FRAMING SUSTAINABILITY AS A PROPERTY OF SOFTWARE QUALITY

EGE İLİKLİER
PARVIN NAJAFLI
YUSUF ÖNDER

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* Dimensions of Sustainability
* Sustainability Analysis Framework
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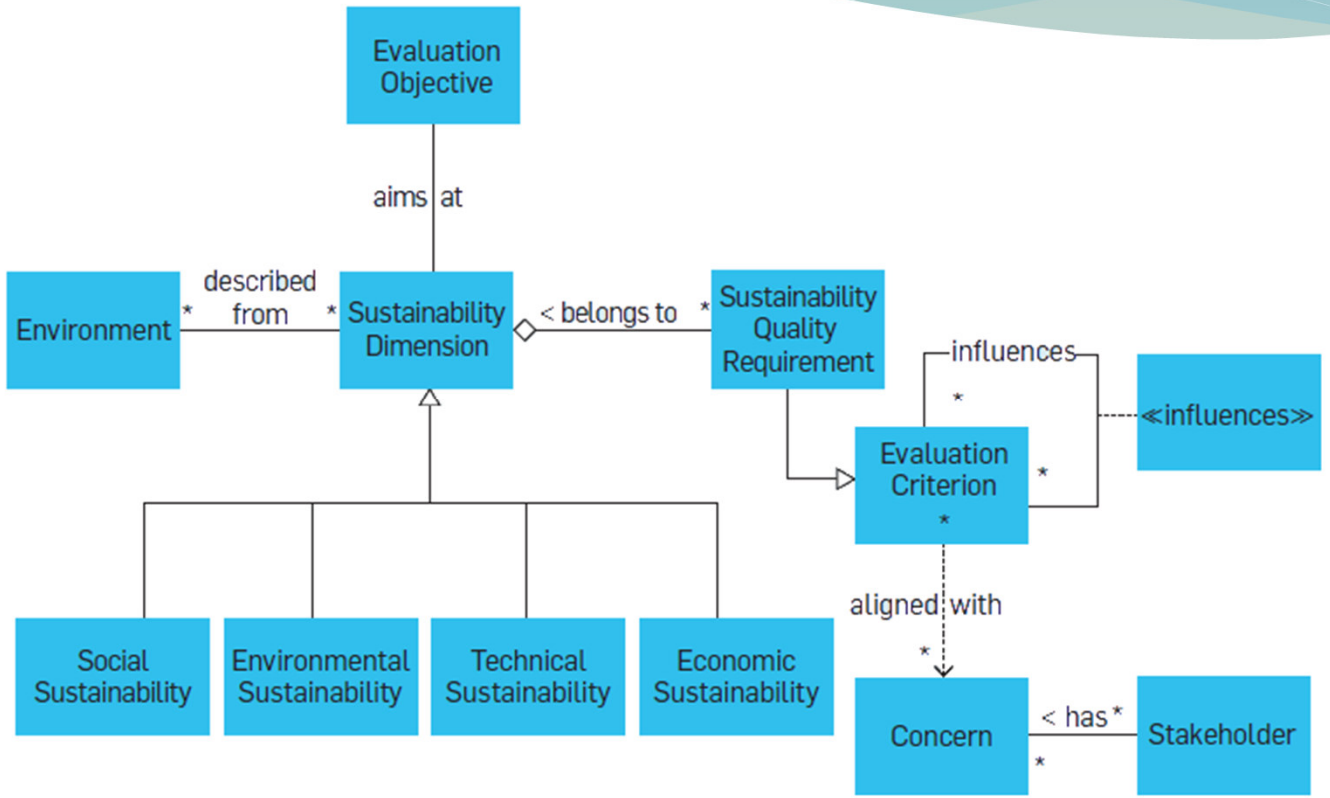
DIMENSIONS OF SUSTAINABILITY

