RES601 Research Design and Fieldwork (SPR2018-1)

***Module 4: DEVELOPING RESEARCH HYPOTHESES***

***Case assignment***

# Introduction

1. What is the research topic of the paper? Why is it important?

# That research topic is titled “Human – robot interaction review and challenges on task planning and programming” published in the International Journal of Computer Integrated Manufacturing. The choice of the publication vehicle set the context to reveal the indisputable links and relationship between the robotic and the manufacturing. This is important because the human–robot interaction (HRI) related topics have proportionally increased productivity of combines human and robot capabilities in diverse form or apparatus.

1. What is/are the research question/s? note that these can be implied or explicitly stated in the papers you have chosen.

The research question is based on the role of digital human modelling systems for human–robot task and the related issues to the process of learning by demonstration, instructive systems or programming through visual guidance and imitation, voice commands and haptic interaction. The other aspect of it is related to the physical HRI safety.

1. How the hypotheses (if any) are related to the research question?

A research topic in HRI is based on attempts to improve task allocation and coordination between humans and robots. It belongs to the wide area of interactive robotics and aims at advanced manufacturing. From the multi-arm robot collaboration 'caged' with fences, to the collaborative industrial robots and to the perspective of humans and robots in adaptive work-sharing, the need for high-level guidance from human operators and dynamic online re-scheduling arises.

1. Discuss and criticize the authors’ approaches for hypothesis development using criteria explicated in the reading materials for this week.

The current demographic trend for increased proportion of older people is reflected to the workforce age structure, according to the EASHW (European Agency for Safety and Health at Work) ([39]). Simultaneously, it is forecasted that in Europe, the oldest age group (55–64 years) will expand by about 16.2% in the next years. At the same time, the working-age population may be shrinking, despite the number of older people keeping on rising, expected from 28% in 2010 to fly to 58% in 2060 (Eurostat). Gender aspects also add value to this trend, as the employment rate for men was 74.6% in 2012, when for women it was only 62.4% (European Commission [42])

1. What methodologies and software package(s) were used for testing the hypotheses?

In the direction of learning systems, the use of virtual demonstrators has been evaluated in the PbD systems. Some researchers consider programming by the physical demonstrator's time consuming and possibly not mandatory (Ehrenmann, Steinhaus, and Dillmann [40]). On the same direction, human operators do not find programming by virtual demonstrators convenient. Teaching by demonstration in a virtual world is an approach that was explained in Onda, Suehiro, and Kitagaki ([88]). The concept is that the knowledge gained from the human contact tasks can be used in VR and have robot motions created automatically through the non-deterministic search type motion. In this approach, the exact demonstrator's motion is not used directly. The method was tested on a peg-in-hole task. Another method of PbD is described in Yokokohji, Kitaoka, and Yoshikawa ([119]), as a future possibility for humanoid service robots. As described in this method, a stereo vision system was fixed onto the demonstrator's head and some markers were placed in his hands and the environment. The main disadvantage of this method was the use of landmarks in the workspace. The motions captured were applied to a 3-DOF SCARA type robot.

1. Think of a variable which the authors did not discuss and can influence their outcome variable (DV). Develop a hypothesis for this effect, and justify your hypothesis

HRI in task planning aims at advanced manufacturing. The role of a human as supervisor and co-worker is a promising aspect of interaction in industrial environments so far. Despite that multiple challenges are encountered. On the one hand, the use of digital human modelling tools promises adaptability and robustness in an HRI system. On the other hand, digital human modelling tools are not always integrated into simulation tools. Furthermore, the DHMs are not always integrated into task planning tools, but instead, they are used as standalone tools, mainly for ergonomics analysis evaluation and in the preliminary design phases. The use of simulation for human-centred learning and training should be evolved, despite being currently used restrictedly in the fields of aviation and automotive. A challenge for the future of digital human modelling tools in the HRI task planning is the provision of a low cost and easy-to-use tool for the evaluation of human–robot collaborative task performance.

1. Conclude your report with a paragraph or so evaluating the entire exercise in terms of what you have learned and your reflections on the topic.

 The natural language interaction capabilities are a challenging issue, as there are several speech recognition software tools; however, understanding and cognitive modelling lack in the required efficiency. Despite that fact it seems that the natural language interactions, such as the voice commands, are not always applicable to the shop floors, due to their high level of noise, as well as the dynamically changing environment. The multimodal interfaces design for interaction also remains an important issue. Despite having made great progress in the development of multimodal communication frameworks, they still lack in efficient methods for managing complex interactions and behaviors. This is a result of the rich data exchange between the sensors and devices.