Université de Sherbrooke
École de Gestion

L'implantation de la robotique collaborative et la gestion des ressources humaines dans le secteur manufacturier: soutenir le changement et l'adoption

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L'implantation de la robotique collaborative en entreprise et la gestion des ressources humaines : soutenir le changement et l'adoption

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RÉSUMÉ

Ce mémoire de maîtrise explore l'implantation de la robotique collaborative en entreprise sous l'angle des pratiques de gestion et des facteurs humains. La visée initiale de ce projet de recherche visait préalablement à circonscrire l'apport que peut prendre la gestion des ressources humaines (GRH) lors de ce type d'implantation technologique, qui implique une collaboration humain-machine plus accrue qu'auparavant. Initialement, l'objectif était donc d'identifier les pratiques de GRH à mettre en place lors de l'implantation de robots collaboratifs. Cela dit, comme ce projet de recherche présente une démarche exploratoire semi-inductive, l'objectif de recherche a évolué vers plusieurs objectifs. Cette ouverture sur de nouveaux objectifs est subséquente aux résultats obtenus lors de la revue systématique de la littérature et de la collecte de données afin de dresser un portrait plus juste, adapté à l'état des connaissances et au terrain. Les objectifs poursuivis sont les suivants : 1) identifier les pratiques de GRH et d'autres pratiques organisationnelles en matière de gestion du changement facilitant l'implantation et l'adoption des robots collaboratifs 2) identifier les facteurs associés à l'humain, au robot et à l'environnement qui influencent l'implantation des robots collaboratifs, l'adoption et la collaboration entre l'opérateur et le robot.

Le processus sous-jacent à cette recherche exploratoire se divise en deux volets principaux. D'abord une revue systématique de littérature, ensuite, une étude qualitative du sujet dont les résultats ont déjà été soumis, ou serons soumis, pour publication. Afin de faire état du sujet ciblé et des questions de recherche associées, le présent mémoire est divisé en quatre parties principales dont deux sont réservées à la présentation d'articles scientifiques rédigés dans le cadre de la recherche. Considérant la structure du mémoire par article, le cadre théorique et la revue de la littérature, la méthodologie, les résultats et la discussion du mémoire sont imbriqués dans chacun des articles et ne font donc pas l'objet de chapitre indépendants.

La première partie du mémoire introduit la problématique associée à l'implantation de la robotique collaborative en entreprise, spécifiquement pour les petites et moyennes entreprises (PME) québécoises. Cette section édifie un portrait sommaire de défis et enjeux exacerbés par l'ascension technologique au sein des organisations. Le portrait dressé sensibilise sur le fait que des enjeux humains et organisationnels peuvent devenir des obstacles importants lorsqu'une organisation entreprend une implantation technologique, comme la robotique collaborative. Ainsi, bien que la technologie puisse sembler remplie de promesses, ces dernières peuvent être difficiles à atteindre lorsque, par exemple, les objectifs financiers ne sont pas atteints, que l'approche envers le processus est inadéquate ou lorsque les employés s'opposent. La problématique met également en lumière le fait que les PME peuvent être davantage à risque lors d'un changement technologique, puisqu'elles n'ont parfois pas tous les leviers nécessaires. Afin d'ériger le pont entre l'implantation de la robotique collaborative et les humains ainsi que l'organisation, cette recherche vise à cerner les pratiques de gestion en matière de GRH et d'adoption technologique qui peuvent soutenir l'implantation de la robotique collaborative.

La seconde partie prend la forme d'un article scientifique présentant les résultats d'une revue systématique de la littérature. Une version abrégée de cet article a été présentée et publiée dans le cadre de la 53^{e} édition du *Hawaii International Conference on System Science* (HICSS), ayant eu lieu du 6 au 10 janvier 2020. Les résultats obtenus indiquent que les pratiques de GRH n'ont pas été bien étudiées en lien avec l'implantation de la robotique collaborative. Également, l'analyse des articles sélection indique qu'une majorité de ceux-ci adresse plutôt des facteurs qui influencent l'interaction humain-robot, que ce soient des facteurs associés à l'humain, au robot ou à leur environnement. Un modèle conceptuel se basant sur les résultats et de la littérature connexe est aussi suggéré afin de soutenir les recherches futures sur le sujet.

La troisième partie est constituée d'un deuxième article dont l'objectif est de présenter les résultats d'une collecte de données qualitatives réalisée au sein d'une entreprise du secteur manufacturier au Québec et ayant implanté des robots collaboratifs. Cette recherche exploratoire a permis, à travers les témoignages de plusieurs intervenants, de cerner les facteurs associés à la collaboration humain-robot, les bonnes pratiques ainsi que l'expérience en soi des participants face à ce changement. À l'aube de la quatrième révolution industrielle, les résultats extraits de l'analyse indiquent que la GRH joue un rôle notable dans l'introduction d'un changement technologique, notamment au niveau de la préparation des employés et de leur engagement dans le changement. Des pratiques de GRH orientée vers le soutien, la santé et sécurité et le partage d'information apparaissent décisives. Aussi un alignement entre la gestion du changement et la gestion du projet de conception et d'implantation des robots collaboratifs apparait comme une condition essentielle. La portée de ces résultats est également discutée.

Finalement, la quatrième partie du mémoire présente une conclusion résumant les résultats des deux phases du projet, puis comment l'ensemble de ces résultats s'arriment dans une optique d'intégration de la GRH dans l'implantation et l'adoption des robots collaboratifs en entreprise. La conclusion ouvre également sur les limites du projet de recherche ainsi que sur des avenues de recherche. Les documents complémentaires à cette recherche tels que les guides d'entrevue, sont présentés en annexe.

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PARTIE 1 : PROBLÉMATIQUE DE RECHERCHE

L'importance grandissante de l'Industrie 4.0 (I4.0) dans le secteur manufacturier s'aligne sur un changement de paradigme visant l'adaptation de ce secteur au nouveau contexte engendré par la 4e révolution industrielle (Schneider, 2018; Sung, 2018). Suivant ces bouleversements dans l'industrie, il est projeté que des transformations technologiques toucheront plus de 900 000 emplois, principalement au dans le secteur manufacturier (Reischauer, 2018). En fait, ce secteur sera fortement affecté par l'automatisation ou la robotisation au Canada, où ces changements technologiques toucheront près de 61% des emplois (Chui et al., 2015).

Au Québec plus spécifiquement, on estime que ce serait près de 1,4 million de travailleurs qui subiront des effets (Noël, 2018) et ce, malgré une hausse de postes vacants (Statistics Canada, 2020). De telles modifications au sein des emplois peuvent être considérables pour les salariés du milieu manufacturier québécois puisque ceux-ci représentent environ 27% du portrait canadien (STIQ, 2020). Parallèlement, alors que les PME représentent 99,8% des entreprises de la province (Gouvernement du Canada, 2019), on reconnait qu'il serait plus ardu pour celles-ci d'investir dans un virage 4.0 puisqu'elles présenteraient certaines lacunes en termes de ressources et de connaissances (Sivard et al., 2014).

Dans cette perspective, l'un des changements technologiques intéressants pour ces entreprises concerne l'implantation de la robotique collaborative. Les robots collaboratifs, ou cobots, sont spécialement conçus pour interagir avec les travailleurs dans la réalisation de certaines tâches. Ainsi, le fonctionnement des robots collaboratifs repose sur une proximité avec un opérateur (Hoffman & Breazeal, 2004). Ceci les distingue donc des robots industriels classiques, habituellement fixes et maintenus à distance des travailleurs (via une enceinte de sécurité notamment) (Universal Robots, 2020) et des robots opérés à distance (Peshkin & Colgate, 1999). Ultimement, les robots formeraient une catégorie distincte d'autres systèmes automatisés, où ils diffèrent au plan de certaines caractéristiques importantes comme la mobilité et l'autonomie (Ishak & Nathan-Roberts, 2015).

En résumé, la principale caractéristique qui différencie la robotique collaborative relève du fait que le robot et son utilisateur partagent des tâches et un environnement de travail selon un principe de collaboration (International Organization for Standardization, 2016; Koppenborg et al., 2017). Ainsi, les robots collaboratifs sont considérés comme une option intéressante pour les entreprises puisqu'ils permettent de bénéficier de la complémentarité de l'opérateur et du robot (Zanchettin et al., 2018). Par exemple, l'objectif même de cette forme de robotique est d'utiliser des robots pour des tâches plus répétitives, mais qui nécessitent force et endurance, tout en misant sur les compétences humaines qui permettent davantage d'agilité (International Organization for Standardization, 2016). De plus, ces robots sont associés à une diminution des troubles musculo-squelettiques (Jocelyn et al., 2017) et la collaboration humain-robot qui en découle offre des conditions de travail plus stimulantes aux travailleurs, ce qui pourrait potentiellement faciliter le recrutement et la rétention (Gilbert, 2019). Enfin, les robots collaboratifs deviennent de plus en plus accessibles pour les PME, autant au plan financier (Zanchettin et al., 2018) que de la programmation (Galin et al., 2020). Ainsi, cette technologie a le potentiel de permettre davantage de flexibilité et de performance au sein des entreprises , tout en répondant à des enjeux et de santé et sécurité; le tout sans nécessairement remplacer les travailleurs (Calitz et al., 2017).

Toutefois deux volets seraient à considérer en contexte d'implantation de robotique collaborative : le volet humain et le volet organisationnel. D'abord, l'aspect humain serait parmi les facteurs les plus déterminants lorsque vient le temps de s'attarder à l'acceptation des technologies (Lewis, Agarwal et Sambamurthy dans Talukder, 2012). À cet effet, plusieurs facteurs peuvent influencer la qualité de l'interaction humain-robot, comme l'âge du travailleur (Kallinen, 2017), son bagage culturel (Li et al., 2010) ou académique (Nomura & Takagi, 2011), son niveau de maturité technologique (Charalambous et al., 2016b), etc. Or, au-delà de l'interaction elle-même, il est soutenu que des changements technologiques auraient le potentiel d'altérer la santé des travailleurs (Atanasoff & Venable, 2017; Brinzer & Banerjee, 2018). Le stress induit par un changement technologique peut être dû notamment aux caractéristiques de la technologie qui pourraient causer une surcharge de travail ou à l'insécurité du travailleur face à ses compétences (Ayyagari et al., 2011). Dans le cas des robots, une conception inadéquate pourrait mener à davantage d'anxiété ou de charge mentale chez son utilisateur (Koppenborg et al., 2017). Un stress supplémentaire pourrait aussi être causé au travailleur s'il craint de perdre son emploi au profit d'un robot collaboratif (Maurtua et al., 2017).

Outre son effet sur la santé des travailleurs, l'émergence d'un stress technologique peut également avoir des conséquences organisationnelles considérables, comme une atteinte à la satisfaction et à l'engagement des employés (Atanasoff & Venable, 2017). Ces conséquences sur la main-d'œuvre seraient susceptibles d'accroître l'intention de quitter de cette dernière (Li et al., 2010). Ceci complexifie donc la gestion quotidienne des entreprises canadiennes, alors qu'elles sont confrontées à une pénurie de main-d'œuvre (Statistique Canada, 2019). Toujours d'un point de vue de performance organisationnelle, un sondage réalisé par la firme McKinsey & Company, en 2018, soutient que 88% des répondants envisageaient d'investir dans l'implantation de robotique et d'automatisation. Pour la quasi-totalité de ces répondants, la réduction des coûts de production était la raison principale (Teulieres et al., 2019). Néanmoins, d'autres statistiques sur la transformation numérique indiquent que le taux des entreprises qui atteignent les objectifs visés par le projet se situe actuellement en dessous 30% (20% en 2012, 26% en 2014 et 20% en 2016) (Martin, 2018).

En termes de retour sur investissement, ces données sont préoccupantes alors qu'il y aurait 45% de chances que ce type de transformation ne mène pas aux bénéfices financiers escomptés (Bughin et al., 2019). Par ailleurs, ces enjeux financiers pourraient être plus menaçants pour les PME, qui possèdent des ressources limitées (Sivard et al., 2014), et dont l'approche face à des projets d'implantation technologique est principalement motivée par les coûts (Moeuf et al., 2018). C'est possiblement l'une des raisons pour lesquelles la robotique collaborative devient peu à peu une option intéressante pour les PME manufacturières (Matheson et al., 2019). De surcroît, les pressions que subissent les PME peuvent être d'autant plus importantes considérant que des échecs en matière d'implantation technologique, surtout s'ils sont répétés, peuvent présenter des enjeux financiers importants, dont une perte de valeur sur le marché (Bharadwaj et al., 2009).

Ce portrait des défis humains et organisationnels pouvant minimiser les chances de succès de l'implantation de la robotique collaborative met en lumière la valeur d'une démarche rigoureuse. Considérant l'importance du facteur humain dans le succès de la démarche, une implication stratégique des pratiques de gestion des ressources humaines (GRH) est à préconiser, puisqu'elle peut permettre aux employés de mieux s'adapter aux changements (Tummers et al., 2015). L'implication élevée de la GRH faciliterait l'adaptation des employés, notamment via des pratiques ciblant la communication, l'*empowermen*t, l'apprentissage et les récompenses (Rubel et al., 2017). Ultimement, l'alignement de pratiques RH appropriées en contexte de changement pourrait diminuer les intentions des employés à démontrer de la résistance (Neves et al., 2018).

L'idée selon laquelle la GRH devrait supporter les changements technologiques n'est pas nouvelle (i.e. Kozlowski, 1987). Toutefois, il semble encore peu naturel pour les entreprises d'aligner leur GRH aux stratégies organisationnelles (Holbeche, 2009). Au niveau des PME, ces dernières formaliseraient dans une moindre mesure leur approche en GRH que les entreprises de plus grande taille (Benmore & Palmer, 1996; de Kok & Uhlaner, 2001; Nguyen & Bryant, 2004). De plus, alors que l'on souligne que les PME peuvent être plus flexibles que les grandes entreprises (Moeuf et al., 2018), elles maintiendraient tout de même une GRH traditionnelle plutôt qu'agile (Heilmann et al., 2020). Pourtant, même si un alignement stratégique entre les pratiques RH et les pratiques manufacturières est susceptible de favoriser la performance (González-Sánchez et al., 2018), il y aurait des lacunes au niveau des PME dans l'alignement stratégique et compétitif de la GRH (Hargis & Bradley, 2011). Cela est d'autant plus important eu égard au fait que la résistance émanant d'une gestion du changement inadéquate pourrait affecter durement le succès d'une implantation technologique tant en termes d'acceptation des employés (Lapointe & Rivard, 2005), que d'adéquation de la technologie avec la réalité organisationnelle (M. L. Markus, 2004).

