IMT Mines Albi
École Mines-Télécom

RÉPUBLIQUE FRANÇAISE
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PhD offer

2026-2029

Designing the future of Hierarchical Supply Chain Planning Systems

1. Global information

Keywords:
Supply Chain Planning, Hierarchical Production Planning, Supply Chain Risk Management, Decision Support Systems, Simulation, Optimization.

Host Institution, location and partners:
The thesis will be hosted by the Industrial Engineering Center (CGI) at IMT Mines Albi (https://cgi.imt-mines-albi.fr/).

The research is embedded in an active industrial collaboration between an aerospace subcontractor and its supply chain partners. This partnership provides the PhD candidate with privileged access to real planning data, ERP/APS systems, and operational teams across multiple sites.

Advisors and CVs:
Thesis advisors:

- Raphaël OGER (IMT Mines Albi) (https://cv.hal.science/raphael-oger)
- Jacques LAMOTHE (IMT Mines Albi) (https://cv.hal.science/jacques-lamothe)

Contract:
3-year full-time contract, starting around September 2026.

Research team:
A team on a human scale, benevolent, competent, ambitious, open to the international, and in constant contact with the business reality (companies, public services, NGOs, etc.).

IMT Mines Albi, a school under the authority of the French Ministry of Industry, is part of the Institut Mines-Télécom, France’s leading group of engineering and management schools. At the forefront of industrial and academic challenges on the international stage, it acts as a scientific and economic driver for its region by combining its four missions—training engineers with a focus on sustainable development, conducting scientific research, contributing to economic development, and promoting the culture of science, technology, and innovation—into a virtuous and innovation-driven cycle.

Its position in education and research establishes IMT Mines Albi as a reference school in three of the IMT’s four thematic areas: future sustainable industries, energy - circular economy and society and, health and well-being engineering.

Through its Centre Génie Industriel (CGI), IMT Mines Albi conducts research at the intersection of artificial intelligence and industrial engineering, in collaboration with national and international public and industrial partners.

The Centre Génie Industriel (CGI) (cgi.imt-mines-albi.fr) comprises approximately 70 people, including 25 PhD students. The center focuses on supporting the transition of ecosystems by enabling responsible and sustainable decision-making in unstable or disrupted environments. This is achieved through the representation, modeling, and analysis of organizational data to formalize knowledge that leads to decision-making in heterogeneous, collaborative, uncertain, and/or disrupted contexts.

The CGI is structured around applied research axes and scientific programs. The applied research axes and program for this PhD are:

- Axis FLOWS: Flexible Logistics and Operations for Sustainable Worlds
- Program HOPOPOP: Hybridization for Operations & Planning, Organizations & Performance, Optimization & Problem-solving

2. Topic

Industrial context & Scientific motivation:

The aerospace industry is currently undergoing an unprecedented production ramp-up, with aircraft manufacturers and their suppliers targeting significant increases in delivery rates. This sustained acceleration places pressure on complex, multi-echelon supply chains, which must simultaneously absorb demand variability, supply disruptions, and capacity constraints.

Hierarchical planning systems — which coordinate decisions across short (days/weeks), medium (months), and long (years) horizons — are the central mechanism by which manufacturers and their partners attempt to balance responsiveness with efficiency. However, the dominant planning paradigm, MRP II (Manufacturing Resource Planning), was designed for relatively stable and predictable environments and exhibits well-documented limitations under uncertainty: nervousness (excessive replanning), bullwhip amplification across echelons, and poor reactivity to disruptions [1, 2].

Alternative methodologies have emerged to address these limitations. Demand-Driven MRP (DDMRP), formalized by Ptak & Smith [3], proposes a fundamentally different logic based on strategically positioned decoupling buffers, demand-driven replenishment, and dynamic buffer adjustments. While early industrial evidence is promising [4], the academic literature on DDMRP remains limited, particularly regarding its performance in multi-site, extended enterprise contexts [5]. More broadly, the question of how to design a coherent, robust hierarchical planning system — one that explicitly integrates robustness, agility, and resilience dimensions — across multiple planning horizons and multiple actors remains largely open [6, 7].

