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The future of employee development in the emerging fourth industrial revolution: a preferred liberal future

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ABSTRACT

The Fourth Industrial Revolution, which is a socio-technical, ideological, and rhetorical construction rooted in the neoliberal discourse that reflects key tenets of global capitalism, is believed to have considerable implications for the development of employees in advanced manufacturing environments. This paper aims to explore the ways in which the learning needs of employees in the context of the Fourth Industrial Revolution could be appropriately identified and how employees could further develop their skills through the design of suitable development curricula. To this end, the paper seeks to interrogate the ways in which the employees' learning needs are likely to be identified in the middle-range future, and problematise the focus of highly specialised and exclusively focused on Science, Technology, Engineering, and Mathematics (STEM) curricula that are likely to be designed to help employees respond to the perceived demands of the Fourth Industrial Revolution. The paper further seeks to explore a preferred liberal future, drawing on the work of Martha Nussbaum, to create the possibility for an alternative future guided by a more holistic conception of employee development through the establishment of learner-centred, liberal – and liberating – interdisciplinary Science, Technology, Engineering, Arts, and Mathematics (STEAM) curricula.

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Introduction: the effect of the fourth industrial revolution on employee development

The Fourth Industrial Revolution (4IR), which is a socio-technical, ideological, and rhetorical construction rooted in the neoliberal discourse that reflects key tenets of global capitalism, such as the necessity for continuous growth and competitiveness as well as the endless accumulation of capital, is believed to have considerable implications for the development of employees in advanced manufacturing work environments (Avis 2018). According to Klaus Schwab, the founder and executive chairman of the World Economic Forum, who first coined

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the term 'Fourth Industrial Revolution' in 2016 'we are at the beginning of a revolution that is fundamentally changing the way we live, work, and relate to one another. In its scale, scope and complexity, what I consider to be the fourth industrial revolution is unlike anything humankind has experienced before' (Schwab 2016, 7). The 4IR, which is intimately linked to the concepts of digitisation, automation, robotisation, interconnectivity, and additive manufacturing triggered by artificial intelligence and deep machine learning, seeks to improve the productivity, efficiency, innovation, and competitiveness of manufacturing (Chenoy, Ghosh, and Shukla 2019).

The current global market forces, which promote innovation and customer demand dynamics as keys to economic competitiveness, are likely to drive significant changes in the nature of work in the advanced manufacturing sector (Davis et al. 2012). According to the UK Commission for Employment and Skills (2015), 'advanced manufacturing is broadly described as manufacturing that is intensive in its use of capital and knowledge and requires a high level of technology utilisation and Research and Development'. In other words, advanced manufacturing companies, which seek to use technologies to improve existing products or create new ones, are urged to foster innovation and embrace the 4IR as well as the technological and organisational changes that are likely to occur as a result of it to stay ahead of the curve. The 4IR, which is currently being viewed by corporations, states, and influential think-tanks, such as the World Economic Forum and Deloitte, as an inevitable technological and societal development within the logic of technological determinism (Morgan 2019), is believed to be likely to alter the future of employment within advanced manufacturing companies due to the rapid changes in the design, production, and operation of manufacturing systems, and, therefore, shape the future of employee development within these companies. In the same vein, large corporations currently claim that their main intent is not to downside by replacing humans with machines, but to release employees from repetitive tasks and 'reskill' them to allow them to progress to high-skilled jobs that are currently in demand (Roose 2019). This way they claim to aim to provide a safety net for those employees whose jobs are likely to disappear as a result of automation. However, according to Brown et al. (2020, 89), the mismatch between skill supply and demand in the job market is likely to result in increasingly 'wasteful competition' or what they call 'a mirage of opportunity'. Simply put, the lack of an occupational structure that could accommodate the increasing numbers of highly skilled employees could lead to credential inflation, declining exchange value of credentials and income, as well as elite closure (Brown and Lauder 1996, 2006; Brown 1999). Moreover, critics have voiced concerns about the critical role of environmental sustainability in creating decent work within an inclusive global economy that should aim to eradicate poverty and establish a socioeconomic system that protects the environment, with particular reference to the issues of energy exploitation, ecological

despoliation, and climate change (McGrath and Powell 2016; Avis 2020). As argued by Erik Brynjolfsson (as cited in Roose 2019, n.p.), the Director of Massachusetts Institute of Technology's Initiative on the Digital Economy 'The choice isn't between automation and non-automation . . . It's between whether you use the technology in a way that creates shared prosperity, or more concentration of wealth'. That said, critics argue that the choices made by companies will determine whether the 4IR will result in increased productivity or widening inequality, increased class struggle, and environmental unsustainability.