Dans une perspective de succès, il devient donc nécessaire d'amorcer des réflexions à propos des effets des changements technologiques sur la main-d'œuvre, mais aussi sur les moyens à mettre en place pour assurer la pérennité des implantations. Considérant que de négliger les facteurs humains dans l'implantation de nouvelles technologies comme la robotique collaborative s'avère risqué (Charalambous et al., 2015), et que les organisations éprouveraient de la difficulté à retirer les bénéfices de la transformation numérique actuelle (Fitzgerald et al., 2014), il devient primordial de mieux comprendre comment favoriser une intégration optimale. Ainsi, l'intégration des robots collaboratifs devrait être approfondie davantage en recherche (Cohen et al., 2019), surtout du point de vue de la GRH (Calitz et al., 2017).

En observant l'impact que peut avoir la robotique collaborative sur les travailleurs, il est légitime de se questionner sur les bonnes pratiques de gestion des ressources humaines à adopter dans le cadre spécifique à cette technologie. Dans le but d'explorer les lacunes au sein de la GRH quant à l'implantation de la robotique collaborative, cette recherche s'intéresse aux pratiques de gestion des ressources humaines et aux facteurs susceptibles d'influencer la collaboration humain-robots. Ceci afin de permettre aux organisations d'optimiser leur performance tout en prenant soin de répondre aux enjeux humains inhérents à l'implantation de robotique collaborative.

PARTIE 2 : ARTICLE 1 − REVUE SYSTÉMATIQUE DE LA LITTÉRATURE[1]

HUMAN-MACHINE INTERACTION AND HUMAN RESOURCE MANAGEMENT PERSPECTIVE FOR COLLABORATIVE ROBOTICS IMPLEMENTATION AND ADOPTION

1. ABSTRACT

The shift towards human-robot collaboration (HRC) has the potential to increase productivity and sustainability, while reducing costs for the manufacturing industries. Indeed, it holds great potential for workplaces, allowing individuals to forsake repetitive or physically demanding jobs to focus on safer and more fulfilling ones. Still, integration of humans and machines in organizations presents great challenges to IS scholars due to the complexity of aligning digitalization and human resources. A knowledge gap does persist about organizational implications when it comes to implement collaborative robotics in the workplace and to support proper HRC. Thus, this paper aims to identify recommended human resources management (HRM) practices from previous research about human-robot interaction (HRI). As our results highlight that few studies attempted to fill the gap, a conceptual framework is

[1] Le contenu de ce chapitre est un article présenté et publié dans le cadre de la 53e édition du Hawaii International Conference on System Science (HICSS), ayant eu lieu du 6 au 10 janvier 2020. La référence complète de l'article est : Libert, K., Cadieux, N. and Mosconi, E. (2020), Human-Machine Interaction and Human Resource Management Perspective for Collaborative Robotics Implementation and Adoption, Dans *Proceedings of the 53rd Hawaii International Conference on System Sciences* (p. 533–542).

proposed. It integrates HRM practices, technology adoption dimensions and main determinants of HRC, in the objective to support collaborative robotics implementation in organizations.

2. INTRODUCTION

Information Systems (IS) research on technology adoption related to organizational and individual behavior (Oliveira & Martins, 2011) has been highly developed in the recent decade. It concurs with Industry 4.0 (I4.0), where digitalization within organizations is growing at an important rate with smarter (Sung, 2018), more autonomous, and even self-conscious systems (Tuptuk & Hailes, 2018). In Canada, 900,000 jobs in the manufacturing industry could be automated or robotized in the future, which represents 61% of the entire Canadian manufacturing industry (Chui et al., 2015). While this technological shift offers great opportunities for organizations, research highlights how challenging technological implementation and adoption can be, especially when it involves workers closely (Oliveira & Martins, 2011).

Indeed, technological implementations can become stressful, affecting workers' health, satisfaction and commitment (Atanasoff & Venable, 2017). Knowing that dissatisfaction among employees can lead to turnover intentions (L. Li et al., 2018), this may become problematic in the current context where organizations are facing human resources shortages (Statistics Canada, 2019). Consequently, neglecting human factors when implementing new and emerging technologies can be risky (Charalambous et al., 2015). Furthermore, the shift triggered by I4.0 changes the external environment where organizations will face more competitiveness (Shehadeh et al., 2017). In this highly dynamic context, organizations have a low margin of error when leading their human resources through digitalization. However, efforts to overcome the challenging aspects of a technological implementation may be worth it as it can lead to greater organizational performance (Oliveira & Martins, 2011). It is notably the case of collaborative robotics that can enable organizations to increase their productivity and efficiency, and to reduce their costs (Bloss, 2016; Richards, 2017).

What characterizes collaborative robotics is that it occurs between a robot and a user in a common workspace specifically designed for human-robot collaborative tasks (International Organization for Standardization, 2016; Koppenborg et al., 2017). Thus, collaborative robotics is built upon the idea of a close interaction between humans and robots. As this topic is less explored from an organizational perspective, more research in IS addressing this aspect is needed.

Then, the main contribution of this paper is to help fill this gap through three objectives. First, this paper investigates the gap concerning the integration of HRM and collaborative robotics adoption through a systematic literature review (SLR). The purpose of this approach is to situate the level of knowledge in research regarding HRM practices involved in organizational HRC. Second, following the SLR, the paper explores the factors responsible for enhancing or hindering HRC and suggests a preliminary conceptualization of the role of HRM practices towards optimal HRC through technology adoption theories. The suggested framework identifies factors that organizations need to take into account when implementing collaborative robotics, especially if they want to reach the full potential it can offer. Oriented towards change management, technological adoption and HRM, it emphasizes the need for interdisciplinary work in the future.

3. THEORETICAL BACKGROUND

3.1. Human-robot collaboration

Robots must be differentiated from conventional automated systems because they vary in their behavioral characteristics, namely in autonomy and mobility (Ishak & Nathan-Roberts, 2015), and in their physical characteristics, such as anthropomorphism or zoomorphism (Desai et al., s. d.). Robots designed for HRC also require to be differentiated from other teleoperated robots (Peshkin & Colgate, 1999) as HRC emphasizes teamwork and autonomy from the robot counterpart (Hoffman & Breazeal, 2004). In this line, Yanco and Drury (Yanco & Drury, 2002) propose a complete taxonomy for human-robot interaction (HRI), considering it a subfield of human-computer interaction (HCI). Their taxonomy classifies HRI according to the robot's level of autonomy vs the human intervention needed, the human-robot ratio, decision support interfaces, task criticality, time-space and types of robot. Ultimately, these categories frame a continuum on which HRI varies. HRC can be considered as a form of HRI, but more oriented towards collaboration and teamwork.

Thus, HRC have modalities of its own to take into account in the manufacturing industry. Besides, collaborative robots are different from other types of industrial robots as they will not serve the same purposes. Until now, industrial robots have been more isolated from humans for safety measures, whereas collaborative robots share the workspace with them (Calitz et al., 2017; Koppenborg et al., 2017). Then, various tasks can be divided between humans and robots benefiting from each other's strengths. Robot would take care of tasks that need a fair amount of physical power and that are repetitive, while workers can focus on tasks requiring human capabilities (International Organization for Standardization, 2016).

To understand HRI, Murphy et Schreckenghost (Murphy & Schreckenghost, 2013) suggested three categories of metrics: humans, robots and the system. In their attempt at a preliminary classification, human-related metrics referred to elements like trust, workload or accuracy of mental models. Robot-related metrics included elements like time spent in autonomous or controlled mode or self-awareness. System-related metrics are numerous and include elements such as safety, effectiveness, efficiency and team productivity. To our knowledge, there is not much variety in the classifications of factors that can influence the multiplicity of HRI metrics, however, trust is a popular topic in HRI as it is believed that it is a main determinant of a successful collaboration (Billings et al., 2012).

3.2. Technological change in organizations

There is no doubt that integrating technology in the workplace has the potential to positively affect organizational performance. However, such technological integration have major consequences on the workforce, as it will not only witness alterations in existing jobs but also the inevitable loss of a number of them (Noël, s. d.). Thus, it becomes legitimate that some workers feel anxiety and reluctance to change (Luthra & Mangla, 2018; Schneider, 2018). In addition, the radical nature of the change and the complexity of the implemented technology may influence employees' skills development and satisfaction, which will affect the success of the change (Aiman-Smith & Green, 2002). A growing presence of technological change in work environment can also have adverse effects on workers' health (Brinzer & Banerjee, 2018). Besides health consequences related to technologically-induced stress (or technostress), there are also organizational consequences to consider, as technostress hinders satisfaction and commitment at work (Atanasoff & Venable, 2017a).

Moreover, changes inside the workforce may pose a significant challenge to technological implementations in organizations. Companies may face challenging labor shortages, coupled with new needs in terms of recruitment, training and retention (Sivathanu & Pillai, 2018). Additionally, the capabilities needed in the workforce vary on an individual, cultural, gender or generational basis (Kerpen et al., 2016). For example, older workers may be more reluctant to use new technologies (Khan & Turowski, 2016) or may present different needs in training and skills development (Peruzzini & Pellicciari, 2017).

3.3. Reaching optimal HRC through an HRM perspective

It is essential to ensure that an optimal synergy occurs between workers and robots. Yet, beyond the factors related to individuals and technologies, factors related to management and work environment can contribute significantly to technology adoption (Peansupap & Walker, 2005). When it comes to collaborative robotics implementation, specific literature pulled from information and communication technology (ICT) or advanced manufacturing technology (AMT) fields gives great leads for HRM. For instance, organizations may have to work on performance assessment, promoting leadership, empowering the workforce (Small, 2007) and creating incentives (Talukder, 2012) in order to ensure the success of the organizational change. Ultimately, workers should be prepared and developed throughout the whole implementation process, even during the pre-implementation, and be aware of the possible consequences related to the robot (Small, 2007; Small & Yasin, 2000).

In addition to training, incentives or rewards (Snell & Dean Jr, 1992), support from management is crucial when it comes to innovation adoption (Talukder, 2012) and AMT implementation. This calls for practices that are included in seven major HRM activities (job analysis, HR planning, recruitment, selection, performance assessment, compensation and training) (Stewart & Brown, 2014). While robotics differs from ICTs or other AMT, research emphasizes the need to adapt HRM practices to the type of technology implemented (Siegel et al., 1997). There is not, however, enough documentation about the role of these practices for collaborative robotics implementation.

4. METHOD

This paper presents a SLR following guidelines suggested by Tranfield, Denyer & Smart (Tranfield et al., 2003). This research method includes three main phases: (1) review planning, (2) review performance and (3) data extraction and synthesis.

Review planning: A set of 48 searched keywords, presented in Table 1, was developed. These words were related to the human-machine/robot interaction, HRM practices and human factors. The goal was to find papers that connected HRC and HRM. We used these keywords to search in five databases (ABI/INFORM, Scopus, PsycInfo, Computer and Applied Science Complete, Business Source Complete and Emerald). These databases cover relevant literature in various fields of this research.

Given the lack of research linking HRM practices and HRC, the extracted data was not comprehensive enough to write a thorough literature review on this topic, even when considering human-computer or more general man-machine interaction literature. We then used the same pool of articles but broadened the scope to include a background of HRI metrics. Therefore, our inclusion criteria were papers: (1) presenting conceptual or empirical findings related to human metrics, human factors or HRM practice to robot use, (2) presenting findings based on human participants when the papers were empirical, (3) being published in English, between January 1st 2010 and May 18th 2018, and (4) being published as a peer-reviewed journal paper or conference paper. We excluded papers according to the following criteria: (1) if the robots were teleoperated or if the robot system had no autonomy, (2) if the robot was an automated vehicle, (3) if the study did not include humans, (4) if the study did not present conceptual or empirical findings, (5) if it was a conference paper presenting the same results as a selected journal paper, and (6) if it studied automation or other machines instead of robots. Also, since we broadened the scope of our SLR, we only considered papers about HRC and HRI to keep some specificity.

Review performance: The database search led to a total of 591 papers. After eliminating duplicates, and reading titles and abstracts, a set of 139 papers was selected according to our inclusion/exclusion criteria. Then, we used a qualitative analysis software (Nvivo) to code the papers according to their methodology and relevant findings. We eliminated more publications that did not meet our criteria. During this step, the peer-review aspect was validated when necessary. Ultimately, we selected a total of 67 papers for further data extraction and analysis (a full list is available on demand).

Data extraction: The data analysis software helped to code and classify information contained in the paper. The results, discussions and conclusions of each paper were analyzed, as they could provide new empirical information or insight from the authors. The categories related to humans, robots, the environment, HRM practices and even research agendas were defined.

Table 1. Searched Keywords

Collaborative robotics
Intelligent machine*, Collaborative robotic*, Man-machine collaboration, Man-Machine interact*, Man-Machine relation*, Man machine collaboration, Man Machine interact*, Man Machine relation*, Human-robot collaboration", Human-robot interact*, Human-robot relation*, Human robot collaboration, human robot interact*, Human robot relation*, HRC, HRI, Human-agent teaming, Human agent teaming, Human-computer collaboration, Human-computer interaction, Human-computer relation*, Human computer collaboration, Human computer interact*, Human computer relation*, HCC, HCI.
AND
Human resources management and human factors
Human resource management, Human resources management, HRM, Human resources management pract*, HRM pract*, Human resources management act*, HRM act*, organi* train*, organi* communic*, employ* participation, operator participation, trust, leadership, human factor, human-factor, manag* support, organi* support, supervi* support, HR commitment, change management, employ* commitment, human resource* commitment.

5. RESULTS

5.1. Descriptive analysis

We selected 67 papers, which includes 51 conference publications (76.1%) and 16 journal publications. Most of the papers were from the ACM/IEEE International Conference on Human-Robot Interaction, and the Human Factors and Ergonomics Society with 11 publications (16.4%) each. The numbers then drop between 5 to 1 for other conferences and journals.

Figure 1 shows trends in publication according to the year of publication. First, it highlights a growing interest from researchers around 2016 and 2017 that presents

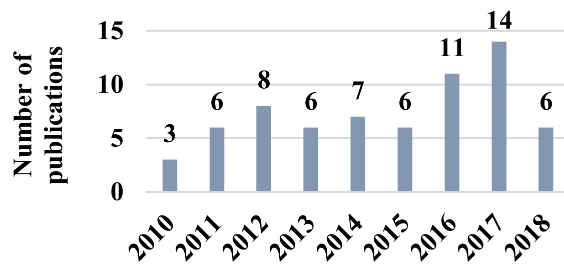

Figure 1. Classification by date of publication

the highest publication level. The lowest number of publications between 2010 and 2011 may be due to the novelty of the topic at this time. The number of publications also decrease in 2018, compared to 2017, most likely because of the date the search was conducted. Thus, papers published after May 18th are not included in the results for the year 2018.