- Economical
- Technical
- Social
- Environmental

SUSTAINABILITY ANALYSIS FRAMEWORK

FRAMEWORK DIAGRAM

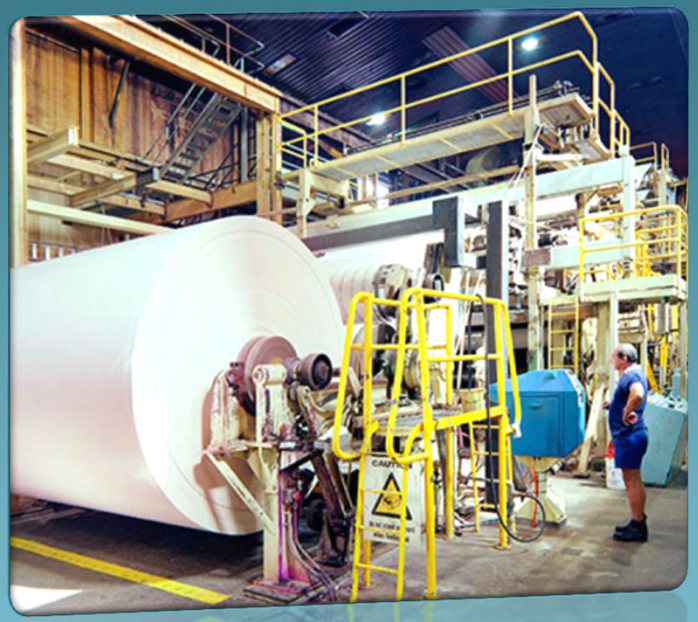


WHAT ARE SUSTAINABILITY QUALITY REQUIREMENTS ?

Requirements can include *traditional quality requirements* such as:

* Security
* Maintainability
* Performance etc.

And *sustainability related requirements* such as energy efficiency



PAPER –MILL CONTROL SYSTEM

* Stakeholders
* Trade-offs

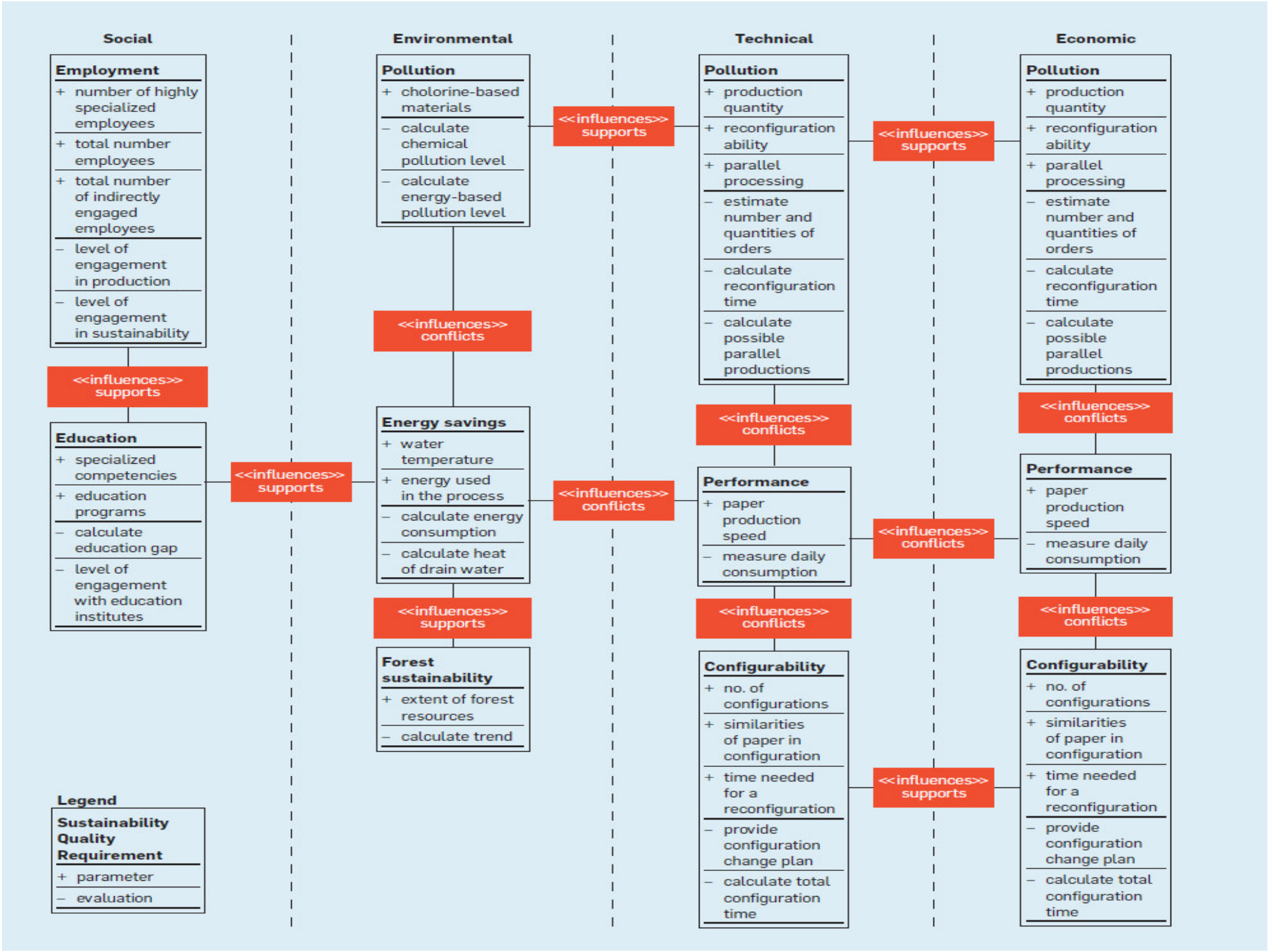
PAPER-MILL CONTROL SYSTEM (cont.)