Despite the ongoing debate of whether the 4IR will result in mass technological unemployment and job displacements, or will instead create new forms of work, there is relative agreement in the literature that the 4IR will lead to significant changes in the nature of work and the skill landscape (Wichmann, Eisenbart, and Gericke 2019; Avis 2020). More specifically, jobs that involve a number of 'routine' tasks, meaning 'a set of codified instructions' (Annunziata and Bourgeois 2018, 4), such as the job of machine operators within advanced manufacturing companies, are likely to be altered since routine tasks will be automated and performed by robots within controlled manufacturing environments, leading to the consolidation of employee responsibilities, which will require advanced troubleshooting skills as well as a sophisticated understanding of the production line (Avis 2018). On the other hand, 'cognitive' tasks, which require interpersonal interaction, adaptability to the situational context, complex problem-solving, strategy development, intuition, creativity, negotiation, and persuasion, such as the role of an engineering manager, are unlikely to be automated, and are, therefore, expected to require multiskilled employees to perform them. This is because machines and robots lack the divergent form of thinking that stems from curiosity and imagination, which means that they are capable of answering questions and solving existing problems, however, they lack the ability to ask questions and find new problems to which solutions can be applied (Yeung 2020). As argued by Avis (2020) the significance of human labour will continue until, and if ever, artificial intelligence is able to overcome the obstacles that it currently faces. Consequently, a number of scholars argue that the job displacement effect caused by automation is likely to be counterbalanced by technologies that will presumably create alternative tasks and jobs, which will change the skill landscape within the advanced manufacturing industry (Kumar, Zindani, and Davim 2019; Lyer 2020; Nygren et al. 2020).

The combination of workforce shortage and a widening skill gap is believed by manufacturing executives to have substantial impact in the ability of their companies to meet customer demands, achieve their productivity targets, implement new technologies, and expand internationally (Deloitte 2015). Consequently, advanced manufacturing companies are urged to upskill and reskill their workforce by designing and investing in learning and development programmes that will aim to help employees respond successfully to the

changes that are likely to be brought by the 4IR. In the context of globalisation and the emerging 4IR that draw on the neoliberal paradigm and the associated human capital theory, which is heavily influenced by the work of the economists Milton Friedman and Gary Becker, the ability of advanced manufacturing companies to use and continuously renew their human capital, which is viewed as a tradable commodity, is promoted as a key for gaining competitive advantage, and, thus, a crucial factor for their successful participation in the global knowledge economy (Peters 2003; Simons and Masschelein 2008; Annunziata and Bourgeois 2018). Within this neoliberal ideology, employees are seen as infinitely agile products capable of reinventing themselves in anticipation of market demands (Gillies 2011; Avis 2020), who 'will deteriorate if not kept in good shape through rigorous training programs' (Olssen, Codd, and O'Neill 2004, 150). This narrow neoliberal conception of employee development, which delimits all aspects of individual development to the instrumental terms of competition and return on investment, and views employees' skills as a stock of productive and consumptive capabilities, raises important questions about the purpose and future of employee development (Hastings 2019).

This paper is an effort to redirect neoliberal thought to avoid some of the pitfalls that it poses, in its current form, for employees, advanced manufacturing companies, the economy, and the society at large. More specifically, this paper aims to explore the ways in which the learning needs of employees working for advanced manufacturing companies in the context of the 4IR could be appropriately identified and how employees could further develop their skills through the design of suitable development curricula. In the present section of the paper, efforts were made to frame the issue and to indicate the ways in which the current neoliberal discourse surrounding the emerging 4IR is likely to affect the development of employees within advanced manufacturing companies. The second section of this paper seeks to provide a general account of the main features of liberal education, on which the critique of a probable neoliberal future as well as the presentation of a preferred liberal future will subsequently draw.