Regarding research methodology approaches, Figure 2 shows a classification by main categories. Conceptual work mostly refers to literature review or theoretical analysis and ideas about HRI/HRC, with no empirical work, whereas empirical work is based on measurable data (Kamble et al., 2018). Results suggest a large proportion of experimental and quantitative research work, which represents 44 (64%) of all the selected papers. There are also fewer publications using a qualitative approach and conceptualizing the topics of HRI and HRC. More specifically, there is also a lack of case studies. Overall, these results indicate that literature may show a lack of diversity in methodological approaches.

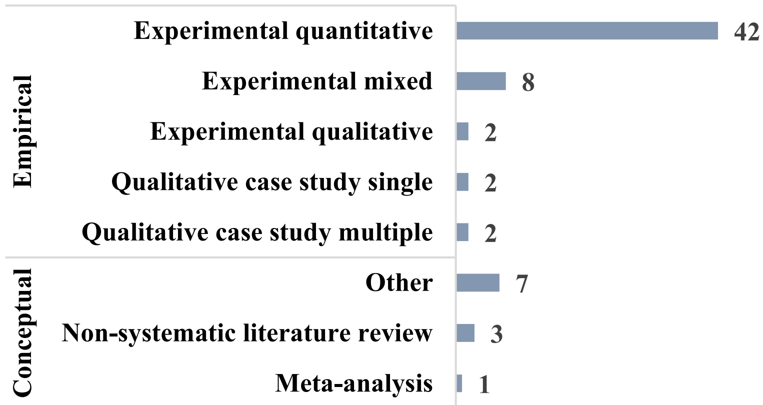

Figure 2. Classification by research method

5.2. Qualitative analysis of literature

5.2.1. Attempt to identify HRM implications

Few papers investigated HRC from an HRM perspective. Indeed more papers addressed robot design and programming (Chauncey et al., 2016; Sanders et al., 2017; Schaefer, Cook, et al., 2012; You & Robert Jr., 2018). Still, some HRM-related challenges and practices have been identified, such as training, change management, workforce's fear of job loss and unionized work environment. These challenges can hinder collaborative robotics implementation in manufacturing organizations and will call for greater focus on human resources management (Calitz et al., 2017). It is also essential to promote active employee participation in the integration process. Indeed, continually informing employees would help reduce resistance to change (Jocelyn et al., 2017). This includes communication with unions and their inclusion into the process (Charalambous et al., 2017).

Besides the implementation itself, organizations must keep ensuring a safe work environment for their employees. This will require greater attention to safety features when choosing the robots and the integration of health and safety management practices (Koppenborg et al., 2017; Maurtua et al., 2017). Ultimately, the work that addressed managerial implication the most specifically comes from Charalambous and his collaborators (Charalambous et al., 2015, 2017). They emphasize the importance of employee inclusion and empowerment, top-down communication and active involvement from senior management. They also suggest identifying a project manager, whom they call a process champion, which acts as an important middleman in the process coordination and communication to the parties involved.

The work synthesized above represents the principal contributors retrieved from the selected papers. Interestingly, only one paper ((Calitz et al., 2017)) was published in an HRM-related journal (SA Journal of Human Resource Management). This suggests that even when addressing management practices in a collaborative robotics context, research may not be published in the journals usually consulted by HRM professionals. The other papers were published in The International Journal of Advanced Manufacturing Technology, Human Factors and Ergonomics Society Annual Meeting, Human Factors and Ergonomics in Manufacturing & Service Industries or International Journal of Advanced Robotic Systems. Three of them were qualitative case studies and two were empirical quantitative researches.

5.2.2. Factors influencing HRC

As observed above, very few papers have investigated the topic of HRC from an HRM perspective. For this reason, we broadened the scope of the SLR. We included the factors that will impact HRI, as these factors are susceptible of being involved in HRC too. We believe that these factors may influence HRM deployment in the implementation process.

Key background elements were split into three categories: human-related factors, robot-related factors and environment-related factors. This categorization was established following the analysis of the data retrieved during the reading phase. The major assessment regarding the categories is shown in Table 2, which summarizes the first and second-level categories and the principal contributors. Almost all the analyzed papers are mentioned in this table[2]. It illustrates that robot-related factors are studied the most, especially robot's performance, which included elements like the robot's motion, speed and external features, such as physical appearance. Regarding human-related factors, users' previous experiences appear addressed the most. Environment-related factors are the least covered of the three.

Table 2. Factors identified in the selected papers

Human-related factors	**References**
Demographics	[P19, P25, P38, P63]
Individual characteristics	[P7, P14, P19, P22, P45]
Perception of health and safety	[P6, P23, P32, P54, P67]
Previous experiences	[P1, P5, P6, 16, P18, P27, P31, P33, P39, P43, P47, P53, P54, P60, P62]
Robot-related factors	**References**
Information sharing	[P8, P17, P26, P29, P40, P48, P50, P57, P61, P64]
Performance	[P6, P8, P11, P12, P13, P16, P18, P23, P29, P30, P34, P36, P42, P44, P58, P59]
External features	[P2, P6, P25, P27, P31, P35, P37, P38, P39, P41, P44, P45, P48, P49, P52, P56, P62, P63, P67]
Social and cognitive behaviors	[P10, P15, P17, P20, P21, P24, P28, P31, P46, P49, P51, P55, P65]
Environment-related factors	**References**
Tasking	[P4, P9, P38]
Context	[P15, P21, P38]

6. DISCUSSION

Our results show that there is a lack of integration of HRM practices and HRC in research. The lack of qualitative case studies on the matter may contribute to the scarcity observed in the literature. In addition, as robot-related factors are more addressed in the literature, this may explain why there are more research-based recommendations concerning the design and programming of robots. Additionally,

[2] Les références complètes des articles sont présentées à l'Annexe A.

because of past struggles to include HR as a major player in organizations (Holbeche, 2009), lesser importance may be given to HR role in organizational strategies.

In the following sections, we attempt a preliminary conceptualization of how HRM practices and organizational collaborative robotics adoption can be integrated using the Technology Acceptance Model (TAM) (Davis et al., 1989). As we could not establish a sufficiently broad portrait of HRM implications and practices, we used the SLR to inventory determining factors of HRC. The hypothesis being that these factors would help us link HRM to HRC and collaborative robotics adoption.

6.1. Collaborative robotics adoption

We chose the the TAM (Davis et al., 1989) as it is already well documented in the literature. In this model, usage of the technology is indirectly influenced by two main variables: “perceived ease of use (PEU)” and “perceived usefulness (PU)”. Their relationships are mediated by the attitude towards use and behavioral intention to use.

Also, PEU and PU can be influenced by external variables (Davis, 1986). These variables can be quite numerous, but a synthesis of the literature by Venkatesh and Bala (Venkatesh & Bala, 2008) identifies four main categories of decisive factors: “individual differences”, “system characteristics”, “social influence” and “facilitating conditions”. Figure 3 shows the model issued from Davis et al. (Davis et al., 1989), combined to Venkatesh’s and Bala’s (Venkatesh & Bala, 2008) addition.

Extrapolating the TAM to collaborative robotics and the factors from Table 2, human, robot and environment-related factors could be determinants of PEU and PU. As for the HRM implications identified in Section 4.2.1., they would probably be considered as a facilitating condition, this variable mainly referring to support from the organization (Venkatesh & Bala, 2008). In fact, possible relationships between the roles of an HR department and variables of the TAM have been suggested before (Voermans & van Veldhoven, 2007; Yusoff et al., 2010).

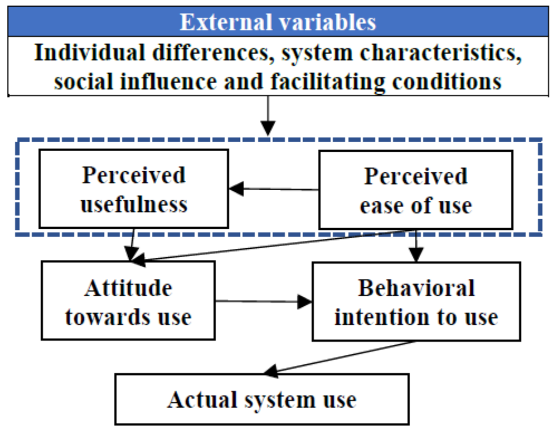

Figure 3. TAM's theoretical framework based on Davis et al. (1989) and, Venkatesh and Bala (2008).

Globally, four specific HR roles taken from Ulrich's work (David Ulrich, 1996) (administrative expert, employee champion, change agent and strategic partners) may have an influence on PU and PEU (Yusoff et al., 2010). For example, the employee champion can listen to the needs of employees in a context of change, the strategic partner can align HR practices with business strategy and business objectives, the change agent can facilitate employees' commitment to change through deployment of transformation-consistent practices and the administrative expert can monitor HR indicators to track productivity (David Ulrich, 1996). Thus, beyond using the TAM to understand collaborative robotics adoption, we might benefit from including a more complete change management perspective in the model. Figure 4 presents how the variables from our SLR could be related to the TAM. The extended model is a start in suggesting how practices in Section 4.2.1. and factors from Table 2 are susceptible of influencing the employees' acceptance of collaborative robots.

The conceptualization based on HR role is that it does not solely include the operational role of HRM. It also positions the HR department as a strategic and active player in the ongoing change and technology adoption. Yet, from a broader change management perspective, HRM implications may be underestimated in the model.

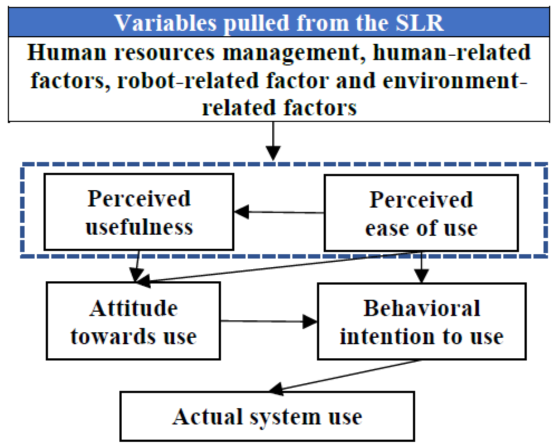

Figure 4. Possible relationships between findings in the SLR and the TAM

6.2. Integrating HRM to the TAM from a change management perspective

Findings presented in Section 4.2. find echo within the change management process. Indeed, Maheshwari and Vohra (Maheshwari & Vohra, 2015) suggested that HRM practices in regards to culture, leadership, cross functional integration, training, communication and technology may have a significant impact on employees' acceptance and commitment to the change. They also suggest that employees need to have a positive perception of managers' intentions through the HRM practices, which may mediate the relationship between these practices and commitment to change. While their framework remains at a theoretical state, it adopts the same perspective as Neves and colleagues (Neves et al., 2018), who mentioned that HR practices can affect intention to resist change through affective commitment to change and a moderating effect of ethical leadership from the direct supervisor. These works could also support the fact that alignment of HRM practices with work transformation is essential in a strategic HRM perspective (Stewart & Brown, 2014; Wright & Snell, 1998) and technology adoption (Carroll & Wagar, 2010).

This leads us to emphasize the need for HRM practices to be strongly integrated throughout the whole technological change process. This means that HRM practices should involve HR professionals, but also any manager and supervisor navigating the change. Furthermore, organizations may not be required to go above and beyond in terms of HRM practices implementation. Indeed, results suggest that some practices may be more important to employees than others, such as communication or rewards (Conway & Monks, 2007). Hence, less may be more in times of change.

In the end, putting greater focus on commitment to change is likely to be a decisive factor as it is "a force (mindset) that binds an individual to a course of action deemed necessary for the successful implementation of a change initiative" 475) (Herscovitch & Meyer, 2002). Hence, commitment to change can lead to higher behavioral support from employees towards the change (Herscovitch & Meyer, 2002), which could translate into using the implemented technology. Therefore, the integration of commitment to change to the TAM would suggest that HRM practices may have a greater influence on technology adoption than anticipated. Figure 5 illustrates our attempt to conceptualize collaborative robotics adoption and HRC with an emphasis on the possible outcomes of HRM practices, which is lacking in the literature.

The variables proposed to extend the TAM are the commitment to change and HRC-related factors that go beyond simple usage of the system. Based on the previous sections, we highlight possible relationships between HRM practices, commitment to change and the TAM. The suggested relationships are illustrated with bold black and blue arrows.

HRM practices may also moderate the influence of factors related to HRC and other external variables on PEU and PU. For example, enabling employees' capabilities to work efficiently within a collaborative cell through specific training could augment PEU. We also believe that HRM practices could directly influence initial variables of the TAM. Indeed, appropriate communication could inform employees of the changes going on, likely affecting PU directly or moderating the effect of attitude towards use. Moreover, specific HRM practices may promote attitudes that are more positive or affect behavioral intention, technology usage and HRC by enhancing commitment to change. In that case, one of many possibilities is that HRM practices oriented towards empowerment or the creation of incentives could promote HRC through employees' commitment to change and actual use of the system.

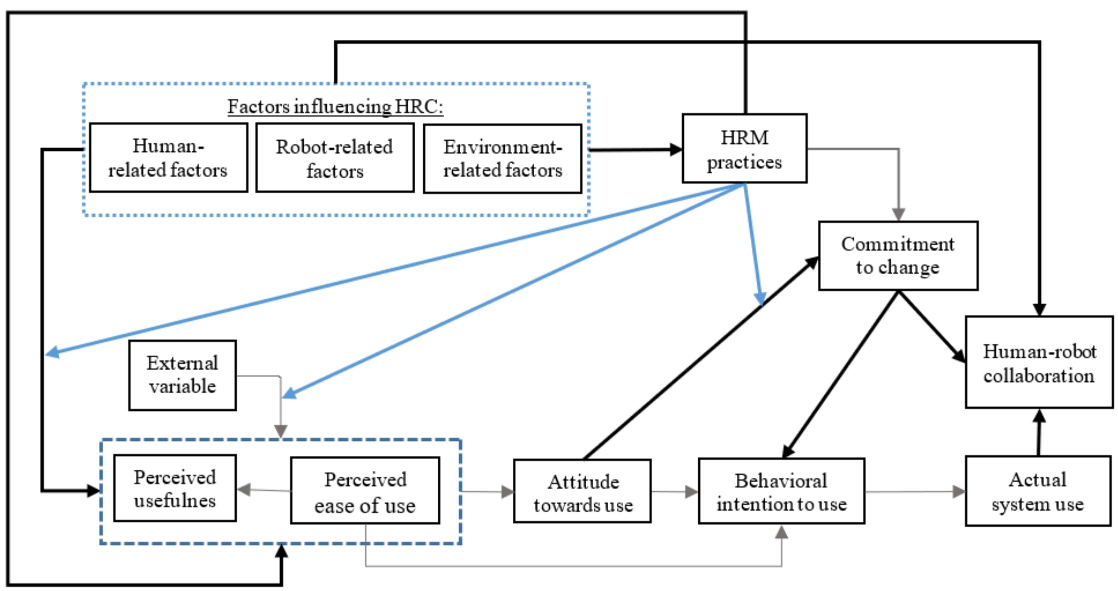

Figure 5. Integrated framework of TAM and HRM practices for collaborative robotics

Additionally, special care from management regarding workers' psychological safety may be advised as it can be affected by stressors like induced work overload or job precariousness (Ayyagari et al., 2011). This is where managers and HR professionals may work on redefining job content and training in order to prevent those. HRM practices may even mediate the effect that the fear of job loss could have on commitment to change or technology usage. But doing so, human factors such as demographic variables, individual characteristics or previous experiences cannot be overlooked as some may have a mediating, or moderating, effect on HRM practices. It is also possible that those factors will directly affect initial attitudes towards use. In the end, the relevance of a better integration of HRM practices becomes even more important when facing potentially negative consequences of collaborative robotics on the workforce.

