G-SCOP
SCIENCES POUR LA CONCEPTION, L'OPTIMISATION ET LA PRODUCTION

# THESIS G-SCOP 2020

**Title:** Multipurpose urban factory – characterisation and circularity
**Supervisor :** Damien Evrard and Peggy Zwolinski
**Phd school** : IMEP2
**Start date** : September 2020
**Financements envisagés – Contexte – Partenaires éventuels :** Research Allowance

**Brief Description :**

European industrial production has been centralised in large installations located far from the places of consumption. This relocation is explained by the search for economies of scale and the avoidance of nuisance problems associated with certain activities, at a time when the clean technologies that exist today were not available. It has also led to a hyper-specialisation of factories, with the need for large volumes of the same category of products in a given location. However, the rise of Industry 4.0 technologies is challenging this model.

The remoteness of industrial activities also emphasizes current and projected problems in recruiting a skilled workforce to operate these new industrial models. Several attempts have been made to study possible urban plant locations and their potential negative and positive impacts through computer models that can be inspired by various existing systems, according to multi-criteria models based on quantitative or qualitative data. Nevertheless, all the current researches found only concerns plants producing only one type of product (asphalt, breweries, or spectacle frames). However, the possibilities offered by additive manufacturing techniques and those from Industry 4.0 (particularly mass customisation) should make it possible to develop multi-purpose urban production sites that would therefore be capable of designing and manufacturing a multitude of different products capable of satisfying a multitude of needs, while sourcing within an optimised perimeter and strengthening the local resilience. It is on this question of the characterization of potential models of urban multi-purpose factory that this thesis topic focuses, while maintaining an orientation towards sustainability and fitting into circular supply and production models. In particular, the characterization of products that can be 'urban' manufactured and of the multi-product 'factory' are the main expectations of the thesis.

The thesis will be carried out in four phases. The first phase will consist in researching the literature and existing data sources relating to the notion of urban factory and on the characteristic parameters of an industrial model (technical, economic, regulatory, etc.). This part will also focus on data collection and processing methods, sampling methods and their uncertainties, as well as modelling and multi-criteria decision-support methods that may already have been applied in other contexts.

Part of this work will focus on the aggregation of data available in open databases (in particular French data centralized on data.gouv.fr) in order to contextualize the geographic, economic and environmental information of a given territory. Whatever the origin of the data, their quality and representativeness will be studied in order to verify their relevance. These will also concern: the characteristics of the industrial sectors, the nature of the products studied and the logistics sectors relating to the subjects of study.

In a second step, these data will be analysed using data analytics and artificial intelligence tools that will enable the identification of the most relevant key products and sectors in relation to the location contexts and needs of a given territory. The avenues that will be explored will involve the use of models based on flows and life cycle analysis, as well as information formalization languages such as UML, which can be used as methodological building blocks for integrating and optimizing a model of a multipurpose urban factory. Once the key parameters and their articulation in the model have been established, its sensitivity and robustness will be studied in order to adjust it and identify the borderline cases for its applicability. Tests with real data can be used, using existing case studies and data from ongoing projects. The resulting model will eventually be developed as a decision support tool to identify the key parameters to be considered in an urban plant design scenario. An information system will therefore be required to capture the relevant input data and to obtain a humanly understandable response from the tool that is useful for project modification.

**Skills required:** General or Industrial Engineering Engineer, with skills in data analytics and systems modeling. Skills in MFA or LCA are a plus. A strong interest in sustainability and circular economy is essential.

Application to send **before May 31st 2020.**

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