The third section intends to challenge the underlying neoliberal assumptions and dominant narratives about employee development by interrogating the ways in which employees' learning needs are likely to be identified in the middle-range future (five to ten years from now), and problematising the focus of highly specialised and exclusively focused on STEM (Science, Technology, Engineering, and Mathematics) curricula that are likely to be designed to help employees respond to the perceived demands of the 4IR. The fourth section, which is dedicated to the exploration of a preferred liberal future, drawing on the work of Martha Nussbaum, intends to move away from detrimental, unexamined, and taken-for-granted conceptions of probable futures to create the possibility for an alternative future guided by a more holistic conception of employee development through the establishment of

learner-centred, liberal – and liberating – interdisciplinary STEAM (Science, Technology, Engineering, Arts, and Mathematics) curricula. With this preferred liberal future in view, advanced manufacturing companies can begin to work towards the reconciliation between the instrumentally and intrinsically valuable in employee development.

A liberal approach to employee development

As argued by Bell (2002), the desirability of alternative futures can only be judged based on ‘some set of values that can be used as a standard of judgment’. The theoretical position of liberalism and its view of education is used in this paper to provide a critical analysis of a probable neoliberal future and to envision a preferred future of employee development in advanced manufacturing companies in the emerging 4IR. The following section seeks to provide a general account of some of the main features of liberal education, on which the critique of a probable neoliberal future as well as the presentation of a preferred liberal future will subsequently draw.

Liberal education is strongly associated with the concepts of freedom, equality, and justice (Bridges 1997; Guttmann 2002), places emphasis on the notion of autonomy – which can be understood in interpersonal as well as intrapersonal terms (Hedge and MacKenzie 2016) – to expand the critical-creative thinking capacity of individuals. It highlights the need for education to focus on its intrinsic purposes – regardless of if non-instrumental purposes might bring about other instrumental benefits – and, promotes breadth in terms of ideas, disciplinary traditions, and types of knowledge (Peters 2003; Robeyns 2006; Nussbaum 2010b).

Liberal education argues that individuals should be encouraged to identify, choose, and pursue their own objectives for their development (Bauman 2003). In other words, they should be seen as ends in themselves instead of as a means to instrumental ends (Bessant 2014). Freedom and choice, in the sense that individuals have the ability to make autonomous choices between viable alternatives based on what they have a reason to treasure, are moral imperatives and necessary conditions in order for individuals to achieve well-being within a just organisation and society (Bessant 2014). As a result, individual development should be of intrinsic value, and should, therefore, not be driven by economic productivity alone, although it might indeed support its growth (Nussbaum 2010a; Cockerill 2014).

A liberal approach to employee development curricula would argue for a reconciliation between the STEM disciplines and the social sciences, humanities and arts, which could be particularly beneficial if the aim of the curricula in question is to develop – through ethical enquiry, reflective practice, and meaningful dialogue – complete individuals who are capable of thinking autonomously, critically, and reflectively; shaping ethical judgements; understanding

the significance of other people's needs and desires; acting passionately and creatively about novel and complex global issues; and, developing the intellect for lifelong learning (Zinser 2002). Nevertheless, the social sciences, humanities and arts, which form part of a broad liberal arts education, are currently being downgraded in favour of highly specialised and narrowly focused STEM curricula that are believed to generate fast profit-making strategies (Nussbaum 2010b). The humanistic aspect of science – the imaginative and critico-creative elements of it – is losing ground due to an overemphasis on highly specialised technical skills that are believed to help organisations and nations pursue short-term profit (Nussbaum 2010b). However, as argued by Nussbaum (2010b, 7–8), STEM disciplines:

When practiced at their best ... [they] are infused by what we might call the spirit of the humanities: by searching critical thought, daring imagination, empathetic understanding of human experiences of many different kinds, and understanding of the complexity of the world we live in ... Science, rightly pursued, is a friend of the humanities rather than their enemy.