7. CONCLUSION AND LIMITATIONS

By means of an SLR, we attempted to pinpoint HRM practices and implications relative to collaborative robotics adoption and HRC. The relationship between HRC and HRM remains tenuous in research. To fill the gap, we believe that a thorough investigation of the relationship between the factors related to HRC and HRM practices is necessary. Thus, our proposition is to integrate HRM practices to technology adoption models in an organizational context, along with the three fundamental categories of factors (human, robot and environment) impacting HRC. We also believe that our work may be used for other technological implementations. Indeed, beyond the type of technology implemented, HRM must be strategic and proactive. In terms of knowledge, this may also require more cooperation between research disciplines (Ellwart et al., 2019), as the determinants of HRC appears transdisciplinary.

The main limitation of this SLR is that it cannot ensure complete inclusivity due to our inclusion criteria and the keywords used in the databases. Besides, we had to broaden our inclusion criteria because we did not find enough studies on HRM practices regarding industrial collaborative robotics implementation. Moreover, given the multidisciplinary nature of the phenomenon, keywords are likely to vary from one discipline to another. Consequently, some relevant studies may not have shown through our research in the databases due to our own keyword selection. Ultimately, feasibility has restrained the result overview. Due to the lack of space, details on determinants of HRC specific outcomes and the various nuances presented in the literature are not presented in this paper.

8. RESEARCH AGENDA

We need to emphasize the need to adapt HRM practices to the variations from the type of technology implemented (Siegel et al., 1997), and the stage of the implementation (Venkatesh & Davis, 2000). This could lead to a detailed roadmap of required HRM practices and possible retroaction loops. In fact, part of our ongoing work in determining factors of HRC echoes with You and Robert's work about human-robot teamwork (You & Robert, 2017). However, adding an HRM perspective could be useful for practitioners. In this line, performing more case studies may prove interesting as it can provide more insight on HRC and HRM practices based on context (Baxter & Jack, 2008)

We also believe that this paper opens a door to many interesting research avenues, as the model in Figure 5 should be subject to further research in IS. Indeed, many relationships and their complexity are not illustrated. Therefore, interaction of the determinants of HRC and the variables in the TAM, along with our current propositions should be explored further. For instance, users' previous experience could be positioned as moderators instead of determinants (Venkatesh & Davis, 2000). Performing a SLR specific to the subject may give interesting insights for further developments. Also, trust was indicated as a major determinant of optimal HRC. However, the relationship between trust, HRC and known technological adoption models seems overlooked in the literature.

Ultimately, with the objective to better understand, to confirm or to refute possible relationships illustrated in Figure 5, we suggest the following questions: How should HRM practices be involved through the various phases of collaborative robotics implementation? What variables will be more influenced by HRM practices, whether it is through a direct effect or moderating/mediating effects? How will the main factors determining HRC (human, robot and environment) impact the effect of HRM practices on adoption and commitment to change? How will HR departments, management and supervisors need to collaborate in collaborative robotics implementation?

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PARTIE 3 : ARTICLE 2 − PRÉSENTATION DES RÉSULTATS[3]

HUMAN RESOURCES MANAGEMENT IN COLLABORATIVE ROBOTICS IMPLEMENTATION: TOWARDS A BETTER ALIGNMENT WITH MANUFACTURING STRATEGIES AND TECHNOLOGY ADOPTION

1. ABSTRACT

Purpose: This exploratory study focuses on collaborative robotics implementation within an organizational context. This paper investigates how management practices, especially human resources management (HRM) practices, support collaborative robotics implementation in manufacturing operations and adoption processes. More specifically, it explores the links between HRM practices, organizational factors and human-robot collaboration (HRC) factors.

Design/methodology/approach: An exploratory qualitative approach was appropriate to investigate participants' perceptions and experiences regarding the implementation of collaborative robotics. Seven semi-guided interviews were conducted within three groups of participants: 1) employees from SME; 2) robot integrators and 3) robot consultant. The method allowed to gain deeper insights by involving perspectives from the different roles played by the participants.

Findings: The main findings suggest that HRM should be involved for successful collaborative robotics implementation. HRM practices can support the technology fit with the organization's context and the acceptance of the change. In addition, they underline the need for a multidisciplinary perspective, where a strategic alignment is

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[3] Le contenu de ce chapitre constituera un article qui sera soumis au International Journal of Operations & Production Management. Les auteurs de l'article sont Libert-Morneau, K., Cadieux, N. et Mosconi, E.

required between change management and project management during the implementation.

Originality: This paper explores the topic from a multidisciplinary perspective, through manufacturing strategies, technology adoption and HRM. Little attention is given in research and practice to the junction of these perspectives, which has the potential to minimize barriers to adoption and help organization to reap the full benefits from technological implementation on production lines. It pushes knowledge boundaries by underlining how the organizational practices, the implementation process and adoption are intertwined. Finally, it pinpoints useful practices for collaborative robotics implementation within manufacturing organizations.

Keywords: Human resource management, change management, technology adoption, human-robot collaboration, collaborative robotics.

2. INTRODUCTION

Successful implementation of collaborative robots (cobots) in industrial context can help organizations to reap benefits from human-robot complementarity (Zanchettin *et al.*, 2018) and decrease physical injuries (Jocelyn *et al.*, 2017). Cobots also represent a financial advantage as they are more affordable than regular industrial robots (Zanchettin *et al.*, 2018) and easily programmed (Galin *et al.*, 2020). Cobots offer interesting benefits for organizations, including flexibility and performance (Zanchettin *et al.*, 2018).

However, organizations have difficulties to reap the full benefits from modern technological transformations (Fitzgerald et al., 2013). Indeed, statistics indicate that the percentage of digital transformation projects within organizations meeting their objectives is actually under 30% (Martin, 2018) and there would be only a 55% chance that the digital transformation undertaken leads to expected profitability (Bughin *et al.*, 2019). Beyond financial performance, failure in technological change can lead to other negative outcomes. It may jeopardize workers' health (Atanasoff and Venable, 2017; Brinzer and Banerjee, 2018), due notably to the system characteristics, work overload or insecurities (Ayyagari *et al.*, 2011). It can also lead to decreased satisfaction and commitment of employees (Atanasoff and Venable, 2017). As lower satisfaction levels are prone to lead to higher turnover intentions (Li *et al.*, 2018), this may be challenging in a context that presents labor shortages (Statistics Canada, 2020).

Neglecting human factors (Charalambous, Fletcher et Webb, 2015) and resistance (Lapointe & Rivard, 2005; Markus, 1983) during the implementation of collaborative robotics can threaten the process. Hence, it is necessary to involve strategic human resources management (HRM) to support the success of manufacturing strategies (González-Sánchez *et al.*, 2018). However, further research is needed about digital transformation from a management perspective (Laumer and Eckhardt, 2012), where the complexity of the technology and organizational elements should evolve conjointly (Bordeleau and Felden, 2019).

Hence, implementation of collaborative robotics should be explored further (Cohen *et al.*, 2019), especially its relationship with HRM (Calitz *et al.*, 2017). This paper aims to contribute by introducing more knowledge about the interaction of HRM practices and individual, organizational and environmental factors in order to support successful implementation of collaborative robotics in the workplace.

3. CONCEPTUAL BACKGROUND

3.1. Human-robot collaboration

The concept of cobots appeared at least two decades ago. It designated robots working within the same workspace as humans, but their given purpose was "not to enhance human strength but to provide virtual guiding surface" (Wannasuphoprasit et al., 1997, p. 3571). In previous research, robotic devices in general are considered different from automated systems because they do not share all the same characteristics, such as the same degree of mobility or autonomy (Ishak & Nathan-Roberts, 2015). As for cobots, they are considered different from usual industrial robots because the formers usually operate within a distance from workers, whereas cobots share more physical proximity with workers. Also, cobots have been distinguished from teleoperated robots (Peshkin & Colgate, 1999) since the first ones rely on more autonomy and teamwork (Hoffman & Breazeal, 2004).

Today's collaborative robotics is a technology built upon the idea of a close interaction between humans and robots. Cobots are currently sharing workspace with the workers (Calitz *et al.*, 2017; Koppenborg *et al.*, 2017). To fulfill the purpose properly, interaction between a human and a cobot involves relying on each other's strengths, therefore allowing the workers to focus on tasks requiring human value (International Organization for Standardization, 2016). This acute collaboration occurs in a common workspace specifically designed to this aim (International Organization for Standardization, 2016; Koppenborg *et al.*, 2017).

Regarding human-robot interaction (HRI), Yanco & Drury (2002) presented several criteria to characterize various forms of HRI, such as robot's autonomy towards human intervention or the types of robots and human-robot ratio. Based on their work, HRC could have modalities of its own to consider in order to reach proper collaboration. Hence, when looking at means to influence HRC, many factors may contribute. A systematic literature review performed by Libert et al. (2020) highlighted several factors related to HRI and HRC that have the potential to influence how a user will perceive the robotic device and interact with it. Adapting the categorization of factors proposed by Libert et al. (2020), Table 3 summarizes examples pulled from the literature.

Table 3. Overview of potential factors influencing HRC.

Human-related factors	**Details and examples**
Demographics	**Cultural background** (Li *et al.*, 2010).
	Academic background (Nomura and Takagi, 2011).
	Age (Kallinen, 2017).
	Gender (Warta, 2015).
Individual Characteristics	**Personality** (Kim *et al.*, 2012).
	Technological readiness level (Kallinen, 2017).
Perception of Health and Safety	**Physical safety** (Charalambous *et al.*, 2016a).
	Psychological safety (Koppenborg *et al.*, 2017).
	Overall safety (Charalambous *et al.*, 2016a; Maurtua *et al.*, 2017; You and Robert Jr., 2018)
Previous Experiences	**Direct interactions** (Aroyo *et al.*, 2017).
	Indirect experiences (Charalambous *et al.*, 2016a, 2016b; Ososky *et al.*, 2013).
Robot-related factors	**Details and examples**
Information sharing	**About robot's decisions** (Lyons, 2013).
	Information flow (Sanders *et al.*, 2014).
Performance	**Task completion performance** (Van Den Brule *et al.*, 2014).
	Collaborative mode (Narayanan *et al.*, 2015).
	Movement predictability (Koppenborg *et al.*, 2017).
	Physical proximity (Ferreira *et al.*, 2016; MacArthur *et al.*, 2017).
	Speed (Koppenborg *et al.*, 2017).
	Robot's awareness of user's state (ex. fatigue) (Lyons, 2013).
External features	**Physical appearance** (Schaefer, Sanders, *et al.*, 2012; You and Robert Jr., 2018).
	Apparent gender (Bernotat *et al.*, 2017; Warta, 2015).
	Human likeliness (Seo *et al.*, 2018) (Martini *et al.*, 2015).
Social and Cognitive Behaviors	**Emotional communication** (Schaefer, Cook, *et al.*, 2012).
	Empathy (Cramer *et al.*, 2010).
	Gazing at the users (Stanton and Stevens, 2014).
	Expression of self-blame. (Kaniarasu *et al.*, 2013).
	Expression of inability (Kwon, 2018).
Environment-related factors	**Details and example**
Tasking	**Task complexity** (Charalambous *et al.*, 2015; Chen *et al.*, 2018).
Context	**Contextual variations** (Nomura and Takagi, 2011; Kim *et al.*, 2013).

Ultimately, a concept that appears major in regard to HRI is trust. Trust is important in HRI literature as it is a "major issue that significantly impacts the effectiveness of human-robot collaboration, particularly in the willingness to share and allocate tasks as well as to exchange of information and create an impetus for supportive behavior" (Freddy et al., 2007, p. 3). In fact, trust is underlined as a determinant when exploring technology acceptance (Bahmanziari et al., 2003; McCloskey, 2006; Tung et al., 2008; Wu et al., 2011). In an organizational context, some suggest that greater trust towards the implemented technology may help individuals to cope with change (Lippert and Davis, 2006). Thus, it may be relevant to take interest in cobotics adoption rather than solely HRC, as it may help to encompass more complexity from the context.

3.2. Technology acceptance and adoption models

Literature about technology acceptance and adoption offers several models. In a recent literature review, Taherdoost (2018) draws an overview of many technology adoption models or theories. According to his results, adoption and acceptance are explained by various models and theories, of which a certain number originated from others. Overall, previous work on technology acceptance underlines its complexity.

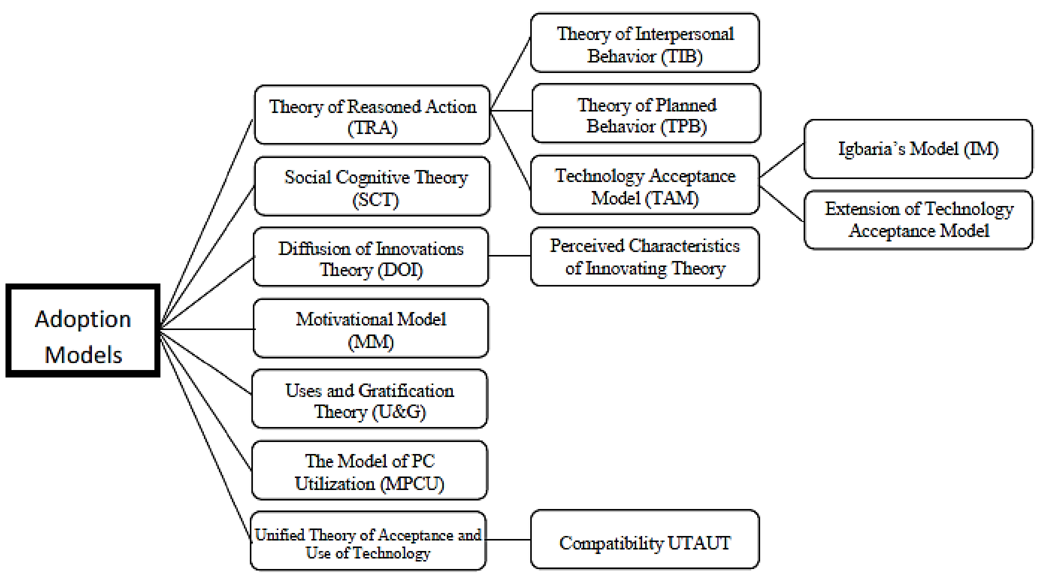

Figure 8. Overview of adoption models from Taherdoost (2018).

