## Post Doctorate Proposal 2017

<table>
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<th>School: Centrale Lille</th>
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<td>Laboratory: CRISTAL</td>
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<tr>
<td>Name of the supervisor: Diego Cattaruzza</td>
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<td>Expected duration (&lt; 24 M): 18M</td>
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**Title:** Integrated scheduling and routing for home care

**Scientific field:** Operations Research

**Key words:** scheduling, vehicle routing, home care

### Background, Context:

In our society, the average age of the population is continuously increasing and with it the need, and then the cost, for required care. To reduce operating costs, hospitals have already started to propose some treatments directly at the home of the patients.

Sufferers may need assistance in different degrees as well as require diverse levels of treatment. Consequently it may be possible to allow them to continue living in their own homes as long as possible. This would reduce social insurance costs and in the meantime increase the quality of life of the patient.

In home healthcare operations, nurses are in charge of carrying out the drug administration at the sufferer’s home and often their operations require a coordination with drug production.

As an example, in home chemotherapy treatments, the drug stability, namely the ability of the medication to maintain the physical, chemical, therapeutic and microbial properties during the time of storage and usage by the patient is reduced to few hours. In addition, chemotherapy treatments are patient-based. It follows that medications cannot be prepared days in advance and stored. This means that production should take place shortly before drug administration at the patient's home.

To optimize the system, one can imagine that delivery operations take place while production occurs, in such a way that drug is produced by pharmacists while nurses are accomplishing part
of their daily tasks at patients’ home. When they have terminated these tasks they may go back to the hospital and retrieve the last produced drugs starting again visiting operations.

This results on the need of highly coordinated systems able to synchronize production and administration of the drugs, taking into account production and delivery constraints. Moreover, with demand for home healthcare services expected to increase substantially, future work is essential to decrease costs and to guarantee service quality (Fikar and Hirsch, 2017).

**Research subject, work plan:**

The aim of the post doctorate is to study the integrated drug production scheduling and nurses routing problem (Chen, 2010) taking into account synchronisation constraints that arise from the home chemotherapy treatments context.

While the general integrated scheduling and routing problem has received attention in the recent past (see, for instance Geismar et al., 2008; Ullrich, 2013), the subject is mainly unexplored when it comes to chemotherapy, homecare or healthcare applications. In this case we are aware on only the work of Kergosien et al. 2017. This last work considers that one single person is in charge of carrying out the drug administration at the patient’s place. We could image that this assumption is too restrictive in real-life applications.

The candidate should have a strong background in operations research and optimisation and should show high coding skills with preferences for Java or C++ languages.

These abilities would allow him/her to:
1. Review the literature on related subjects and consequently propose new mathematical formulations for the problem;
2. Conceive, design and implement high-efficient solving methods. The exact or heuristic nature of the procedure will be chosen together with the candidate, based on his/her background and interests;
3. Test the method and analyse the results.

**References:**