Nonetheless, the currently dominant neoliberal discourse of employee development, which focuses solely on highly specialised STEM curricula, ignores the fact that even economic interests require us to draw on the social sciences, humanities and arts to establish a culture of innovation and to allow organisations to grow. Thus, as highlighted by Nussbaum (2010b), we are not forced to choose between education for economic growth and education for individual flourishing. This is because the skills that are required for human flourishing are also the skills that support economic growth, such as critical and independent thinking, imagination, and collaboration. Moreover, skills exist in and are developed through the structure of social relations. Thus, they cannot be abstracted from the cultural context of their acquisition and transmission (Bernstein 1975). Most importantly, emphasis should be placed on recognition that a flourishing economy is a means to human ends, and not the ultimate end (Nussbaum 2010b). Hence, we should aim at the reconciliation between the intrinsically and instrumentally valuable in employee development.

A probable neoliberal future

As highlighted by Serra del Pino (2002, 83), 'any studies of futures are inextricably linked with the past'. The following section aims to explore and critique a probable future of employee development in advanced manufacturing companies in the emerging 4IR, which is likely to continue being shaped by the neoliberal paradigm. More specifically, this section seeks to challenge the underlying neoliberal assumptions and dominant narratives about employee development by interrogating the ways in which employees' learning needs are likely to be identified in the middle-range future (five to ten years from now),

and problematising the focus of employee development curricula that are likely to be designed to help employees respond to the perceived demands of the 4IR. The critique of this probable neoliberal future of employee development draws on four features of liberal education, namely breadth, non-instrumental purpose, autonomy, and equality.

'One-size-fits-all' competence management frameworks

The development of 'one-size-fits-all' competence management frameworks for the identification of the employees' learning needs is likely to continue being promoted within advanced manufacturing companies. Within this probable neoliberal future, employees are likely to continue being viewed as a cluster of competences, meaning that specific competences will be identified based on the employees' current and future job role within the organisation (Deloitte 2015). The starting point of the competence management process is likely to be a competence gap assessment, which will involve the deconstruction of jobs into component tasks; the evaluation of which tasks could be best performed by humans, computers and robots, or a hybrid approach; and, the definition of the required competences for the performance of the identified component tasks that are believed to be best performed by humans. More specifically, the competence gap assessment will seek to determine the gap between the employees' current competence level and the expected level based on predetermined future career paths that will be designed to help the organisation respond to the perceived demands of the 4IR.

Furthermore, the digitalisation and automation of competence management frameworks is likely to involve the creation of a list of 'profiles' based on the employees' current and future job role, which will be linked to predefined groups of competences that the employees are expected to acquire or develop to a predetermined level within a specific timeframe to perform effectively at their current and future role within the organisation. Digitised and automated competence management frameworks, which will be developed with the use of artificial intelligence and big data, are likely to be used by advanced manufacturing companies to generate standardised career development plans for large groups of employees, which will be designed to act as automated career counsellors that will aim to narrow the gap between the employees' current level and the competence level required to maximise their performance (Kohl and Swartz 2019).

This approach is likely to be embraced by advanced manufacturing companies to quantify and, subsequently, measure the return on investment of employee development programmes. In other words, employee development is likely to continue being viewed in exclusively instrumental terms, meaning that the guiding principle of employee development will be its perceived return on investment. More specifically, the previously described competence

management frameworks, which are likely to be influenced by the instrumental rationality of the neoliberal discourse and its associated ideology of obsessive measurement as a means for assessing the merits of employee development, are expected to praise knowledge and skills as long as these are believed to generate market advantage (Garrick 1998). This type of narrowly conceived frameworks is unlikely to account for social competences that exist in the relations among employees, such as self-confidence, interpersonal sensitivity, and communication skills, which although they are hard to capture and quantify, they could considerably affect an employee's overall performance (Brown, Lauder, and Cheung 2020). That said, as Brown, Lauder, and Cheung (2020) suggest, the notion of 'competence' should be expanded to encompass both the employee's mind and character. Therefore, an employee's perceived competence should also include their 'social capacity for learning, innovation and productivity' which are predicated on social relations (Brown 1999, 237). This is because employees who are required to work collaboratively towards a common objective, cannot perform effectively by exclusively applying their individual competences. In other words, employees are not skilled in the abstract, but within the context that defines them as skilled (Brown, Lauder, and Cheung 2020)

