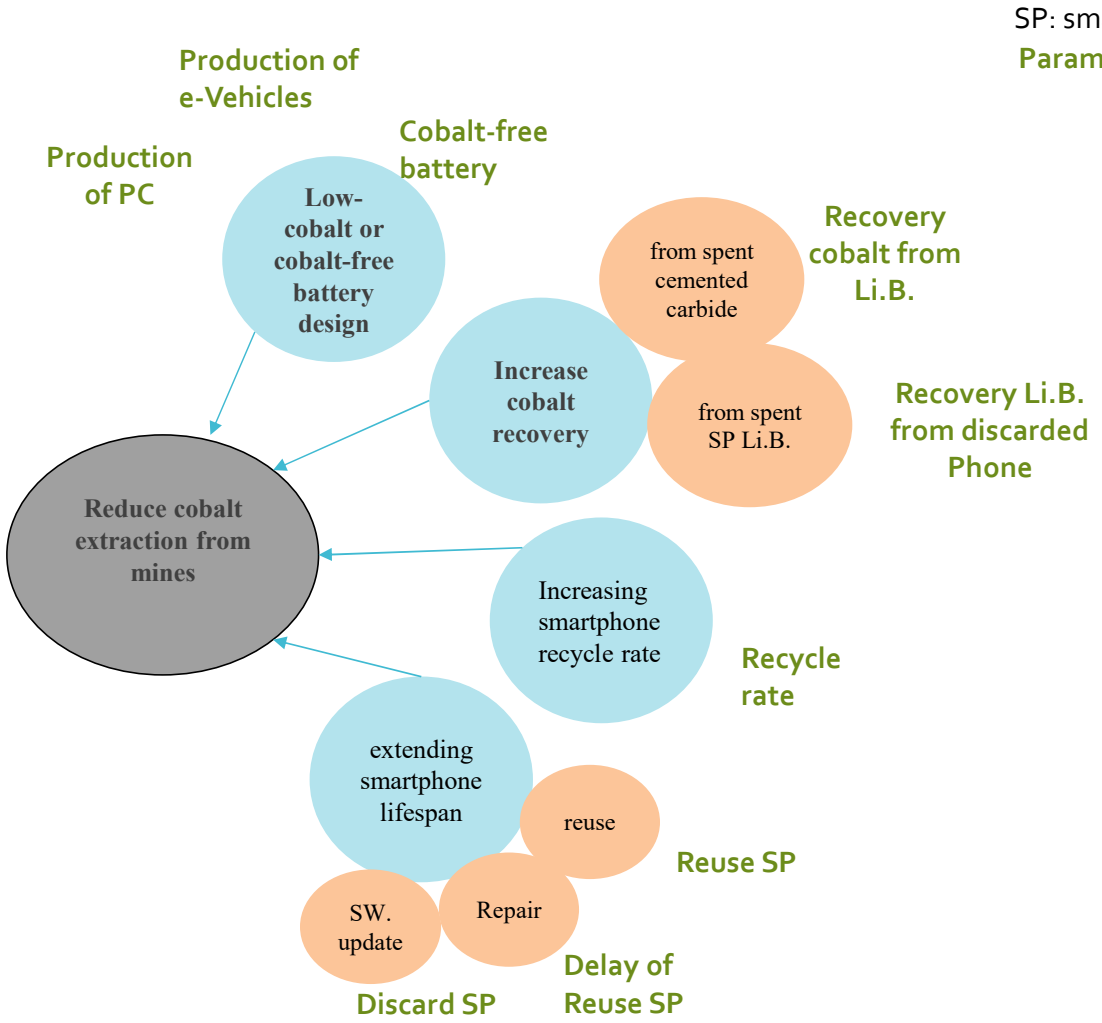
# V. Modeling with Simulation Software Stella®

# V. Modeling with Simulation Software Stella®

- ***Identify Parameters***
- ***Building and Calibration of Model***
- ***Visualization and Simulation of Model***