30 years before

* Paper-production of several days.
* World manage entire process through a few hundred sensors and actuators.
* More environmental impact.
* 200-300 m^3/t H2O consumption.

Today

* Paper-production cycle is only a few hours.
* Can handle several thousand signals.
* Less environmental impact.
* Less than 50m^3/t H2O consumption.


Social
Environmental
Technical
Economic
Employment
+ number of highly specialized employees
+ total number employees
+ total number of indirectly engaged employees
– level of engagement in production
– level of engagement in sustainability
<<influences>> supports
Education
+ specialized competencies
+ education programs
– calculate education gap
– level of engagement with education institutes
<<influences>> supports
Pollution
+ cholorine-based materials
– calculate chemical pollution level
– calculate energy-based pollution level
<<influences>> conflicts
Energy savings
+ water temperature
+ energy used in the process
– calculate energy consumption
– calculate heat of drain water
<<influences>> supports
Forest sustainability
+ extent of forest resources
– calculate trend
<<influences>> supports
Pollution
+ production quantity
+ reconfiguration ability
+ parallel processing
– estimate number and quantities of orders
– calculate reconfiguration time
– calculate possible parallel productions
<<influences>> conflicts
Performance
+ paper production speed
– measure daily consumption
<<influences>> conflicts
Configurability
+ no. of configurations
+ similarities of paper in configuration
+ time needed for a reconfiguration
– provide configuration change plan
– calculate total configuration time
<<influences>> supports
Pollution
+ production quantity
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Configurability
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+ time needed for a reconfiguration
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– calculate total configuration time
Legend
Sustainability Quality Requirement
+ parameter
– evaluation

TRADE-OFFS

In this case study the trade-offs are typically require between

- Economic & Social
- Economic & Environmental

This paper-mill case example illustrates how the sustainability analysis framework can be applied in development processes of large, long-lived systems.