Moreover, this type of competence management frameworks run the risk of focusing solely on the learning outcomes and disregarding the most important variable in the learning process, which is the learner and their interests, values, abilities, and goals (Baines 2015). Therefore, this process is likely to ignore the heterogeneity and incommensurability of goals and values of the employees, who will not be able to make autonomous choices between viable alternatives based on what they have a reason to treasure for their development. As highlighted by Brown, Lauder, and Cheung (2020, 103), 'what is required to make people immediately employable is not the same as what is required for people to lead fulfilling and productive lives'. Consequently, this approach is likely to limit the employees' freedom to pursue heterogenous and pluralistic development paths, which they are more likely to find intrinsically meaningful and rewarding.

The assumption that automated competence management frameworks could produce optimal results in the assessment of the employees' competences by eliminating the occurrence of human errors and biases, should be contested. This is because if the data that has been selected to be fed into the system is not objective, the outcomes of the automated algorithms are unlikely to be objective (Cappelli, Tambe, and Yakubovich 2020). Hence, issues related to the reliability and validity of these systems as well as issues related to employee equality, fairness, and procedural and distributive justice are raised. For instance, a question that needs to be raised is whether these uniform competence management frameworks could support to the same extent the development of both young employees, who might have recently earned an

engineering degree and been trained using the latest technologies, and mature employees, who might have not had the opportunity to engage with the technologies that surround the 4IR (Chuang and Graham 2020). Additionally, this approach is likely to ignore the hidden impediments to the development of women within advanced manufacturing companies. Salient factors of comparison, which require a nuanced understanding of women's development based on a careful consideration of their particular histories and contexts, as well as a general familiarity with the women's personal and socio-environmental impediments to development, are likely to be neglected (Nussbaum 2009). This is because this neoliberal approach fails to make a distinction between the notion of 'capability', meaning what an individual is able to do and to be, and the notion of 'functioning', meaning what an individual actually does (Nussbaum 2000). On the other hand, the capabilities approach understands that 'internal capabilities' require the application of several 'conversion factors' (Sen 1992, 100), meaning an enabling social and organisational environment, to be converted into 'combined capabilities', which could allow the exercise of the desired 'function' (Nussbaum 2000, 84–5). This might not only have serious consequences for women who are likely to face increased difficulties in leveraging their abilities, but it might also jeopardise the innovative capacity of manufacturing companies, which is positively correlated with increased gender diversity (World Economic Forum 2016). Thus, employee development based on uniform competence management frameworks and standardised curricula is unlikely to help women flourish in the workplace.

Highly specialised STEM Curricula

Advanced manufacturing companies are currently urged to act to address the STEM competence gap, which, according to the Deloitte's report (2015, 14), is 'becoming an increasingly troublesome trend'. The probable future of employee development within advanced manufacturing companies is likely to reflect the design of highly specialised and solely focused on STEM curricula based on the results of uniform competence management frameworks. The main aim of these curricula will be to help employees influence product design changes, increase production efficiency, and operate effectively within advanced manufacturing plants. This type of curricula, which will lack appreciation of the humanity of science, is likely to abstract science and technology from wider social contexts, and to narrowly delimit STEM learning to the acquisition of decontextualised technical competences and compartmentalised disciplinary knowledge, resulting in disconnected and ephemeral learning (Krug and Shaw 2016; Yanez et al. 2019).

Broad educational aims are likely to be deconstructed into sets of tasks and clusters of related competences. The conversion of broad educational aims to clustered learning objectives with associated assessments is likely to be the

basis of competence-based curricula exclusively focused on STEM. This process will allow advanced manufacturing companies to use standardised tests to assess the level to which the predefined learning outcomes have been met (Spector 2015). This is one of the reasons why a broad liberal arts curriculum, which promotes the development of the learners' autonomy, critical and independent thinking, creativity, and imagination, that cannot be simply quantified and assessed, would be unlikely to serve the needs of competency-based models (Spector 2015).