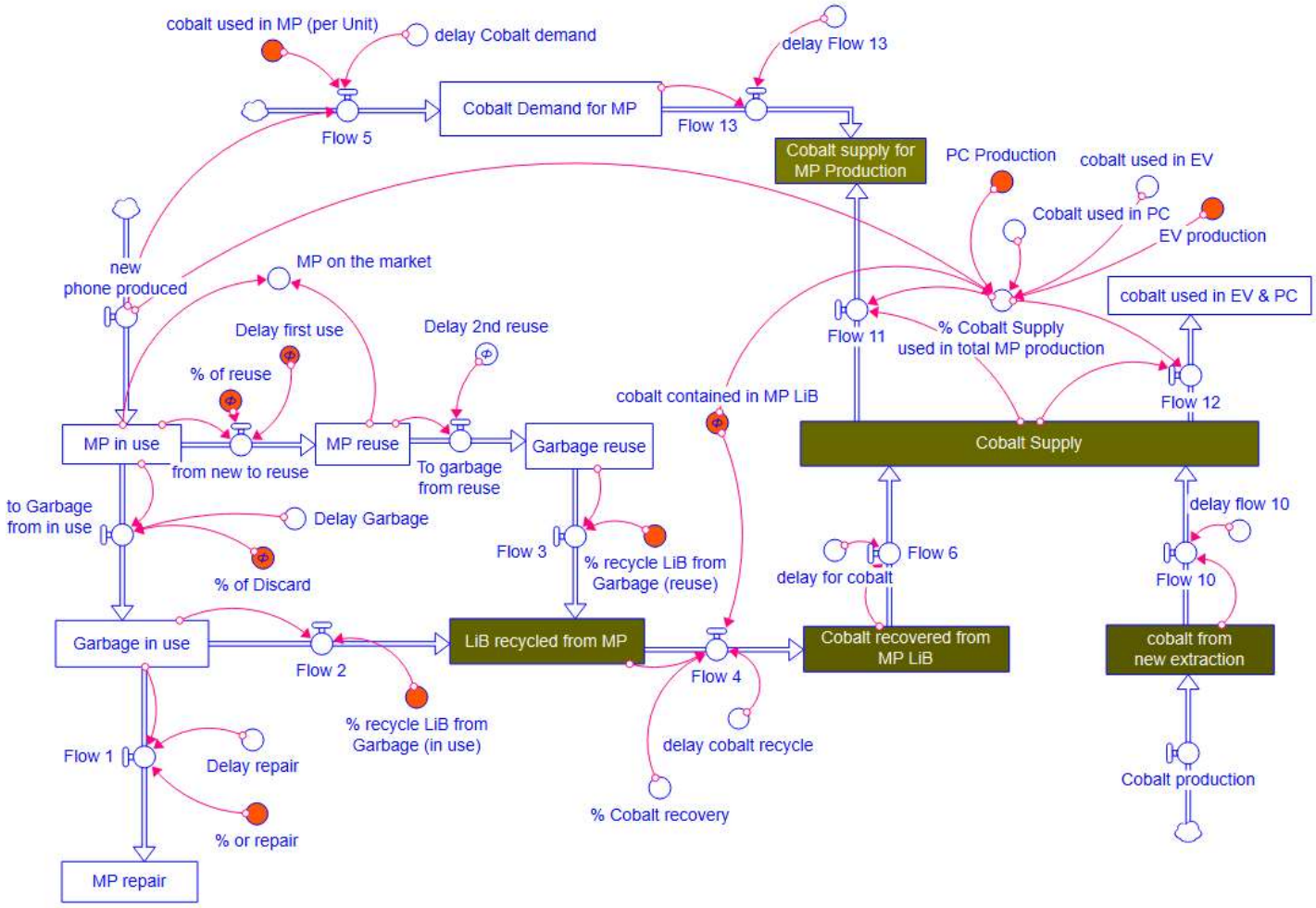
# V. Modeling with Simulation Software Stella®

