**PROJECT TITLE:**

CASCADE (Criticality Analysis for Supply Chain Availability and Dependency Evaluation)

**PROJECT DESCRIPTION:**

Premise: Both scientific literature (Kalaitzi et al., 2018; 2019) and outlooks by Institutional agencies (European Commission, 2020) hint that the World Economy will likely face a serious issue of resource scarcity – particularly, critical raw materials (CRM) scarcity – over the next few years, which will pose challenges to value chains’ fundamental role of ensuring continuous supply. The Covid-19 pandemic, as well as the recent geopolitical crisis, further exacerbated the issue – in the form of substantial commodity price increase and shortages of critical supplies (e.g., semiconductors). With the aim to strengthen its economic competitiveness and secure its strategic autonomy, the EU has identified a list of industries that are key to these objectives, and it has started to delineate a strategy to ensure access to CRM, which are often essential to such industries. Yet it is still unclear (a) how National Governments, including the Italian one, should adopt and support these general guidelines; (b) which managerial strategies and practices, including circular economy-related practices, could be more effective in tackling the scarcity-driven issues and ensuring supply continuity.

Main objectives: Again this backdrop, the CASCADE project – in addition to contribute to advance knowledge and scholarly management literature on scarcity-driven issues within value chains – will pursue three main objectives. First, it will develop an original methodology for the identification, among the strategic supply chains/industries, of the associated raw materials that are considered “critical” for a given country in a given period, as well as of other possible sources of criticalities/scarcity. Second, it will contribute to increase the awareness of firms, industrial associations and governments about the risks raised by CRM and other sources of scarcity in strategic supply chains, to support their decision-making process. On top of that, it will provide managerial and policy suggestions on how to enhance competitiveness and reduce external dependencies in one selected strategic product value chain (PVC) belonging to one of the industries listed as “strategic” by the EU. Third, it will contribute to foster the sustainability of the production ecosystem, by analysing how the shift towards the circular economy paradigm allows not only to decrease the dependency of the strategic supply chain from critical raw materials, but also to improve the efficiency of the whole production system.

Structure: CASCADE is organized into 7 phases, sequenced in order to ensure the achievement of the project’s goals. Each phase will enable the accomplishment of a particular project milestone. Empirically, CASCADE will investigate a specific PVC, selected through the methodology developed in the project’s initial phases. The empirical analysis will consist of a delphi study, a value chain mapping, and case studies on the selected PVC.

**PROJECT ACTIVITIES:**

The CASCADE project is structured on 7 phases (corresponding to the project’s workpackages). The phases are logically and chronologically sequenced in order to ensure the achievement of all the goals presented above. Each phase will enable the achievement of a specific PROJECT MILESTONE, and the key contents and outcomes of each phase will be synthesized in the relative Deliverable (s).

PHASE 1 – SELECTION OF THE INDUSTRY

The research team will better define the empirical context of study, by starting from the lists of strategic industries and ecosystems recently developed by EU’s dedicated reports (e.g., European Commission, 2020); these documents also include a preliminary analysis of the CRM that are more significant for these industries, and that can potentially jeopardize their supply. Through a desk-analysis, among these industries the research team will select one that will emerge as particularly important for the Italian economy, based on both economic (e.g., Impact of the industry on the Italian manufacturing GDP; impact on total manufacturing exports; employment in the industry, especially in less developed Italian regions) and sectorial (e.g., presence of Italian “champions”/“leading companies” within the industry) factors. The deliverable of phase 1 will (a) illustrate the selection methodology, (b) specify the selected industry, and (c) explain the motivations for its choice.

PHASE 2 – SELECTION OF THE PRODUCT VALUE CHAIN

The research team will finalize the definition of the context of study, by selecting the value chain of a specific product (PVC) – belonging to the industry identified in phase 1 – that will be the object of the empirical investigation. As a matter of fact, “industry” is a quite broad and heterogeneous category: risk assessments and mitigation practices of scarcity driven issues might result too general and ultimately of limited practical value if conducted at the industry level. Besides, the range of scarcity driven issues in a given industry is wide and varied, making an in-depth, comprehensive analysis of the resulting criticalities (and possible remedies) almost impractical within the project duration. Therefore, the research team will focus on a narrower empirical context. Through a desk-analysis, it will identify a PVC of high relevance for the National Economy and the considered industry, using the same criteria used for the industry selection. Considerations about the PVC’s growth potential, as well as its possible integration with strategic European and global value systems will also be taken into account in the PVC selection process. The deliverable of phase 2 will include a document to (a) illustrate the selection methodology, (b) specify the selected PVC, and (c) explain the motivations for its choice.