One of the models widely used to explain information system adoption is the Technology Acceptance Model (TAM) from Davis (1986) (Taherdoost, 2018). In this model, the two main variables that predict usage of the system are *perceived usefulness*

(PU) and *perceived ease of use* (PEU). Perceived usefulness (PU) refers to the user's perception that his job performance will be increased by the system; perceived ease of use (PEU) refers to the user's evaluation of the effort required to use the system (Davis, 1986). Since its first publication, the TAM evolved significantly, where Venkatesh & Bala (2008) introduced the latest version of the TAM, the TAM3, presented in figure 7. This version of the models addressed information technologies (ITs) adoption in organizational settings.

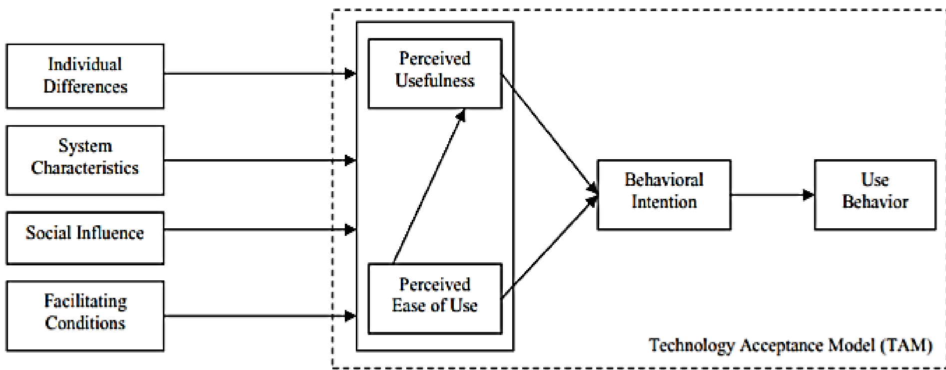

Figure 11. TAM as presented in Venkatesh & Bala (2008).

Using the TAM3, Bröhl et al. (2016) suggest that the model can be used to explore adoption in HRC. Figure 8 shows their extension of the TAM, a robot acceptance model.

Furthermore, while adoption models are interesting to understand which variables influence adoption, they do not address what may lead to resistance instead. In fact, there is a lack of research on this topic (Laumer and Eckhardt, 2012). Results from Lapointe and Rivard (2005) reveal that resistance behavior towards IT can vary through the implementation process and that there would be triggers to resistance, like peers' actions or systems' consequences, and highlight that managers need to respond well to resistance behavior, otherwise it may create an escalation. Hence, principles from change management may play a role in the success of technological implementation in the work environment (Lippert and Davis, 2006) It would also require to go beyond a simple combination of system implementation and change management practices (Bordeleau and Felden, 2019; Markus, 2004). Considering these issues, an approach integrating technology implementation and HRM becomes relevant.

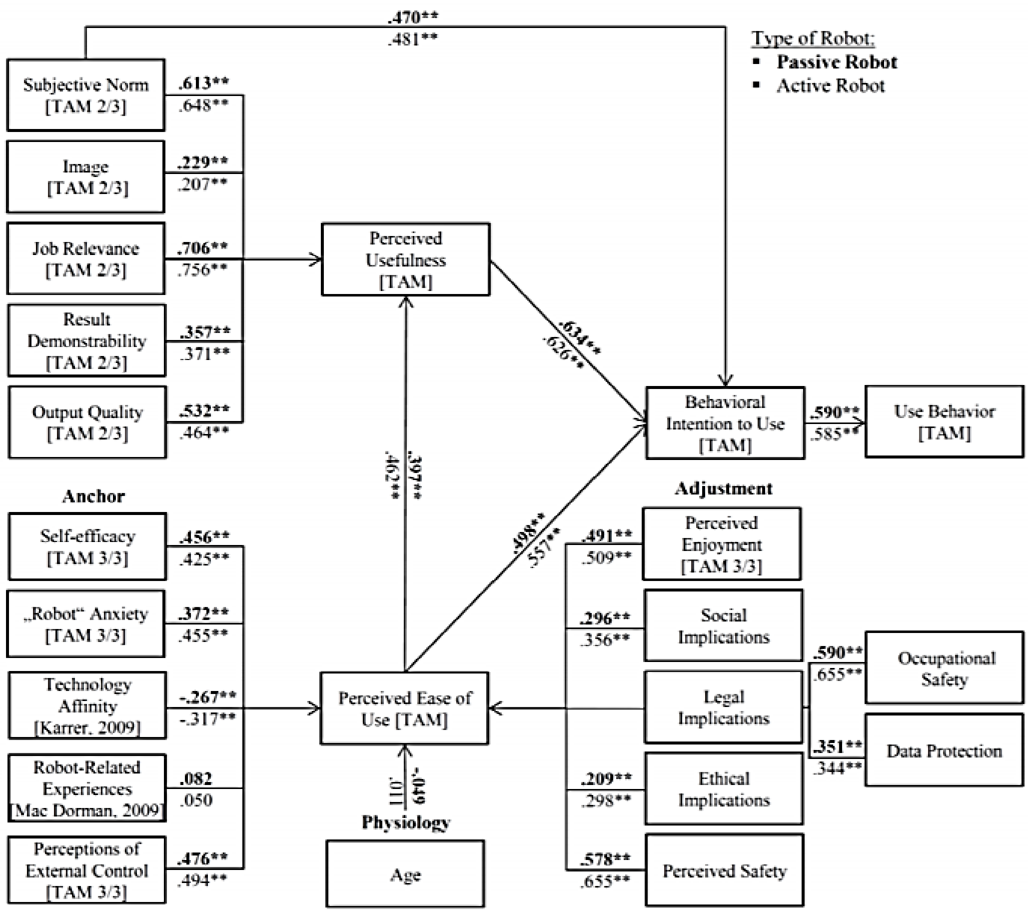

Figure 14. Results for the robot acceptance model from Bröhl et al. (2016).

3.3. HRM and Change Management in technological implementation

Change management includes preparing and managing organizational change and assessing its enablers (Oakland and Tanner, 2007). An important focus on employees is required during organizational change, since they can experience several concerns according to several stages of preoccupations (Bareil & Gagnon, 2005). For instance, employees may wonder about what will happen to them during the change or the relevance of the decisions made by the organisation (Erwin and Garman, 2010). When looking more specifically at technological change, when employees do not understand well organizational decisions, they may become more reluctant towards the change, reducing the implementation success and system usage (Fisher and Howell, 2004). To face this challenge, HRM practices become relevant in supporting the process and support coping abilities (Maheshwari & Vohra, 2015; Neves et al., 2018).

HRM is a structured way to manage and organize the workforce inside an organization. It involves specific activities such as hiring, training, career management, performance assessment, health and safety management or work design (Stewart and Brown, 2014). However, professionals' practices in regard to HRM can influence employees' reaction to the change through various areas. These areas include, for example, the organizational culture, the communication processes, employees' behaviors or the working environment (Maheshwari and Vohra, 2015). Previous research in information systems (IS) and advanced manufacturing technology (AMT) suggest that HRM activities are necessary during technological change projects. For instance, HR professionals and managers may involve practices aiming towards assessing performance, promoting leadership, empowering the workforce (Small, 2007) or creating incentives (Talukder, 2012). In addition, HRM practices can promote employees' capacity to deal with organizational changes, especially if they emphasize autonomy, teamwork and active role in decision processes (Fisher and Howell, 2004; Tummers *et al.*, 2015). Ultimately, alignment between HRM and organizational strategies for technological change (Fenech *et al.*, 2019; Kozlowski, 1987) and the participation of professionals from HRM-related fields at the beginning of the implementation process are pointed out as necessary for the change's success (Fisher and Howell, 2004). For the manufacturing context, research suggests this helps achieving greater performance (Fabi *et al.*, 2009; González-Sánchez *et al.*, 2018).

3.4. Research gaps and aims of this study

Considering the value of addressing human-related challenges in industrial HRC implementation, notably through organizational practices, both HRM and change management perspectives become relevant to explore the topic. Although organizational change management may not automatically lead to a successful implementation (Tummers *et al.*, 2015), it provides great complementarity to implementation project management (Markus, 2004). As implementation of collaborative robots should receive more attention from research (Cohen *et al.*, 2019), questions remain in how to achieve a fit between HRM and manufacturing strategies (Fabi *et al.*, 2009; González-Sánchez *et al.*, 2018). In addition, authors mentioned a need for further exploration of the strategic role of HRM in technological implementation (Fenech *et al.*, 2019). However, research is scarce regarding the role of HRM practices within the implementation of collaborative robotics, as shown by Libert et al. (2020). The implementation of collaborative robotics presents several challenges and calls for greater focus on HRM (Calitz *et al.*, 2017). Since managers often fail to consider workers' reaction to technological change (Fisher and Howell, 2004), new research should focus on the HRM practices that can increase coping with technological change (Rubel *et al.*, 2017).

Hence, using an exploratory qualitative method, this study aims to better the understanding on how HRM practices can improve the implementation of collaborative robotics and HRC. This study relies on a multidisciplinary perspective, considering that insights from various actors, such as employees, managers or integrators, can be involved during the implementation process.

4. METHODOLOGY

4.1. Data collection

This study adopted an exploratory qualitative approach, based on a semi-inductive method with semi-directed interviews. It aims to provide an overview of the factors and practices influencing the implementation of collaborative robotics, with the purpose of orienting professionals and researchers in the field. This research approach enables the exploration of employees' experience relatively to the implementation of cobots (Tracy, 2013; Roberts, 2020). This will allow to reach a better understanding of the factors and practices facilitating or hindering the implementation of HRC and collaborative robotics.

The interview guides[4] contained open-ended questions, allowing participants more freedom in their answers, while framing the interviews according to the research question (Roberts, 2020). We created the interview protocols based on a literature review that highlights the main themes already associated with the topic of interest in the literature. This helped to establish a portrait of the concepts that oriented the questions for the interviews (Tracy, 2013). Consequently, the questions aimed for elements related to the main categories of factors (human, robot and environment) identified in the systematic literature review (SLR) with an emphasis on how the participants experienced the change and related practices. The interviews were designed to last around 45 minutes to an hour.

Some questions of the interview guide were adapted beforehand according to participants' function. This was deemed necessary in order to remain relevant to their reality and give them questions to which they were in position to answer. Participants from a managerial or HR position had the same interview guide. For the first two guides, questions were grouped in two main themes: the perception of the change and how the change was experienced. For the integrators, questions mainly addressed the implementation process and possible improvements. Such approach is more useful for

[4] Les guides d'entrevue sont présentés à l'Annexe B.

the purpose of the study, as we do not seek to test hypotheses, but to pinpoint information that research should explore further.

4.2. Participants

In order to collect data, we identified a Canadian SME that undertook the implementation of collaborative robotics after seeing it mainly as an opportunity to answer labor shortages and ergonomic issues on the production line. At the time of the interviews, the partnered SME had three shops and had been implementing five collaborative robots since 2017. According to the purpose of the study, we aimed for a little number of participants, but with a broader scope of functional background. Hence, it does not aim for redundancy or saturation in the data, but rather to gain a cross-functional perspective of the implementation of collaborative robotics and adoption. Therefore, participants were selected according to their job function and their role towards the implementation process or cobot usage. This purposeful sampling method was indicated considering that the study required variations between the participants to gain a wide range of knowledge on the topic and its complexity (Tracy, 2013). It is also consistent with the context of the study (Sandelowski, 1995) which, in this case, is to gather insight from various actors. To preserve anonymity, the masculine form is adopted to refer to each participant, despite having two female participants. Relevant participants were identified through the help of the SME and are described in Table 4.

To carry out the design and implementation of collaborative robots, the SME hired integrators from an external firm. We included two participants from the firm as they were able to provide input on the process that employees of the SME could not. We also interviewed another consultant in collaborative robotic implementation, a technical sales representative, who was not hired from the company. Because his role was slightly different from the previous two, his input was considered relevant in comparison to the integrators.

Interestingly, the SME did not actively involve its HR department during the implementation process. However, the HR employee's input remains valuable regarding possible consequences from the change on his work and the workforce, and what could have been done better from an HR professional perspective. This employee was the only one already working for the company when the changes were introduced at first. Other participants were those who were engaged in the implementation process within the company or who now work alongside collaborative robots.

Table 4. Participant's description

<table>
<tr><th>SME's employees (4)</th><td rowspan="6">7 participants
Women: 2
Men: 5</td></tr>
<tr><td>- Operator (1)
- Operation supervisor (1)
- Operation director (1)
- HR employee (1)</td></tr>
<tr><th>Participants consulting for the SME (Integrators) (2)</th></tr>
<tr><td>- Project manager and engineer (1)
- Robotics technician (1)</td></tr>
<tr><th>Other participant (1)</th></tr>
<tr><td>- Technical sales representative in collaborative robotics (1)</td></tr>
</table>

4.3. Data Analysis

The coding process was performed through QDA miner. The process included going over the verbatims and the coding tree several times. Upon final coding, another researcher of the team went through a major part of the codes. Researchers then discussed and agreed on changes. This was performed in order to ensure greater validity.

At first, the coding specifically looked for the HRM practices involved in cobots implementation in manufacturing companies. However, as mentioned before, the SME did not involve its HR department during the process. Thus, after the first coding process, we broadened the scope of the interviews in order to identify facilitating factors, challenges and employees' perception of the change, along with other organizational practices prone to affect implementation, adoption and HRC. We broadened the coding tree by adding a new category of organizational factors referring to factors that promote or hinder cobots implementation adoption, other HR-related practices. New categories were added for PU and PEU pulled from the TAM to consider the major components of technology adoption as suggested by the model.