*Identify parameters*



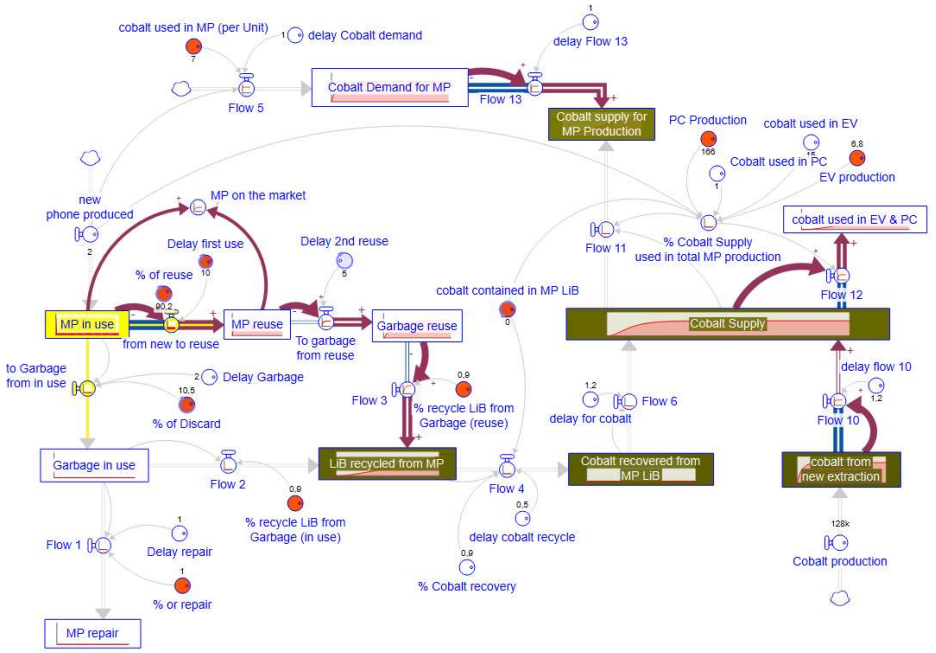
# V. Modeling with Simulation Software Stella®

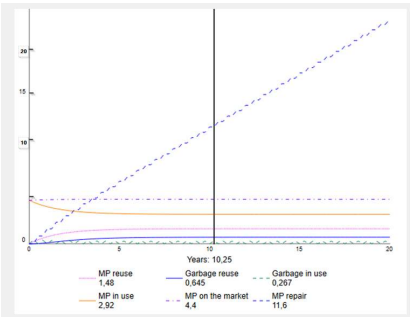
*Building and Calibration of Model*

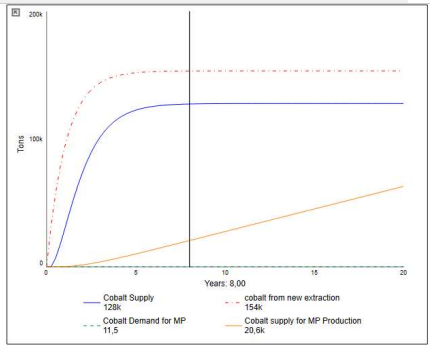


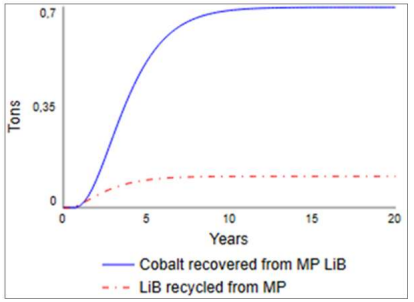
# V. Modeling with Simulation Software Stella®