Despite their limitations, highly specialised competence-based curricula exclusively focused on STEM are likely to be adopted by advanced manufacturing companies due to their alleged 'ability to create and sustain globally competitive economies' (Spector 2015, 4). Within this neoliberal narrative of global competition, highly specialised STEM curricula driven by instrumental and techno-capitalistic interests, are likely to continue being promoted as a panacea that can address the very deficits and crises neoliberalism reproduces (Yanez et al. 2019). Consequently, employees are likely to be treated as 'a physical and mental embodiment of the market' (Gillies 2011, 215), and their competences to be commodified based on their perceived future exchange-value (Weinstein, Blades, and Gleason 2016).

However, exclusive focus on the STEM disciplines would compromise the breadth and diversity necessary to navigate within a complex manufacturing environment probably resulting in a decrease of scientific productivity and innovation. Consequently, this type of narrow and hyper-focused on STEM curricula, which disregards the broader connections of science to other disciplines, such as the social sciences, humanities and arts, runs the risk of limiting the employees' potential career paths, who are likely to experience the downsides of extreme specialisation in the long run (Imad 2019). This approach, which compromises the employees' freedom to be actively involved in the process of critical enquiry and meaning making as well as engaging in a learning process in which their own interests and goals are valued, is likely to alienate employees from the intrinsic pleasure of learning, and paralyse their critical and creative thinking capacity as they are procedurally inducted into neoliberal STEM narratives, epistemologies, and values (Yanez et al. 2019). In other words, as highlighted by Imad (2019) 'science education must support the development of the whole person rather than just "the scientist within" if we are to prepare informed, reflective, and collaborative thinkers'.

A preferred liberal future

Following the critique of a probable neoliberal future of employee development, the present section, which is dedicated to the exploration of a preferred liberal future drawing on the work of Martha Nussbaum, who attempts to accommodate both liberal themes and instrumental needs, intends to move

away from detrimental, unexamined, and taken-for-granted conceptions of probable futures to create the possibility for an alternative future guided by a more holistic conception of employee development through the establishment of learner-centred, liberal – and liberating – interdisciplinary STEAM (Science, Technology, Engineering, Arts, and Mathematics) curricula.

Individual learning and development paths

The 4IR requires employees to develop their critical and independent thinking as well as their creativity, which can only be enhanced when individuals are autonomous. Therefore, employees should be perceived as rational and autonomous individuals, who are capable of engaging in critical reflection about the planning of their own development (Weinstein 2020). Hence, in the process of identifying the employees' learning needs, emphasis should be placed on the heterogeneity and incommensurability of their goals and values. This liberal approach argues against a view of employee development as a preparation for a particular kind of job driven by exclusively instrumental purposes as well as the consideration of income or economic growth as the ultimate means to individual freedom and well-being (Powell and McGrath 2014). Instead, it encourages the inclusion of a range of ideas, disciplinary traditions, and types of knowledge, and argues that development cannot be equated to economic growth. Thus, employee development should take account of the irreducible plurality and neutrality of life goals and values, which do not allow for the establishment of an interpersonally justifiable ranking of the latter (Okin 2003; Robeyns 2005; Bessant 2014; Gaus and Courtland 2018).

This is not to deny that improvements in economic growth and technological advancements could prove to be important for human flourishing. However, they should be appraised in terms of their contribution to the enrichment of human lives instead of being seen as the ultimate ends (Robeyns 2005; Nussbaum 2010b). Therefore, employees should be encouraged to cultivate their individuality, which can only be enhanced if they are free from organisational constraints when they make decisions about their own development paths. Moreover, allowing employees to 'be themselves' and develop in their own unique ways is more likely to help organisations improve their innovative capacity (Bauman 2003). Leading corporate executives around the globe understand that critical voices are necessary if the aim is to build an organisational culture characterised by both individuality (uniqueness) and accountability. On the contrary, 'a culture of yes-people, where authority and peer pressure ruled the roost and critical ideas were never articulated' would compromise the organisation's innovative capacity (Nussbaum 2010b, 53). In conclusion, allowing employees to choose their own development paths can keep an organisational culture dynamic by offering depth and breadth of vision and helping

employees cultivate their critical and creative thinking (Nussbaum 2010b), which are necessary in order for advanced manufacturing companies to succeed in the emerging 4IR.