5. RESULTS

From data analysis emerged some factors related to the successful implementation of collaborative robotics, HRC and management practices. Coding frequencies are indicated between parentheses in the text. They indicate the number of times the code has been mentioned during the interviews for the set of participants. Frequencies are presented in the tables for the main categories, subcategories and examples. The latter are used to illustrate the results but are not presented in the tables, thus they are underlined in the text. The tables also show the number of participants that have mentioned a same response element. This way of presenting the results in the tables aims to indicate the predominance of elements, while adding some relativity by showing how a same idea is shared across participants altogether. Results are presented according to the following four categories:

1) **Organizational factors (189)** include practices and factors about organizations and their operations. They refer to how organizations can support employees for collaborative robotics acceptance and usage and how to manage the implementation process.
2) **Human-related factors (16)** refer to results based on users' reactions and characteristics that shaped how they will first experience the change.
3) **Robot-related factors (35)** involve results that are related to the robot's characteristics and how it functions.
4) **Environment-related factors (19)** refer to contextual elements, whether they are from the internal context of the organization or the context in which it evolves.

These are mainly factors framing the reality of the organization, on which they have low control, if not at all.

5.1. Organizational Factors

These factors are represented in two main categories: facilitating practices (76) and success factors (113) of the implementation of collaborative robotics and adoption process. Facilitating practices are means or conditions that can support the implementation process and adoption. Based on the results, crucial practices are oriented towards supporting employees on diverse fronts to ensure that the change is perceived and experienced positively, but also that the implementation process is facilitated. Success factors are specific conditions that facilitate the implementation of collaborative robotics and adoption processes.

5.1.1. Facilitating Practices

Table 5 shows the two most mentioned practices by participants: training (20) for HRM practices and ensuring the transition (33) for change management. Few HRM practices were mentioned except training (20) and ensuring safety (3). Training is important for participants by developing employees' capabilities to use the cobot (7) or for improving technical skills (4), and for security measures (1). In terms of possible modalities for training, it was mentioned to train employees before the implementation (1) and to adapt the training to its public (1). Training HR professionals (1) may be a modality to explore as:

"HR are often more reluctant when it comes to safety" (Participant 1).

The second subcategory of facilitating practices is related to change management. The practice that seemed more important is ensuring the transition (33) by supporting employees' understanding of the change and acceptation. It includes, for instance, informing the employees of the upcoming change (8) and the reasons behind the decision (2), giving them time to adapt and learn (5), along with explaining what a cobot is (4). Regarding the latter, offering visuals of cobots (7) with videos, photos or demonstrations were helpful ways to do it. Mainly, we observe that participants' opinions are congruent when it comes to change management practices that inform, support and reassure the employees throughout the change, whether it is about the process undertaken or the robot more specifically.

Giving support (10) during the implementation is perceived as important by most of the participants, especially reassuring employees (8) regarding job loss:

"I really try to show the operator that the robot is not here to replace him." (Participant 1)

Or regarding insecurities:

"I said: "Listen, they will explain everything to you. Don't be worried, it will be easy". I said: "The first time you worked here, you didn't know how your Sandblaster worked either". You know. So, I said: "You know it, you will learn it day by day, and at some point, it's is going to go very well." (Participant 1)

Participant 4 also suggested that offering employees a different job position (1) when there is reluctance to work with the cobot, instead of forcing them, can be another way to support employees.

Participants also underlined the importance of involving employees actively in the implementation process (10) to gain relevant input that help design the cobot efficiently and to make sure that it has value for operators on the shop floor. On these matters, asking for employees' input (7) was suggested the most. A participant underlined how it is important:

"If the operators, those that will use it, that will work alongside it everyday, if they are not involved in the process, surely they will be reluctant from the beginning. I include them from the very beginning. […] We include them in our brainstorming or design meetings, because they still have ideas. It's them who always do it the same way. Who are… if you need to work on a specific part, it's them who manipulate this part. So sometimes people will say: "We should take it like this", but the operator usually will say: "Yes, but if you take it this way, you will have difficulties to do that part, that movement."" (Participant 1)

However, participant 4 suggested that instead of asking operators to seat in formal meetings, going to the factory floors to exchange might be more suitable and comfortable for them.

Table 5. Facilitating practices

<table>
<tr><th colspan="5">Organizational Factors (1/2)</th></tr>
<tr><th>Category</th><th>Subcategories 1</th><th>Practices</th><th>Frequencies</th><th>Number of respondents</th></tr>
<tr><td rowspan="5">Facilitating practices (76)</td><td rowspan="2">HRM practices (23)</td><td>Training</td><td>20</td><td>7</td></tr>
<tr><td>Ensuring safety</td><td>3</td><td>2</td></tr>
<tr><td rowspan="3">Change management-related practices (53)</td><td>Supporting the transition</td><td>33</td><td>6</td></tr>
<tr><td>Offering support</td><td>10</td><td>5</td></tr>
<tr><td>Giving an active role to operators</td><td>10</td><td>5</td></tr>
</table>

5.1.2. Success factors

First, perceived positive organizational outcomes (60) appeared as the most important success factor. Indeed, numerous advantages related to cobot introduction in the SME were mentioned, which seemed to support acceptance. Overall, the results show that participants appear satisfied with the cobots because of how they optimized the work environment and the use of resources, and reduced workload:

"Well, it gets easier every day. […] You tell the robot only once. I need a programmer, yes. But I have one internally. So, it corrects my glue spot and it's settled for the day guys and the night guys. Everything is easier. Managing an employee. One more employee to manage, it doesn't seem like it but it's one more employee to take care of. And, I often had people at that job that didn't like it, who found it unpleasant and difficult. We tried to make it better, with hoses and everything, but it remained heavy." (Participant 2)

More precisely, Table 6 shows that after the implementation, participants perceived several positive outcomes, like improving health and safety at work (21), improving production (14) and reducing workforce-related problems (14). For these categories, the examples given were reducing risks of injury (9) and boring tasks (5) for chain workers, increasing productivity (4) with regularity on the production line, and alleviating issues related to absenteeism (4) or labor shortages (4). Making the work easier (6) referred to how the robots lighten some tasks for operators and non-operators. Cobots also enabled resource saving (5) by being a cheaper technology (1), causing fewer resource waste (2) and optimizing the use of human resources (2).

Second, project management (42) also appeared as an important factor involved in the successful implementation of collaborative robotics. Mostly, having realistic expectations (15), retroaction between actors in the project (12), and capabilities and knowledge in project management (8) appeared more important when it comes to support the project's success. Results suggest that participants framed project management as a useful way to help the coordination and the involvement of various actors and points of view. It was also perceived as helpful in defining boundaries to the project in order to reduce setbacks or failure rates. These elements from project management seem more oriented towards supporting the implementation success, rather than people's acceptance of the change.

Table 6. Success factors

Organizational Factors (2/2)				
Category	**Subcategories 1**	**Subcategories 2**	**Frequencies**	**Number of respondents**
Success factors (113)	Simultaneous project management (42)	Feedback between project's actors	12	4
		Capabilities in project management	8	4
		Realistic expectations	15	3
		Various actors' involvement	5	3
		Project evolution monitoring	2	2
	Matching HR practices		8	3
	Employees' commitment		3	3
	Perceived positive organizational outcomes (60)	Health and safety at work improvement	21	6
		Production improvement	14	5
		Workforce-related problems addressed	14	4
		Working becomes easier	6	4
		Resource saving	5	4

For instance, realistic expectations are important mostly because they match the project magnitude to the true needs of the organization, rather than what is perceived as desirable. This would keep the project from being too ambitious. According to participants, it is mainly required to <u>validate the needs in terms of robotization</u> (6), to <u>make the first project as simple as possible</u> (3) and to <u>validate expectations throughout the project</u> (3).

Retroaction between actors implies fluidity in communication, by being open to feedback and looking for it, especially by <u>going on the factory floor</u> (5) and <u>doing follow-ups between the organization and the integrators</u>

(3). Project management as a capability was especially about designating a project manager (6) that will act as a "*contact point*" (Participant 3) and make sure that when the project is delivered and implemented *"there is no surprises"* (Participant 3). This condition was mainly important to ensure a good coordination between the organization and the integrators.

In addition, participants did not evoke many specific HRM practices. However, they highlighted the need to match the decisions regarding staffing and remuneration to the context emerging from cobots implementation. This implied revising job descriptions or tasks (3), salaries (2) and profiles required for the job (2). It was also considered relevant by Participant 7 to involve HR's input about health and safety management (1) during the implementation process. Finally, employees' commitment (3) seems viewed as a requirement, where employees believe in the project and share the vision undertaken. Although it was not addressed frequently, participants who underlined employees' commitment considered it crucial:

"Because, if management is convinced that a robot is needed and we implement it in the factory, but the union of the employees are not convinced, it is obvious that it won't work. I've already seen it…" (Participant 1)

5.2. Human-related factors

Table 7 shows findings about human factors, which are mainly related to the operator himself and could influence how he experiences the implantation process and the adoption of the new technology. The categories of factors identified are the operator's preoccupations towards the change (7), his personality (4), his technological knowledge (3), along with his age (2). It is possible to observe that, besides preoccupations towards the change, the other three factors refer more to the person's characteristics influencing how he will receive the change, rather than his reactions.

Table 7. Human-related factors

Human-Related Factors		
Categories	**Frequencies**	**Number of respondents**
Preoccupations towards change	7	4
Personality	4	4
Low technological knowledge	3	3
Age	2	2

First, participants mentioned that preoccupations towards the change (7) and personality (7) can influence how the worker experiences cobot's arrival. Both were primarily related to anxiety. Regarding preoccupations towards change, manifestations were mostly fear or apprehension for his own safety, for a lack of capability or for breaking the robot. Other manifestations were stress and anxiety towards cobot's arrival. Each of these factors seemed to affect how the employees will greet the change. For example, first reactions may be nervousness:

"I was nervous. I didn't know what to expect." (Participant 6)

Or even fear:

"We often noticed that people don't know what collaborative robotics is. So, sometimes, the operators are scared at first: "Will it kill me? (laughs) […] What will happen?" (Participant 2)

Thus, it seems that the receivers of the change, mostly operators, experience a state of apprehension towards the robot in the beginning of the process and are unsure of how it might affect them. As for personality, results suggest that people vary in their reactions towards cobot implementation, and that certain personality traits can influence those reactions. An anxious personality type was mentioned as having an impact on how the operator receives the change. Participant 5 highlighted the fact that working with a robot as a colleague, instead of a human, might not be for everyone, as some people enjoy talking with a colleague while working, which can be motivating for each other. In his opinion, an operator that does not need that kind of communication may have a more suitable profile for the job. Hence, a tendency to introversion was reported as a personality trait that could promote a more positive working experience with the cobot.

Another factor identified by participants as having an impact on how the user experiences the introduction of the cobot is the lack of technological knowledge (3). Two participants linked discomfort working with a cobot to the lack of comfort to use other technologies, like computers:

“I don’t know anything about it (laughs). I am having trouble using a computer, so imagine… Phew!” (Participant 6)

About technological capability, another participant linked reluctance from employees to use the cobot to that technological discomfort:

“Well, maybe the most difficult part is that it is obviously not everyone who… at a computer or technological level…who are… Who are comfortable to use these things. So, of course, sometimes… I would not say by choice but… We would easily see someone operate at this place and he would say: “Oh no, look, I don’t want to touch a computer. I am not comfortable.”" (Participant 4)

Finally, age (2) was mentioned as a factor influencing the willingness to work with the cobot, because younger operators would understand more easily how to operate the robot, but also because they were considered less fearful towards it.

5.3. Robot-related factors

Participants were questioned about the characteristics of cobots that they see as hindering or facilitating the implementation process and the willingness to work alongside it. As shown in Table 8, elements referring to cobot's performance (30) were predominant, and some challenges associated to its conception were mentioned.

Primarily, the comparison between cobot's dependability (12) and human's dependability was more frequent. The cobots were considered more dependable than workers:

"It is always on time", "You ask it for overtime, it is always there. It is always working" or "It never has stomach aches." (Participant 5)

Also, two participants underlined the technology's dependability, such as being safer than industrial robots or requiring low maintenance. In the same vein, the technology was considered easy to use (6), especially for the operators, by its simple design and being user-friendly. When asked if there would be some ways to make cobots even more optimal for usage, a participant pointed out:

"Well, collaborative robots are rather user-friendly, I would say. If, for example, we want to make it move or something, they can shift it in free motion, and they will play with it and position it as they want. For people who never played with robotics, I believe that it is the most appropriate robot to have fun with and learn about." (Participant 2)

The ease of use was also associated to the ease of programing and optimization for the task by some participants. However, although the robot is perceived as easy to use for a task, it was also perceived as limited, mostly in moving, picking up some pieces or because it could not optimize a task entirely for the human operator. Such limits were qualified as "*annoying"* (participant 6).

From a perspective involving social behaviors (7), characteristics of the cobot were perceived by some participants as more pleasant than a human coworker's. It was underlined that the teaming of a human worker with a cobot reduced risks of conflict and other inconveniences associated with a human coworker, like a colleague being in a bad mood or complaining. While the cobot appears to reduce negative social interaction at work, participant 5 also raised the idea that it does not allow for positive social interactions for the operators.

Finally, while cobots appear highly customizable for the needs of organizations and their users, it poses some conception challenges as it is qualified as a *"trial and error"* (Participant 3) kind of project. Participant 2 pointed out that it can be challenging to simplify usage for the operators as much as possible, along with the fact that each implantation project is different from the other because clients' needs vary. The limits (5) seemed to have more impact on the earlier phases of the implementation process, where conception and design are involved.

Table 8. Robot-related factors

Robot-Related Factors			
Categories	**Subcategories**	**Frequencies**	**Number of respondents**
Cobot's performance (30)	Dependability	12	4
	Ease of use	6	4
	Social behaviors	7	3
	Limits	5	2
Conception challenges		5	1

5.4. Environment-Related Factors

Factors related to the environment of the organization were highlighted during the interviews. As observed in Table 9, internal (12) and external (7) environment played a role in facilitating cobots implementation. Regarding internal environment, it facilitated the implementation and adoption mostly because <u>no job had to be cut in the process</u> (5), which may have effected openness from employees towards the new technology, by reducing their fear of losing their job. Also, having been in contact with previous technologies (3), like *Ipads* or other industrial robots was perceived as facilitating previous experiences from certain participants. About external factors, the actual context, with labor shortage (2), seemed to play a favorable role for robotics implementation, along with external support from integrators (3).

Table 9. Environment-related factors

Environement-Related factors			
Category	**Subcategories**	**Frequencies**	**Number of respondents**
Facilitating factors (19)	Internal	12	3
	External	7	5

5.5. Adoption manifestations

Although the interview guide was not specifically asking about adoption manifestation, a few comments emerged from participants. Those observations are presented in the results since they may represent positive outcomes from an implementation that is well managed. The manifestations quoted by participants were being happy of having the robot in the workplace (8), giving a name to the robot (2), being proud to work alongside the robot (1), disappearance of fears towards the use of the robot (1) and appreciation of the new pace on the production line (1).