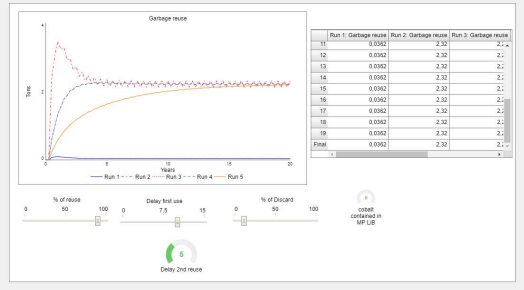
*Visualization and Simulation of Model*



# VI. Conclusion and Future Work

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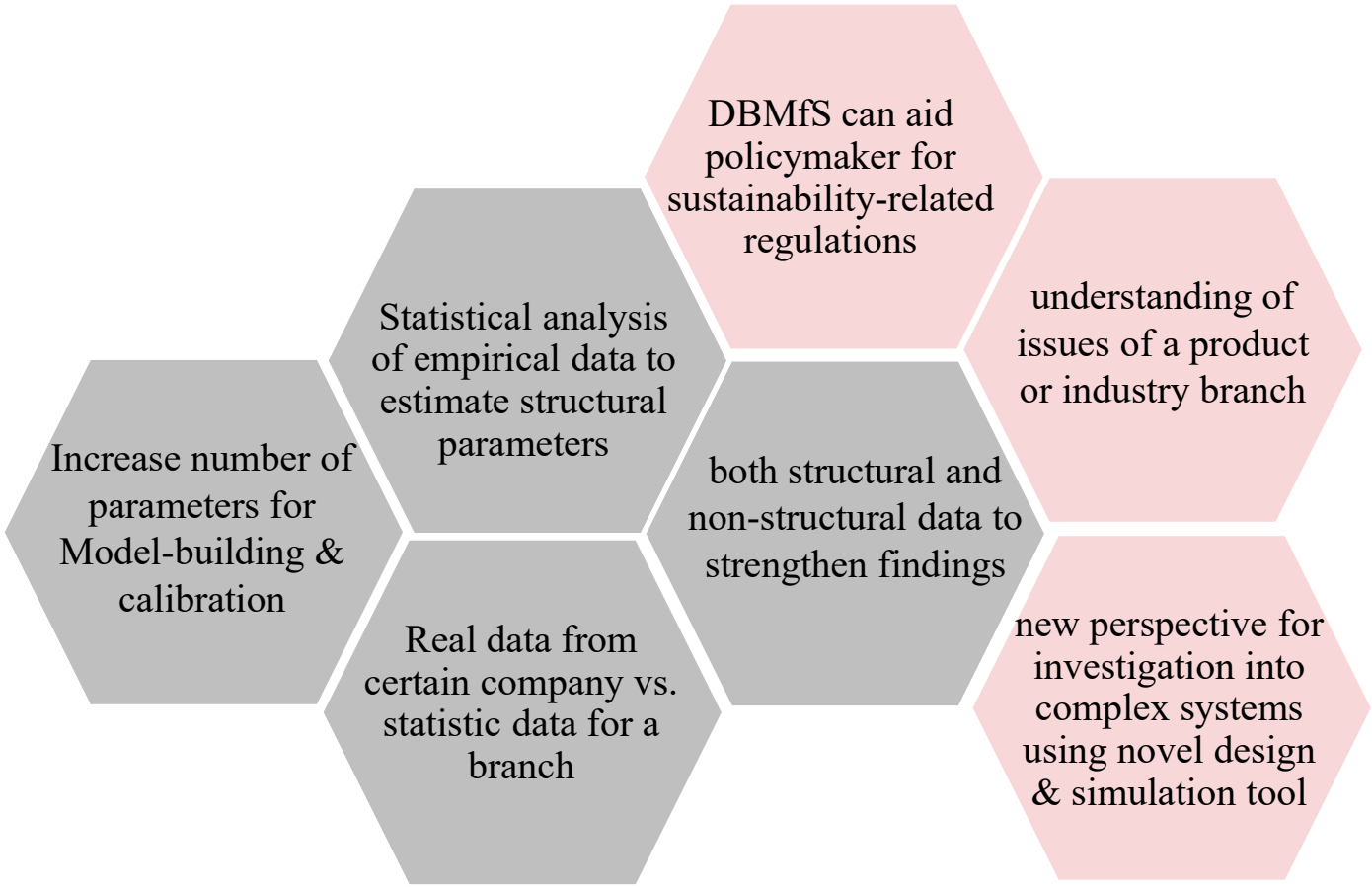

# Any Questions

# Thank You
# For Your Attention