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Definition of the ecopark's multi-criteria decision-making problems and their challenges

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Abstract

An ecopark is defined as “*a community of businesses (of all sizes, from the industrial or service sectors) located on a business park planned and built in a sustainable approach, that cooperate with each other and with the local community to efficiently share information, materials, energy, infrastructure or services (for the companies or the employees), leading to economic environmental and social gains for the businesses and the local community.*” [Le Tellier et al., 2019]. This emerging archetype attempts to provide an answer to, the economic, environmental and social shortcomings faced by mixed industrial parks in Europe and North America [Lambert et Boons, 2002].

Such a vision of ecoparks leads to the handling of two important features.

- An ecopark is built around cooperation between companies one the one hand and between companies and local communities on the other hand.
- An ecopark is designed and built following the principles of sustainable urban planning, which includes the development of buildings, the use of land and the design of urban infrastructures such as transportation, communications, and distribution networks.

An ecopark is controlled by a designated manager:

- on behalf of a variety of stakeholders (resident companies, their employees, the local community, the environment);
- at different stages of its lifecycle (design, construction, operation, retrofit, expansion);
- at different timespans (form very short-term to long-term).

Essentially, the ecopark's control consists of deciding about a collection of actions which aims at achieving its finality, that is sustainability. Sustainability is interpreted in its consensual way, as the conjunction of its three pillars [World Commission On Environment and Development, 1987]. Hence, sustainability is handled according to three overall criteria to which three goals are associated, respectively:

- reducing the environmental impact of the ecopark site;
- generating economic benefits from the ecopark operating;
- generating social benefits from the ecopark operating.

In accordance with industrial continuous performance improvement approaches and the Deming wheel principle (Plan-Do-Check-Act), the ecopark's control requires an expression of its performance based on the declaration and the decomposition of its goals in order to define an adequate action plan. The definition of actions can be interpreted as the choice, among a set of potential actions, of the adequate action or set of actions to improve the ecopark's performance. Keeping in mind that this performance is expressed within multiple criteria, resulting from the sustainability overall criteria, each action typically offers advantages and disadvantages respectively to each criterion, timespan or stakeholder. In summary, in the ecopark's control context, the definition of the action plan can be seen as a decision process that includes both choice and sorting decision-making problem.

Since an ecopark is both a park, designed and built in a sustainable way, and a community of collaborating companies, we postulate that two action plans can be defined to reach its goals: one with actions related to the sustainable planning of the site and one with actions relating to the companies' collaboration. Those two action plans relate to different lifecycle stages. Indeed, the sustainable planning of the site mostly concerns the ecopark's design, construction, retrofit and expansion, and the companies'

collaboration concerns the ecopark's operation. As a result, those two action plans lead to two different kinds of decision-making problems with different decision-makers, criteria and alternatives. The definition of the "sustainable urban planning" action plan engenders a specific decision-making problem, that is the selection of features and elements of the ecopark's urban planning. On the other hand, the definition of the "companies' collaboration" action plan is associated with a different decision-making problem, that is the agreement of applying companies. The following two paragraphs describes those decision-making problems and their respective challenges.

We first describe the decision-making problem associated with the "sustainable urban planning" action plan. The sustainable planning of an ecopark entails several choices to make, such as the ecopark's location and layout, its buildings and infrastructures, their quality, locations or retrofit.

The planning of the ecopark is executed by the ecopark's manager which makes them the main decision maker for this problem. In some cases, a building or an infrastructure may be owned by another stakeholder such as a resident company or a private owner. In that case, the managers share their decision-making capacity with them.

The criteria may depend on the choice that is being made but, should always be connected to the three previously cited goals of the ecopark. As there may be interactions between the criteria, the nature of the relations between pairs of criteria could be investigated.

Eventually, the challenges of the decision-making problem associated with the sustainable urban planning of an ecopark are the following:

- the selection of adequate criteria;
- the determination of interactions between criteria;
- the determination of the criteria's weights;
- the selection of an adequate multi-criteria decision aiding method that can accommodate several decision-makers.

The decision-making problem associated with the "companies' collaboration" action plan is the agreement of a company aspiring to be implemented in the ecopark. This decision-making problem is a sorting problem, where the alternatives, or the applying companies, are sorted in two classes: accepted or rejected. The decision-maker for this problem is the ecopark's manager and the criteria are expressed by them in an agreement charter (for an example of an ecopark's agreement charter, see Savoie Technolac's [Chambéry-Grand Lac Economie, 2010]). A particular criterion is the impact that the applying company may have on the ecopark, or in other words, to which extent does the applying company may affect the existing collaboration between companies. The challenges of the decision-making problem associated with the "companies' collaboration" action plan are the following:

- the selection of a criterion evaluating the impact an applying company as on the existing collaboration of an ecopark;
- the determination of the criteria's weights;
- the selection of an adequate multi-criteria decision aiding method.

La méthode d'aide à la décision retenue devra permettre de prendre en compte les interactions entre critères et pourra être une méthode d'agrégation comme MACBETH ou UTA adaptée à l'Intégrale de Choquet [Clivillé 2007] [Angilella 2004]

In summary, the ecopark's is a community of collaborating businesses located on a business park planned and built in a sustainable approach. Its control requires the definition and continuous revision of its two action plans, namely "sustainable urban planning" and "companies' collaboration". This constitutes two decision-making problems, with different decision-makers, criteria, alternatives and challenges: the selection of features and elements of the ecopark's urban planning for the definition of the "sustainable urban planning" action plan and the agreement of applying companies for the definition of the "companies' collaboration" action plan.

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