PHASE 3 – SETTING OF THE CRM-SCARCITY DRIVEN RISK ANALYSIS

The aim of this phase is threefold: (a) to develop a risk-assessment tool, by operationalizing the various dimensions of CRM-scarcity driven issues (e.g., country of origin’s economic and geopolitical risk; degree of market concentration; etc.); (b) to conduct a preliminary desk-analysis of these risks for the selected PVC; (c) to delineate the state of the art of the extant national and supranational policies for CRM that are relevant for the selected PVC, as well as a preliminary picture of (potentially) substitute materials and technologies alternative to those CRM-based. In addition to provide an initial assessment of the CRM-scarcity driven risk for the selected PVC, these outcomes will represent the base for the semi-structured interview protocol that will be used for the following Focus Group (phase 4). On top of that, they will represent a protytipe of a replicable methodology for a comprehensive risk and context analysis, applicable to other PVCs. The deliverable of phase 3 will consist of (a) the PVC risk assessment report based on the developed tool, (b) the PVC context (i.e., policy, alternative technologies, opportunities from second life sources) report, and (c) the semi-structured interview protocol for the Focus Group.

PHASE 4 - DELPHI STUDY

The aim of this phase is focused on developing a Delphi Study to identify the scarcity-driven criticalities of the selected PVC. As a preliminary activity to refine the questions defined in phase 4, a Focus Group will be carried out in order to design the instruments to be used in the following activities. Specifically, it will support the panel definition so to guarantee proper experts identification and commitment assessment, and the detailed design of the questionnaire adopted in the Delphi study.

The focus of the study will be to identify and validate the criticalities of PVC, based on the preliminary factors identified in phase 3. Attention will also be mainly given to CRM, however other elements will be collected so as to guarantee a wider perspective on the factors that can influence the scarcity-driven criticalities. Attention will be given both to current criticalities and to those that could

become relevant in the next 10 years, due to technological, political, social and economic development. As Deliverable of phase 4, a detailed report will be developed to illustrate the details of the applied methodology and to provide a complete view of the obtained results. In particular, the report will provide the final list of criticalities the panel identified and also the contingent elements that could influence their role in the selected PVC.

PHASE 5 - VALUE CHAIN MAPPING

In this phase, an analysis at global level of the considered PVC will be carried out using consolidated methodologies, such as the Global Value Chain analysis. The analysis will allow the development of a general overview and of a more complete assessment of the phases most impacted by the identified criticalities. The main output will be a general understanding of the flows of critical materials in the considered PVC with the identification and characterization of the key manufacturing phases and key players localization. The deliverable of phase 5 will consist of all the data sources needed to create and detail the PVC’s map.

PHASE 6 – DEVELOPMENT OF A MIX OF INNOVATIVE ACTIVITIES TO REDUCE SCARCITY-DRIVEN CRITICALITIES

Based on findings emerged in the previous two phases, this phase aims to develop a set of activities to be implemented by both, companies operating in the considered PVC and policy makers at the Italian and European Union levels, capable of mitigating the impact of scarcity-driven issues and ensuring continuous access to the critical supply. At the firm level, such innovative activities will regard the relationships between Italian leading compan(ies) operating in the selected PVC and their upstream supplier(s) of the CRM which emerged as the most critical in previous phases (including suppliers utilizing the selecting CRM for their production). Such activities might include the reshoring of some of these suppliers either in Italy or in Europe. Also, it will be evaluated the possibility of developing new supply relationships with European companies already implementing circular economy technologies to extract the selected CRM by exhausted products.

In order to reach these aims, up to two Italian companies playing a relevant role within the selected PVC will be chosen and their relationship(s) with upstream supplier(s) of the selected CRM will be analyzed through case studies; their approaches to risk management and governance of critical supplier relationship(s) will be deeply analysed. Moreover, evidence of reshoring initiatives (if any) already implemented by any upstream supplier of the selected CRMs will be identified through a proprietary dataset developed by the UnivAQ RU, and analysed through case studies. On top of that, technologies allowing to extract the selected CRM by exhaust product will be identified through a patents analysis, complemented by a literature review.

Deliverables of Phase 6 will be: (a) a set of managerial practices, and advice to policy-makers, useful to mitigate the scarcity-driven issues and ensure the continuity of supply; (b) verbatim transcriptions of semi-structured interviews and a report of patent and literature reviews. The key findings of the case studies (phase 6) will be merged with those of the previous empirical phases (i.e., phase 4 and 5) to consolidate the final set of managerial practices and advice to policy-makers.

PHASE 7: METHODOLOGY CODIFICATION AND GENERALIZATION, AND RESULTS DISSEMINATION

In order to provide an integrated methodology to be replicated in other strategic industries and with reference to other CRM, the activities conducted in each of the previous phases will be reported and described, so to keep track of best practices and potential criticalities. At the same time, activities implemented to take into account specificities (if any) regarding the selected PVC will be addressed in order to generalize them. A general methodology to be implemented in other contexts will be designed, together with suggestions for its implementation. Finally, dissemination of the results will start in this phase.