# Master Degree in Software Engineering
# Internship position
# 2021/2022

Université de Nantes is hiring a Master Student for its RODIC Project in Nantes, France.

## Research Subject

***Performance Benchmarking of Executable Domain-Specific Languages***

## Abstract

The RODIC project (4-year french national funding) has an open internship position for a Master student with the perspective to be recruited as a PhD student for the next 3 years. The research domain is Software Engineering, with the goal to help Industry 4.0 when reconfiguring production chains by the use of techniques and platforms based on Model-Driven Engineering, Domain-Specific Languages (DSL), Software Testing, Human-Machine Interfaces. This internship subject focuses on the design and the execution of benchmarks to evaluate the performance of chain configurations designed with executable DSLs.

## Supervisors

- Jean-Marie Mottu, Erwan Bousse, Massimo Tisi – LS2N lab – NaoMod Group
- Pascal Berruet - LAB-STICC lab

## Key-words

- Domain: Model-Driven Engineering, Industry 4.0, Domain-Specific Languages, Software Testing
- Technologies: Java, Eclipse, EMF, DSL

## Context

The evolution of industrial systems to so-called "Industry 4.0", “Factory of Future” or “Cyber-Physical Production Systems”, is mainly based on the development of highly connected resources throughout the whole production process and beyond. The RODIC project focuses on the reconfiguration phase: when switching from one configuration to another, a Reconfigurable Manufacturing Systems [RMS] needs to reconfigure both hardware and software components. A model of the production chain can then be modelled (left of the Figure 1), the scenario can be verified (right of the Figure 1), and DSL can be used to simulate the execution (simplified example of such a DSL: https://github.com/szschaler/pls_language).

The approach of RODIC is to consider most of the reconfiguration using the same models for the definition, verification, evaluation, validation, and code generation. During this internship we focus on the *evaluation*: when a new configuration is being designed, the operator needs to evaluate its performance before the (costly, time consuming) reconfiguration of the production chain in the physical world. This evaluation must rely on the existing models used for designing the new configuration and verifying its correctness.

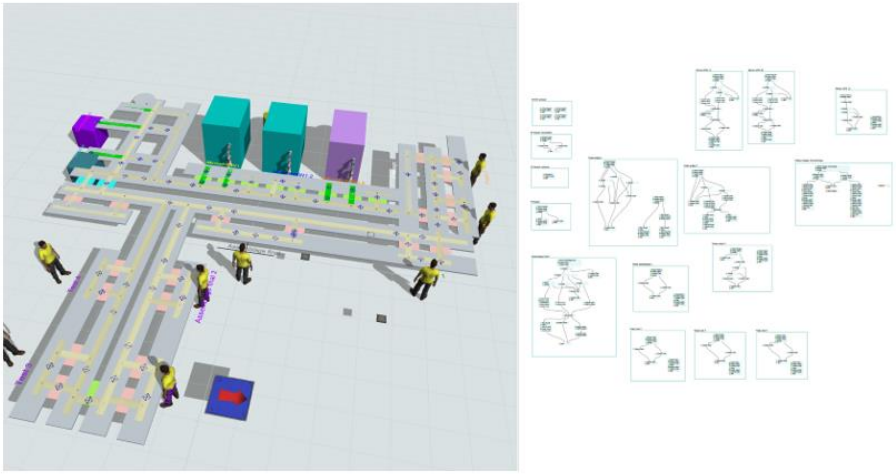

*Figure 1- Simulation of chain configurations, graphical model and scenario [Capawa21].*

## Problematic and Objectives

RODIC aims to provide the operators of a factory with a Model-Based Software Engineering (MBSE) framework to reconfigure RMS. Such a framework is constructed around Domain-Specific Languages (DSLs) to design configuration models, and also provides methods and languages to manipulate the models and generate production code. In particular, for evaluating performance, the framework must provide a way to simulate the production system by *executing t*he models (using a model interpreter) before the system can be deployed in real-world. For this task, executable DSLs (xDSLs) are a kind of modeling languages that allow the definition and the execution of the behavioural models of the system. The preliminary work of the internship is to realise a state of the art about xDSL and their use for manufacturing systems and RMS.

Providing testing facilities for xDSLs—ie. to be able to define and execute test cases for executable models created with xDSLs)—is a topic that was already studied for functional testing [Meyers16]. However, evaluating the performance of a simulated system requires defining benchmarks, which is a form of *non-functional* testing. In such a benchmark, the evaluator must identify and add Key-Performance Indicators (KPI, [Capawa20]) to the configuration model. **The first goal of the internship is to consider how to add KPIs to the definition of an xDSL.**

In addition, we want to use a standard language for the evaluator to be able to design a benchmark in the same way while considering different systems and their xDSLs. The Test Definition Language (TDL) [TDL] is a standard language, and an interesting candidate for benchmarking [Gheorghe20]. In our previous work, we already considered how to use TDL to provide functional testing for xDSLs [Khorram20]. **The second goal of the internship is to extend this existing work with non-functional testing, by taking into account the KPIs defined in the xDSL (as achieved by the previous goal).**

Finally, running a benchmark does not provide simple verdicts but measurements that needs to be stored in models to be analysed. In our previous work, we have considered specifically energy consumption measurements [Béziers20]. **The third goal of the internship is to consider how to represent and store the results obtained from performance benchmarks simulations.** The existing Structured Metric Metamodel [SMM] is a good candidate for that purpose.

## Environment

Université de Nantes, NaoMod team of the LS2N lab, located at the IMT Atlantique, collaboration with LAB-STICC.

The internship is funded.

## Perspective

RODIC project will recruit a PhD student to consider more aspects of the current research subject and to collaborate with the members of the project on the other parts of the process: definition, verification, validation, code generation.

## Requirements

The candidate is preparing a Master Degree in Computer Science with strong skills in Software Engineering.

The candidate can write and speak English fluently, as the working language of the NaoMod team is mainly English, and as research results must be written in English.

## Application

Applicants should provide a curriculum vitae with detailed information regarding their academic degree, research/development projects and a motivation letter.

To apply and for more information please contact jean-marie.mottu@univ-nantes.fr.

## References


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