Interdisciplinary STEAM Curricula

Liberal arts are currently faced with the mandate to justify their existence within a neoliberal discourse that privileges highly specialised curricula solely focused on STEM due to their perceived scientific rigour and practical application as well as their presumed potential to contribute to economic growth (Lewis 2015). Such assumptions are rather simplistic and do not accurately represent the rigour associated with the all-encompassing liberal arts curricula (Marmon 2015). On the contrary, a liberal arts education is likely to become increasingly salient in the twenty-first century and the emerging 4IR because the innovation economy requires more than ever that employees develop the cognitive flexibility and the habits of mind that allow for lifelong learning (Lewis 2018; Gobble 2019).

Within the context of globalisation that results in greater global interconnection, rapid technological advancements, and large-scale problems, a STEAM curriculum, which overcomes the false dichotomy between the STEM disciplines and the social sciences, humanities and arts, can help employees address issues that require sophisticated problem-solving skills and innovative thinking (Madden et al. 2013; Lansiquot 2016). This is because, while a mind educated in a single discipline could be overwhelmed by a complex phenomenon that requires the individual to look at it from different angles, a mind educated in multiple disciplines is more likely to draw on a diverse body of knowledge to understand the phenomenon in question (Gogus 2015).

It is important to note that the 'A' in the acronym STEAM does not represent a fifth discipline. Instead, it suggests the synergistic integration of the social sciences, humanities and arts into STEM education with the intention to offer a more holistic and interdisciplinary approach to employee development (Spector 2015). In other words, what is proposed here is a more humanistic form of engineering education that blends STEM disciplines, such as electrical and manufacturing engineering, with liberal arts, such as literature, arts, psychology and so on (Penprase 2020). As highlighted by Vanderlick (2011, 1):

Engineering is the bridge between the sciences and humanities. Simply put, engineers apply scientific principles to advance the human condition. Their success relies as much upon an understanding of physics and math as an appreciation of history and psychology.

Furthermore, Washington's National Research Council (2011) estimated that half of an engineer's working time is spent on reading and writing. This is because scientific theories must be articulated accurately and coherently so

that they can be tested and modified. Thus, language arts, such as reading, writing, and speaking, are crucial as they provide the foundation upon which STEM knowledge is created (Baines 2015).

Moreover, as argued by Lewis (2018), in the context of the 4IR, humanity is likely to reach 'new moral and ethical boundaries of what it means to be human'. As a result, the assumption that technology and the associated science that brings technology to life are value-neutral, objective, and impartial, is left unsupported (Yanez et al. 2019). The exclusion of learning related to ethics from narrowly designed STEM curricula could have serious consequences for employees both personally and professionally. The study of ethics, which is predominantly included in the disciplines of philosophy and sociology, is especially salient in the emerging 4IR, which is accompanied by a massive explosion of information that entails dangers related to intellectual property and data privacy (Spector 2015). Hence, the integration of ethics into STEM curricula could prove to be particularly beneficial. It could help employees to cultivate the moral virtues and develop the practical wisdom (phronesis), which would allow them to make wise judgements in novel moral circumstances and resolve ethical dilemmas, such as 'How can I relate to this technology in a way that helps me become the sort of human being I would like to be?' (Vallor 2015, 116).

Additionally, according to Gary (2016), who has published in the World Economic Forum a list of the ten competences that organisations would need in 2020 to thrive in the emerging 4IR, creativity holds the third place preceded by critical thinking in the second place and complex problem solving in the first. Technologies strongly associated with the 4IR, such as augmented reality and 3D printing, are inextricably linked with the notion of creativity (Marmon 2019). STEAM curricula can enhance the employees' creativity, which is a necessary component of innovation, through the cultivation of their divergent thinking, which refers to their ability to experiment, recognise links among non-apparent associations, make unexpected combinations, move beyond the ordinary, look at a problem from different angles, actively seek out new alternatives to produce multiple answers or solutions to a given question or problem, and create narratives about the value of these answers or solutions to logically analyse their strengths and weaknesses (Nussbaum 2010b; Madden et al. 2013; Barabasch 2018; Gobble 2019). These abilities can be developed through a liberal arts curriculum that draws on a wide array of disciplines and types of knowledge, which support the production of new ideas resulting in enhanced creativity (Gogus 2015).