6. DISCUSSION

This study aims to reach a better understanding of the utility of organizational practices oriented towards HRM during the implementation of collaborative robotics. Results highlight the utility to focus on HRM in cobot adoption and the necessity to involve HR professionals to support the process. Employees' commitment was perceived as a crucial condition by participants and HR involvement surely has helped achieve it as HRM practices that enhance commitment can reduce intents in resisting change (Neves *et al.*, 2018). These findings bring important insights to managers as for the use of HRM to promote technology acceptance and trust from their employees (Rubel *et al.*, 2017).

While the TAM extended to robot adoption draws a portrait of various relationships related to work context, such as job relevance and output quality influencing PU or anxiety, self-efficacy and perceived safety influencing PEU, it may not be sufficient to understand how to ensure adoption. Indeed, results shed light on the insight that successful implementation and adoption rely on a strategic alignment between HRM, change management, project management and factors influencing HRC. This alignment can lead to other antecedents of technology usage, like higher job relevance or lower levels of self-efficacy. Then, some factors in the TAM, or other adoption models, may mediate relationships between HRM, change management practices, project management practices or factors influencing HRC in a successful implementation.

6.1. The Relevance of HRM

Results reveal that an HRM perspective contributes to readiness to cobot implementation and continued commitment throughout the changes within the work environment. Considering participants' opinions and the successful implementation within the SME studied, results suggest that HRM is decisive, specially to nurture a working environment that relies on safety, information, support and employees' involvement in the context of change. These results concur with previous work (e.g. Calitz et al., 2017; Charalambous et al., 2015; Jocelyn et al., 2017; Koppenborg et al., 2017; Maurtua et al., 2017) while offering additional insight.

First, the facilitating practices identified are support oriented and may have led employees to perceive more organisational support during the implementation process. Perceived organizational support (POS) is associated by employees to the "extent to which the organization values their contribution and cares about their well-being" (Eisenberger et al., 1986, p. 501). When POS is increased, it can lead to higher job satisfaction, commitment and information technology adoption (Rhoades and Eisenberger, 2002). By leading employees to perceive that they are treated with care and consideration, the identified facilitating practices are probably efficient for nurturing coping capabilities and a positive perception of the change (Tavakoli, 2010). Literature already mentions that support from management is important for innovation adoption (Talukder, 2012) and cobot implementation (Charalambous *et al.*, 2015). However, the relationship between support from management and cobot adoption should be more nuanced as the discretionary intention behind supportive organizational practices is crucial (Eisenberger *et al.*, 1997). This suggests that some facilitating practices are perceived more supportive than others. During organizational change, POS can reduce resistance to change through readiness for change (Ming-Chu and Meng-Hsiu, 2015). Also, POS has been linked to intrinsic motivation to use IT and acceptance (Mitchell and Gagné, 2012).

Second, according to our findings, bringing awareness on the reasons behind the change and explaining why the robot is useful seems to promote adoption. It brings up interesting insight about communication as a practice inherent to various subprocesses and other HRM practices involved in cobot implementation. Communication seems to positively connect human, robot and environment-related factors towards acceptance. For instance, the studied SME experienced labor shortages and ergonomically challenging tasks, which played an important role behind the decision to implement collaborative robots. Communicating how collaborative robotics can address those issues to employees probably helped them to understand implementation's benefits. Moreover, addressing concerns such as fear of job loss may have increased job security for employees, reduced concerns about the changes and anxiety levels (human-related factors), and increased change acceptance (Iverson, 1996). Furthermore, management communication is also indicated as an antecedent of POS because positive communication behaviors from management can show employees that they are supported and that their input is valued (Neves and Eisenberger, 2012). Indeed, the results of this study show that management and integrators adopted a reassuring discourse and sought for employees' feedback.

Third, findings suggest that involving employees is important to get valuable input at the conception phase, which would support adequation of the cobot's design with operators' reality. It highlights that employees are valuable assets for the fit between technology and working context. This practice may also have helped increasing employees' trust towards management and acceptance of the change. Indeed, trust is an important factor in technological change (Lippert and Davis, 2006; Rubel *et al.*, 2017), commitment and POS (Celep and Yilmazturk, 2012), and can be increased by employee involvement (Morgan and Zeffane, 2003).

Finally, results show that HRM practices and HR professionals can support the organization in getting ready for the implementation of collaborative robotics as well as aligning the organizational context and needs with the cobot's design. They can help managers to develop the right organizational capabilities to support the change from an HRM perspective. To do so, results suggest that HR professionals should be trained on collaborative robotics, should give input regarding health and safety, and should help to develop new job profiles and descriptions. This insight is supported by previous literature that suggests that HRM should be aligned with manufacturing objectives (González-Sánchez *et al.*, 2018) and should develop organizational culture and a sense of security for workers (Calitz *et al.*, 2017). In the end, by considering the projects' objectives and the new work environment, HRM practices can help build an organizational context suitable for collaborative robotics. Thus, aligning HRM may be even more important in order to support implementation's sustainability in time.

6.2. Aligning project management and change management

Results show that the implementation process must ensure that the technology is suitable for the organizational context and needs in order to reap benefits and avoid multiple setbacks. As perceived positive organizational outcomes were important success factors in the results, these positive outcomes may have come from the fact that the technology was well designed and implemented. Results underline that adequate project management processes are a requirement in the way they include communication between actors, alignment of the project with the organization's reality and capabilities in project management, as well as the involvement of multiple actors to benefit from diverse perspectives and knowledge.

Results also stress the importance to inform and involve employees early on, as this can help optimize the implementation process through relevant input and lead to a positive change experience. Indeed, good alignment between project management and organizational change management may have helped the SME to support operators' transition and preparation (i.e. through training, showing the robots on video/photos, organizing demonstrations, etc.). These findings congruent with studies underlining the importance of workers' preparation through the implementation process (Small, 2007; Small and Yasin, 2000). In addition, the involvement of integrators is interesting because they supported the SME and took over the design and the installation. Findings are similar to those of Charalambous et al. (2015) who identified that a project manager is necessary to support and coordinate the cobot implementation process. They also underlined how integrators' knowledge and competency, or lack thereof, may affect the implementation process, the delays and the costs. Also, our results show that collaborating with integrators, who take cobot design and implantation in charge, was useful for the SME. Hence, it may be advantageous for organizations to delegate to integrators, as Charalambous et al. (2015) suggested that it is difficult to allow human resources for production while supporting and developing the system.

6.2.1. Human, robot and environment-related factors

The analysis demonstrates that the user's own characteristics can influence how he may first react to cobot implementation. It sheds light on the importance to consider these characteristics when evaluating or anticipating the individual's enablers or obstacles. For example, age has already been underlined as a factor influencing HRI

(Kallinen, 2017). Furthermore, results underline the relevance to assess how personality can affect HRI and HRC, as they suggest that anxious people can be more reluctant to go through technological changes. This may influence decisions about HRM strategies. Also, by suggesting that some profiles may be more suitable for HRC, like introversion and not needing to exchange extensively with coworkers, results highlight that working alongside a robot may not be for everyone. However, Kim et al. (2012) showed that the user's need for affiliation could lead to more trust, attachment and relationship satisfaction with the robot. Thus, organizations may take personality profiles into consideration to recruit the right candidates and make sure that they are satisfied at work. This reinforces the relevance to match HRM activities, such as reviewing job profiles, with the implementation of collaborative robotics.

In addition, the social aspect of the cobot's performance was enlightening because it raised questions about the positive impacts of the cobot on work environment that goes beyond productivity. It was pinpointed that it is sometimes easier to deal with a cobot than a human coworker because the former "*doesn't complain*". Hence, the cobot may help avoid some conflict between workers. Another interesting aspect is how it was perceived as more reliable than human workers in terms of showing up for work, which seems to reduce issues related to absenteeism.

Finally, environment-related factors were categorised differently from other published work identified in Libert et al. (2020). For instance, previous work on trust has classified tasking in environment-related factors (Hancock *et al.*, 2011). However, considering that the task is dependant on the organization and its activities or needs, tasking was classified under organizational factor rather than environmental-related factors. Then, environment-related factors may refer more appropriately to the context in which the organization evolves, whether it is internal or external. For instance, issues related to labor shortages could create openness among employees towards the implementation of collaborative robotics by minimizing their fear of being replaced, thus facilitating the implementation process. Also, support availability in the external environment, for instance from integrators, may become a facilitating factor for the organization.

7. CONCLUSION

Our findings show that collaborative robotics implementation in an organizational context is a complex process. Main findings suggest that the success of cobot implementation depends on two major aspects: managing the project and managing the change. First, such endeavour should present value for the organization, as illustrated by the perceived positive outcomes and the several benefits suggested by participants. Consequently, it should be aligned with manufacturing objectives and reality to ensure functionality since a misalignment of the technology with organizational context may lead to failure (Markus, 2004). In that sense, we emphasize that operation managers, production line managers and HR professionals should collaborate closely in order to align change management practices to technological implementation strategies.

Second, benefits depend on how it will be user-friendly, optimized for the task and how the users present openness to work alongside such technology. Indeed, resistance from employees may be counterproductive (Tavakoli, 2010) and jeopardize successful implementation (Lapointe and Rivard, 2005). Furthermore, a positive work climate appears crucial when it comes to technology adoption (Mitchell and Gagné, 2012; Yoo *et al.*, 2012) and HRM practices can reinforce it.

Our research also highlights that organizations can control some factors, but not all of them. It pinpointed the relevance to understand and strategically manage barriers and enablers related to factors (i.e. human, robot and environment-related factors). This appears critical for a successful implementation. Besides, involving various actors in the project may be key to ensure that the complexity of the project is properly grasped, and that practices and success factors are considered accordingly.

Ultimately, our findings reveal that, in order to achieve success in cobot implementation and adoption, organizations and research should adopt a multidisciplinary approach to consider all the facets of collaborative robotics mentioned above.

8. LIMITATION AND RESEARCH AGENDA

This study has some limitations. While the semi-inductive qualitative method used to collect and analyse the data leads to the emergence of interesting results that can truly contribute to extend knowledge, the pool of participant was quite limited. The same method using more participants would be interesting. For instance, only one demographic variable (age) was underlined in the results. Further research using a larger and more diversified group of participants could help to identify if other demographic variables should be taken into consideration, as previous studies also suggested variations between culture (Li et al., 2010), academic background (Nomura and Takagi, 2011) and gender (Warta, 2015) in HRI.

Moreover, some quantitative analysis may be required to assess the relative influence of the various factors identified on the success of the implementation process and technology adoption. It would be interesting to see how the advances made about the complementarity of project management and change management can be integrated into a framework intended for technology implementation and adoption, based on further empirical evidence. Comparisons between case studies should be performed in order to diversify organizational context (Baxter and Jack, 2008). It could be helpful to observe which factors may be more generalizable to explain success or failure of the implementation process, along with exploring more in depth the global effect of work climate on technology adoption. Ultimately, more work should examine the integration of technology implementation and organizational change through technology adoption and resistance (Lapointe and Rivard, 2005; Laumer and Eckhardt, 2012) and the implications for HRM (Fenech *et al.*, 2019).

This study did not explore exhaustively the impact of collaborative robotics implementation on various job functions, such as employees further on the manufacturing line or HR professionals. This may be even more relevant if future research explores how other forms of collaborative robots can assist other job functions. Indeed, HRI may not be limited to the production line. In addition, results showed that advantages of collaborative robotics go beyond resource economy and productivity. Indeed, they illustrated some perceived advantages such as decreasing irritants related to human-human interactions or other human behaviors like not showing up for work. It would be interesting to explore further the impacts of such benefits on the workforce.

Finally, further research can investigate how organizations and integrators assess the success of the implementation, both from a project management and adoption point of view. Although several positive outcomes of the implementation were mentioned, the process itself and the setbacks encountered were not really explored. On that matter, the adoption manifestations, highlighted in the results, may be interesting to provide adoption indicators that go beyond usage. It may help to better assess the level of HRC. Indeed, such manifestations seem to indicate that an adoption level is not limited to robot usage, but also to that a bond with the robot can be created.

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PARTIE 4 : DISCUSSION ET CONCLUSION

L'étude menée visait à explorer la place de la GRH dans l'implantation de la robotique collaborative. Ce volet a d'abord été exploré via une revue systématique de la littérature. Lors de cette étape, la perspective du projet de recherche a dû être élargie aux facteurs susceptibles d'influencer la collaboration humain-robot, puisque la littérature présentait peu de publications référant spécifiquement à la GRH. Ensuite, une collecte de données qualitative a été menée auprès d'une PME. Lors de cette étape, les objectifs de recherche ont dû être élargis de nouveau afin d'inclure des pratiques de gestion plus générales et des facteurs humains en contexte organisationnel, toujours en lien avec l'implantation de robots collaboratifs. La nécessité d'élargir les objectifs de recherche est essentiellement liée au caractère récent de l'objet d'étude, en particulier dans une perspective en ressources humaines. Au-delà des résultats présentés aux chapitres précédents, la nécessité d'élargir les objectifs met en lumière des constats importants relativement à la place accordée à la GRH dans ce type de contexte.

Premièrement, les constats soulèvent la présence probable de lacunes quant à l'intégration de pratiques de GRH et de la terminologie liée à ce domaine dans l'étude de l'implantation de robots collaboratifs en entreprise. Cela fut notamment démontré au second chapitre, où un seul article retenu était publié par une revue destinée à la GRH. Aussi, peu de pratiques s'apparentant spécifiquement à la GRH ont été identifiées dans les articles sélectionnés. On y remarque d'ailleurs qu'un accent est mis plutôt sur la conception et la programmation du robot et les caractéristiques qui en découlent. Ceci est cohérent avec des lacunes déjà identifiées dans la recherche qui créent peu de liens entre les domaines des systèmes d'information et de la GRH (Johnson et al., 2016). Considérant que la recherche peine encore à joindre ces deux domaines, malgré le fait que les systèmes d'information soient déjà très utilisés en entreprise (Nankervis et al., 2019), il n'est pas étonnant que la robotique collaborative soit peu étudiée sous l'angle de la GRH. Ainsi, afin d'outiller convenablement les professionnels en GRH au niveau de leurs connaissances et de leurs compétences, des avancées en recherche sont requises. Alors, un meilleur arrimage en recherche en ce qui concerne l'étude des implantations technologiques en lien avec la GRH pourrait avoir des retombées pratiques plus que dues.