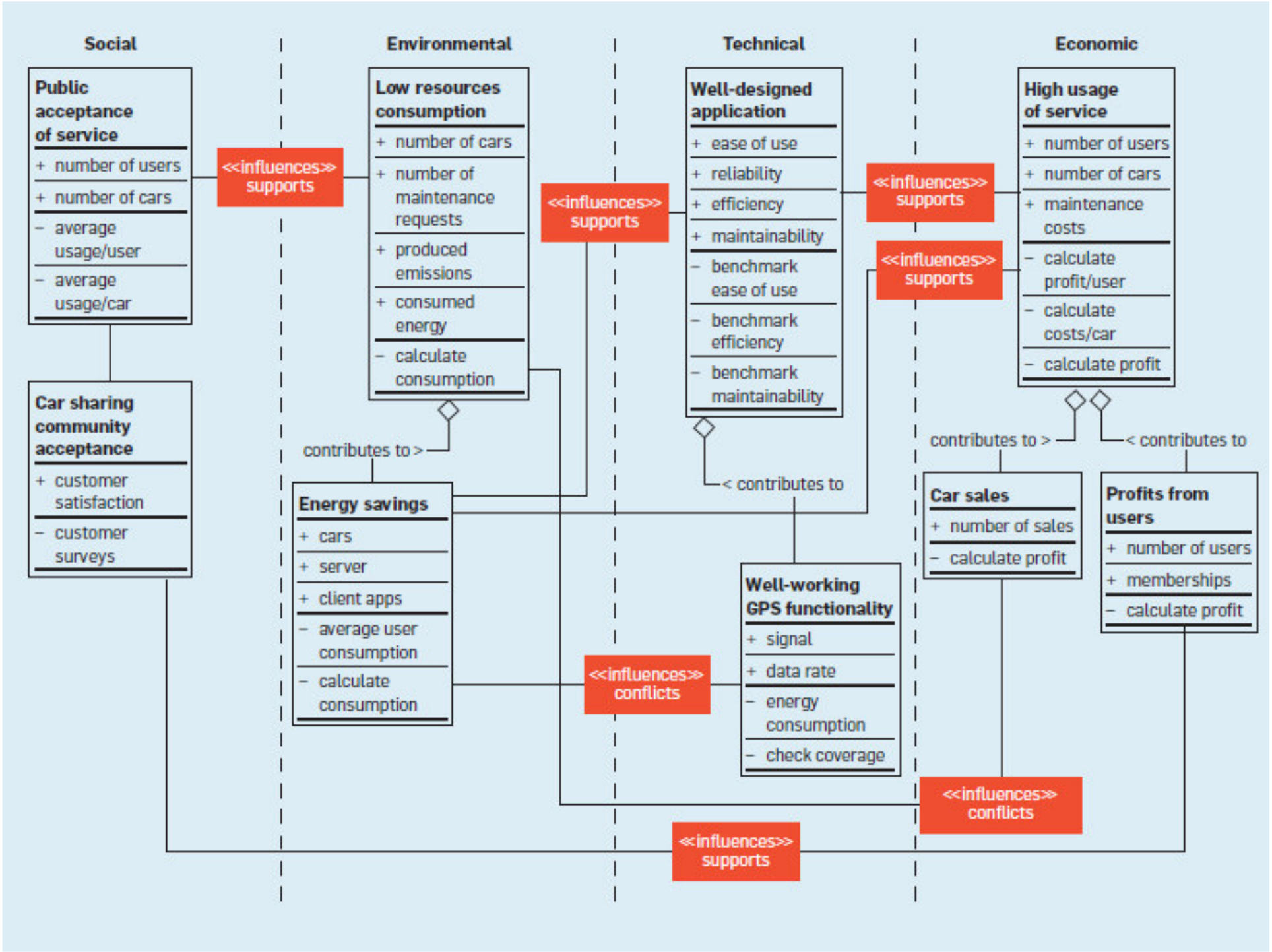
CAR SHARING PLATFORM

* Environmental Sustainability
* X order effects

ENVIRONMENTAL SUSTAINABILITY

Environmental sustainability in terms of energy saving is affected in at least three ways :

* GPS : Adding it will, in turn , negatively affect energy savings
* Energy : As more people share cars, car production reduces, hence increases energy savings
* Marketing : Shared cars will be seen by potential customers who may be motivated to buy them leading to less energy savings due to increase car production


Social
Environmental
Technical
Economic
Public acceptance of service
+ number of users
+ number of cars
– average usage/user
– average usage/car
<<influences>> supports
Low resources consumption
+ number of cars
+ number of maintenance requests
+ produced emissions
+ consumed energy
– calculate consumption
<<influences>> supports
Well-designed application
+ ease of use
+ reliability
+ efficiency
+ maintainability
– benchmark ease of use
– benchmark efficiency
– benchmark maintainability
<<influences>> supports
High usage of service
+ number of users
+ number of cars
+ maintenance costs
– calculate profit/user
– calculate costs/car
– calculate profit
<<influences>> supports
contributes to >
< contributes to
contributes to >
< contributes to
Car sharing community acceptance
+ customer satisfaction
– customer surveys
Energy savings
+ cars
+ server
+ client apps
– average user consumption
– calculate consumption
Car sales
+ number of sales
– calculate profit
Profits from users
+ number of users
+ memberships
– calculate profit
<<influences>> conflicts
Well-working GPS functionality
+ signal
+ data rate
– energy consumption
– check coverage
<<influences>> conflicts
<<influences>> supports

X ORDER EFFECTS

* First order effects
* Second order effects
* Third order effects

INTERRELATION OF DIMENSIONS

* One example of often-underestimated relations among the dimensions our framework helps analyze is the use of electric cars.
* They must be drive in right way to ensure they produce less pollution.

OBSERVATIONS

There are also some limitations to what the Sustainability Analysis Framework can provide :

* The influence among the sustainability quality requirements must be determined by developers and/or stakeholders.
* As the framework can provide only the means for linking them but not the analysis itself.

THANKS FOR LISTENING

QUESTIONS ??