This PhD addresses this gap by combining rigorous simulation modelling with close industrial collaboration, on the real-world supply chain of an aerospace manufacturer and its partners. Discrete-event simulation (DES) and agent-based modelling (ABM) are increasingly used to study supply chain planning configurations under uncertainty [17, 18]. Anylogic, the platform used in this PhD, will support hybrid modelling combining DES, ABM, and system dynamics, making it particularly well-suited for multi-echelon, multi-actor supply chains [19]. Key methodological references for simulation-based supply chain research include Law [20] for DES fundamentals, and Kleijnen [21] for design of experiments and sensitivity analysis in simulation studies.

Research questions:

The following 3 research questions are foreseen to structure this PhD:

- RQ1 (Short-term): What planning configurations (MRP2, DDMRP, Kanban, CONWIP, hybrid, etc.) best enable an aerospace multi-site supply chain to absorb short-term variability in demand and supply, and what are the key configuration parameters (buffer sizing, decoupling points, priority rules, etc.) that determine its performance?

- RQ2 (Multi-horizon): How should short-, medium-, and long-term planning be configured and coordinated across a multi-actor aerospace supply chain to support effective demand and capacity management during production ramp-ups, and maintain excellent performance?
- RQ3 (Robustness & resilience): How can a hierarchical planning methodology be designed to explicitly integrate robustness, agility, and resilience criteria, and what decision-support tools (scenario analysis, stress testing, adaptive parameterization) are required to operationalize this methodology?

Expected contributions:

Academic contributions

- A comparative, simulation-based framework for evaluating hierarchical planning configurations (MRP2, DDMRP, hybrid) in multi-site, multi-actor aerospace supply chains under uncertainty.
- Original experimental results on the performance of DDMRP in a multi-echelon, extended enterprise context.
- A novel integrated planning methodology embedding robustness, agility, and resilience dimensions, with formalized design principles applicable beyond aerospace.
- Methodological contributions to the use of hybrid simulation (DES + multi-agent) for multi-horizon supply chain planning research.

Industrial contributions

- A validated, calibrated simulation model of the partner supply chain, reusable as a decision-support tool for planning reconfiguration and stress testing.
- Concrete recommendations for planning parameter reconfiguration: buffer sizing, decoupling point positioning, lot-sizing, and S&OP cadence.
- Formalized best practices for multi-actor collaborative planning, including information exchange protocols and synchronization routines.

References:

The following references constitute a non-exhaustive foundation for the scientific positioning of this PhD (some mentioned in the previous paragraphs and others not):

[1] Orlicky, J. (1975). Material Requirements Planning. McGraw-Hill. — Foundational MRP reference.

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[20] Law, A. M. (2015). Simulation Modeling and Analysis (5th ed.). McGraw-Hill.
[21] Kleijnen, J. P. C. (2015). Design and Analysis of Simulation Experiments (2nd ed.). Springer.
[22] Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. MIS Quarterly, 28(1), 75–105.

3. Application

Applicant’s profile:

Holder of a master's degree in engineering, science, or management with proven knowledge in one or more of the following fields: industrial engineering, supply chain management, discrete event simulation, agent-based simulation, decision sciences, data sciences, applied mathematics, decision support systems. A strong background in production and supply chain management is highly desirable.

A good level of English, both in writing and presentation, is required. Strong skills or a strong motivation in computer programming are preferred.

Application materials:

CV, cover letter, Master’s transcript, Master thesis or previous research works, recommendation letters (especially from industry and research experience), and any other document likely to help assess the candidate's level and motivations.

Application deadline:

Application must be sent before June 14th, 2026, using the following link: https://institutminestelecom.recruitee.com/o/phd-proposal-designing-the-future-of-hierarchical-supply-chain-planning-systems
Shortlisted applicants will have the opportunity to present their motivations orally during an interview to be scheduled in June 2026.

Contact:

- Raphaël OGER: raphael.oger@mines-albi.fr
- Jacques LAMOTHE: jacques.lamothe@mines-albi.fr