À cet effet, il serait pertinent d'explorer l'implantation de robots collaboratifs, ainsi que d'autres technologies, en explorant davantage la réalité des professionnels en GRH. Ce type d'études pourraient, entre autres, permettre d'explorer le niveau de préparation de ces professionnels en lien avec les changements technologiques à venir, leurs zones de développement, leurs forces et leur propre ouverture à l'adoption des nouvelles technologies. En effet, les professions en GRH et les activités qu'elles englobent seront-elles aussi affectées par les changements technologiques (Sivathanu & Pillai, 2018). Afin de demeurer une réelle valeur ajoutée pour les organisations, il serait important que les professionnels en GRH adaptent leurs pratiques à ces changements technologiques (Amladi, 2017; Ulrich et al., 2013). Cela dit, ces professionnels seraient eux-mêmes peu enclins à adopter les avancées technologiques (Nankervis et al., 2019) ou manqueraient de proactivité à le faire (Morelli et al., 2015). Il importe donc que les chercheurs s'attardent davantage aux changements que subira le rôle des professionnels RH dans les décennies à venir, afin de baser des recommandations qui s'arriment avec le contexte moderne et futur. Cela permettra de maintenir leur rôle actuel et de favoriser leur alignement avec les stratégies organisationnelles.

À ce titre, une meilleure collaboration entre le monde de la recherche et les professionnels terrain serait une avenue fort pertinente pour permettre la création de ponts en ce qui concerne les connaissances et la compréhension des enjeux liés aux innovations technologiques. Cette façon de procéder favoriserait assurément l'actualisation du terrain et de la recherche. Par ailleurs, il est certain qu'une jonction entre diverses disciplines associées notamment à la GRH, la psychologie du travail et les systèmes d'information est un point de départ nécessaire.

À l'instar de la recherche, les organisations pourraient démontrer des lacunes persistantes quant à l'alignement du rôle des professionnels en GRH avec leurs stratégies. Ce constat est mis en lumière par le fait qu'un faible nombre de pratiques issues spécifiquement des activités de GRH et des rôles professionnels associés ont été mentionnées par les participants. Plus spécifiquement, les résultats indiquaient l'utilisation de la formation et de la gestion de la santé et sécurité au travail, qui sont deux pratiques spécifiques à la fonction RH. Cela dit, ce qui rend le contexte étudié intéressant par rapport aux objectifs de recherches est que la PME n'a pas activement impliqué son département RH lors de l'implantation des robots collaboratifs.

Ce manque d'implication actif du département RH pourrait trouver écho dans le fait que la GRH est encore trop peu considérée dans une optique d'alignement aux stratégies organisationnelles (Holbeche, 2009). Cela serait également cohérent avec le fait que les PME ont tendance à adopter une approche moins formelle en matière de GRH (Benmore & Palmer, 1996; de Kok & Uhlaner, 2001; Nguyen & Bryant, 2004), ainsi que moins agile (Heilmann et al., 2020). La proposition d'unir davantage le terrain et la recherche dans un angle de proactivité pour faire face à la présence grandissante d'innovations technologiques au travail, comme la robotique collaborative, prend encore plus d'importance, à la lumière de ces constats.

Néanmoins, en rendant les objectifs de recherche plus inclusifs, il a été possible d'identifier un ensemble de pratiques et de facteurs organisationnels qui ont joué un rôle de près ou de loin dans le succès de l'implantation des robots collaboratifs. Soit ces facteurs ont influencé positivement l'adoption, soit ils ont permis d'arrimer le projet technologique à l'organisation et ses employés, soutenant le succès sur le plan de la gestion du changement. Globalement, ce que les résultats illustrent est l'utilité de la GRH pour soutenir l'ensemble du processus, autant en bénéficiant de l'expertise des professionnels en GRH qu'en arrimant leurs pratiques à d'autres pratiques organisationnelles. Cela abonde dans le même sens qu'Ulrich et al. (2013), où l'impact majeur des professionnels GRH en lien avec la performance organisationnelle se situe au niveau de leur implication dans l'alignement des stratégies, des pratiques et de la culture, ainsi que dans le soutien du changement. On note que l'apport des professionnels en GRH est d'autant plus nécessaire considérant que les défis principaux associés à la présence grandissante d'innovations technologiques en organisation concernent l'implantation technologique, la gestion du changement et la GRH en soi (Schneider, 2018).

L'implication des professionnels en GRH semble encore plus importante, alors que le contexte actuel demandera aux organisations de revoir leurs façons de faire, notamment en ce qui concerne les conditions de travail, les profils d'emploi et de compétences, la structure organisationnelle et de l'utilisation des technologies (Schwarzmüller et al., 2018). En ce qui a trait à l'implantation des robots collaboratifs, les résultats ont mis en lumière la nécessité d'aligner les descriptions de poste, les profils des employés et la rémunération.

En complément, l'étude menée a également soulevé la nécessité d'arrimer la gestion du changement au projet de conception et d'implantation. Dans cette optique il est judicieux d'impliquer les professionnels en GRH, alors qu'ils ont eux-mêmes un rôle d'acteur de changement (Dave Ulrich et al., 2013). Toutefois, le bon déroulement apparent de l'implantation de robots collaboratifs au sein de la PME impliquée dans l'étude laisse également présumer qu'au-delà du rôle clé de la profession de conseiller RH, les pratiques de GRH et de gestion du changement, comme la communication, le soutien et l'implication des employés, sont essentielles. Ce qui est intéressant ici, c'est que la profession RH n'est pas la seule porteuse de ce type de pratique. Plutôt, ce type de pratiques peut devenir une responsabilité partagée entre les divers acteurs impliqués dans le projet. Également, divers professionnels œuvrant dans le domaine de la GRH, sans être des conseillers RH, devraient apprendre à soutenir les organisations dans un contexte d'implantation technologique. On soutient même que les professionnels en

GRH devraient être impliqués dans la conception des technologies implantées afin d'assurer une meilleure concordance avec la réalité organisationnelle (Parker & Grote, 2020). Ultimement, l'implication des professionnels en GRH plus spécifiquement, devient pertinente afin de soutenir le processus (Fenech et al., 2019). Ils sont également en mesure d'offrir un apport pertinent en termes de santé psychologique chez les travailleurs (Bondarouk & Brewster, 2016), de développement de compétences (Hecklau et al., 2016) et, de gestion du changement (Neves et al., 2018; Ulrich et al., 2013).

En conclusion, les éléments susmentionnés sont en cohérence avec González-Sánchez et al. (2018), qui soutiennent que l'alignement stratégique entre les pratiques de GRH et les stratégies manufacturières serait susceptible de favoriser la performance. Toutefois, des lacunes semblent demeurer auprès de la PME ayant participé à l'étude en ce qui concerne l'alignement stratégique et compétitif de ses stratégies en GRH, alors que le département RH n'a pas été activement impliqué. Afin de soutenir les PME qui semblent communément éprouver ce type de difficulté (Hargis & Bradley, 2011), les professionnels en GRH auraient la responsabilité de développer leurs pratiques et leur compréhension du nouveau contexte technologique (Bondarouk & Brewster, 2016).

Dans cette optique, l'étude mène à diverses implications pratiques. Il importe que les gestionnaires, les professionnels en GRH et les intégrateurs travaillent en étroite collaboration afin de couvrir les divers enjeux associés à l'implantation et à la conception des robots collaboratifs, ainsi qu'à la gestion du changement. Ainsi, les professionnels en GRH auraient, eux aussi, une contribution importante dans le succès des stratégies organisationnelles en arrimant leurs activités aux orientations prises par l'organisation, de façon à soutenir le volet humain et à outiller les gestionnaires à en faire de même. De plus, les résultats énoncés soulèvent des préoccupations quant aux connaissances et aux compétences des professions en GRH à jouer un rôle de levier dans le cadre de virages technologiques comme la robotique collaborative. En effet, les résultats énoncés soutiennent que les pratiques issues de leur domaine ont un impact crucial sur la gestion de la main-d'œuvre et du changement. Cela dit, la taille de cet impact dépendra de la capacité des professionnels en GRH à mieux comprendre les changements technologiques et à demeurer proactif au sein de l'organisation.

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ANNEXE A
ARTICLES RETENUS POUR LA REVUE SYSTÉMATIQUE DE LA LITTÉRATURE

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ANNEXE B
CANEVAS D'ENTREVUE

Canevas pour les opérateurs sur la ligne de production

Mise en contexte

1- Quel âge avez-vous?
2- Quel poste occupez-vous?
   - Pourriez-vous me décrire brièvement ce qu'est une journée type dans le cadre de votre emploi?

Partie 1 : La perception du changement

3- Parlez-moi des changements qui ont eu lieu en lien avec l'intégration de robots collaboratifs dans votre environnement de travail?
   a. Pour quelles raisons croyez-vous que l'entreprise procède à ces changements?
   b. De quelles façons votre emploi a-t-il été affecté, s'il y a lieu?

4- Pourriez-vous me décrire comment vous avez été impliqué dans l'arrivée des robots collaboratifs?
   a. Comment avez-vous été mis au courant de ces changements?
   b. Au départ, quelle a été votre réaction face à ces changements?

5- Après avoir vécu ce changement, quels sont les éléments qui ont évolué depuis le début?
   a. Pour vous spécifiquement? (Ex. l'aisance avec le robot, craintes face à l'emploi, insatisfaction, etc.)
   b. Au niveau de l'ambiance/environnement de travail?
   c. Au niveau de votre perception du changement;
   d. Qu'est-ce qui pourrait faire changer votre perception, selon vous?

6- À votre avis quelles sont les répercussions, positives et négatives, issues de ce changement?

7- Est-ce qu'il y a autre chose que vous aimeriez ajouter par rapport à la façon dont le changement s'est déroulé ou la façon dont il vous a affecté?

Partie 2 : Le processus de changement

8- Pourriez-vous me parler de la façon dont s'est passée votre première expérience avec le robot?
    a. Globalement, comment vous êtes-vous senti dans cette situation?
    b. Parlez-moi des principaux défis rencontrés à ce moment ?
    c. Comment l'entreprise y a-t-elle remédié?

9- Pourriez-vous me parler des facteurs qui ont été facilitants dans le cadre de ce changement? (ex. formation, acteurs clés, expériences antérieures)
    a. Parlez-moi de la façon dont vous avez été soutenu dans le cadre de ce changement?

10- Si vous aviez à améliorer la façon dont les changements ont été introduits, que feriez-vous différemment?

11- Dans un monde idéal, à quoi ressemblerait votre travail aux côtés du robot collaboratif?
    a. Qu'est-ce qui vous permettrait de mieux collaborer avec le robot?
    b. Qu'est-ce qui vous le permet moins actuellement?

12- Si vous pouviez améliorer les caractéristiques mêmes du robot, que changeriez-vous?

13- Est-ce qu'il y a autre chose que nous n'avons pas abordé et que vous aimeriez partager?

Canevas pour la conseillère RH et la direction

Mise en contexte

1. Quel âge avez-vous?
2. Quel poste occupez-vous?
    a. Pourriez-vous me décrire brièvement ce qu'est une journée type dans le cadre de votre emploi?

Partie 1 : La perception du changement

3. Parlez-moi des changements qui ont eu lieu en lien avec l'intégration de robots collaboratifs dans votre environnement de travail?
    a. Pour quelles raisons avez-vous procédé à ces changements?
    b. De quelles façons votre emploi a-t-il été affecté, s'il y a lieu?

4. Pourriez-vous me décrire comment vous avez été impliqué dans l'arrivée des robots collaboratifs?
    a. Comment avez-vous été mis au courant de ces changements?
    b. Au départ, quelle a été votre réaction face à ces changements?

5. À votre avis quelles sont les conséquences/répercussions, positives et négatives, issues de ce changement?

Partie 2 : Le processus de changement

6. Comment s'est passée votre première expérience d'implantation des robots collaboratifs?
    a. Parlez-moi des principaux défis rencontrés à ce moment ?
    b. Comment y avez-vous remédié?
    c. Quels sont les facteurs qui ont été facilitants dans le cadre de ce changement? (ex. formation, acteurs clés, expériences antérieures)

7. Si vous aviez à améliorer la façon dont les changements vous été introduits, que feriez-vous différemment?

8. En résumé, quelles sont, selon vous, les meilleures pratiques à mettre en place par l'organisation?
    a. Par rapport à l'implantation du robot en soi.

b. Par rapport aux employés.
c. Par rapport à la direction.

9. Comment voyez-vous l'implication des diverses parties prenantes dans le processus d'implantation? (Ex. Employés, direction, consultants externes, fournisseurs, clients, etc.)

10. Quelles limites identifiez-vous actuellement en termes de…
    a. Connaissances?
    b. Services/accompagnement pour les entreprises?
    c. Autre?

11. Est-ce qu'il y a autre chose que nous n'avons pas abordé et que vous aimeriez partager?

Canevas pour les consultants en implantation de robots collaboratifs

Mise en contexte

1- Quel est votre âge?
2- Quel poste occupez-vous?
    a. Pourriez-vous me décrire brièvement ce qu'est une journée type dans le cadre de votre emploi?

Partie 1 : Le processus d'implantation

3- Parlez-moi de la démarche (différentes étapes) d'implantation de robotique collaborative avec vos clients.
4- Pourriez-vous m'expliquer quels sont les facteurs considérés dans la conception du robot pour faciliter son implantation.
    a. Ex : par rapport à la tâche
    b. Ex : par rapport aux travailleurs qui vont utiliser ces robots ?
    c. Etc.

5- Quels sont les défis que vous pouvez rencontrer durant un processus d'implantation de robots collaboratifs?
    a. Parmi ces défis, lesquels étaient les plus importants et pourquoi à votre avis ?

6- Qu'est-ce qui est le plus facilitant dans un tel processus d'implantation?
    a. Facteurs clés;
    b. Acteurs clés;
    c. Autre.

7- Comment voyez-vous l'implication des diverses parties prenantes de l'entreprise dans le processus d'implantation? (Ex. Employés, direction, consultants externes, fournisseurs, clients, etc.)

8- Quelles sont les conséquences positives et négatives que vous observez, suivant l'implantation de robots collaboratifs?

Partie 2 : Amélioration du processus d'implantation

9- Comparativement à la façon habituelle de procéder, quelles améliorations suggéreriez-vous?

10- En résumé, quelles seraient les meilleures pratiques à mettre en place par l'organisation, selon vous?
  a. Par rapport à l'implantation du robot en soi?
  b. Par rapport aux consultants?
  c. Par rapport aux employés?
  d. Par rapport à la direction?

11- Si vous pouviez apporter des modifications aux robots présentement sur le marché, que changeriez-vous?

12- Quelles limites identifiez-vous actuellement, en termes de…
  a. Connaissances?
  b. Services/accompagnement pour les entreprises?
  c. Autre?

13- Est-ce qu'il y a autre chose que nous n'avons pas abordé et que vous aimeriez partager?