In the same vein, the arts, which are central to the development of the individual's whole personality (Nussbaum 2010b), can act as a stimulus for creativity development and help organisations engage their employees intellectually, emotionally, and physically (Schiuma 2017). For instance, learning activities that seek to enhance the aesthetic and design skills of employees working for advanced manufacturing companies could involve the study of a

combination of artefacts and electronics (Marmon 2015). It is important to note that 'art', which is often narrowly conceived in the form of fine or performing arts, is a necessary component of the design of any physical, immaterial, and virtual product, not only from an aesthetic or intrinsic perspective – in the sense that the arts express and define humanity – but also from an instrumental perspective, in the sense that the arts can enhance an organisation's creative capacity resulting in increased innovation (Schiuma 2017; Barabasch 2018). Finally, as argued by Kobayashi (2019), even STEM disciplines, such as mathematics, should be regarded as forms of art in the sense that they 'deal with ideas composed of deeper abstractions'. Therefore, the inclusion of the social sciences, humanities and arts in STEM curricula could provide employees with the design skills necessary to create innovative products that are technologically, economically, and ethically sound (Penprase 2020).

In conclusion, the synergistic integration of the social sciences, humanities and arts into STEM curricula could bridge the inquiry, creativity, and innovation, which can be found in both art and science resulting in a well-rounded curriculum that might be beneficial for the employees as well as the organisation as a whole. More specifically, a liberal arts curriculum that incorporates multiple disciplines and ways of knowing as well as in-depth study in the employees' specific area of interest for professional development could provide both disciplinary breadth and depth (Gogus 2015). This type of interdisciplinary STEAM curricula could have twofold benefits. Firstly, the embracement of well-rounded and learner-centred development programmes – characterised by breadth, depth, and pluralism – that aim at the overall flourishing of the employee could enhance their motivation and feeling of personal fulfilment. Secondly, the organisation could use these interdisciplinary skills for dynamic problem-solving, which is considered to be the *raison d'être* of the engineering profession (Temes and Solymar 2015; Lewis 2018; Imad 2019). Additionally, this holistic approach to employee development could cultivate individuals who would be able to conceptualise in multiple levels of abstraction and synthesise information across multiple disciplines (Madden et al. 2013). Therefore, employee development curricula should not be an 'either/or' question between STEM and liberal arts, but a combination of STEM and liberal arts.

Conclusions

As argued by Inayatullah (2013) 'how one sees the world actually shapes the future one sees'. This paper attempted to redirect neoliberal thought to avoid some of the pitfalls that it poses, in its current form, for employee development in advanced manufacturing companies in the emerging 4IR. More specifically, this paper attempted to focus on the arena of the possible and the preferred, rather than the predetermined (Dator 2002), and to create the possibility for an alternative future guided by a more holistic conception of employee

development through the development of learner-centred, liberal – and liberating – interdisciplinary STEAM curricula. As previously highlighted, the creation of interdisciplinary STEAM curricula, which overcome the false dichotomy between the STEM disciplines and the social sciences, humanities and arts, and aim at the development of the employees' autonomy, critical and independent thinking, ethical judgment, ability to learn, imagination, and creativity, could also help advanced manufacturing companies respond to the perceived demands of the 4IR, such as innovation, complex problem-solving, flexibility, and lifelong learning.

Finally, despite the currently dominant neoliberal assumption, which is rather simplistic and often unsupported, that liberal arts education could only contribute to a limited extent to the enablement of the 4IR and the enhancement of the economic competitiveness of advanced manufacturing companies, as it has been argued in this paper, we should not be forced to choose between employee development for economic growth and development for individual flourishing. This paper does not suggest the omission of extrinsic purposes of employee development, instead, drawing on liberal themes, it argues for the reconciliation between the intrinsically and instrumentally valuable in employee development. Furthermore, this paper does not ignore the challenges that the implementation of the proposed liberal future would entail. It is clear that this would not be a straightforward or easy to implement project. Scholars have already raised concerns about the operationalisation of the capabilities approach in social evaluations, including time and cost considerations (Powell and McGrath 2014). However, as highlighted by Green (1997, 186) 'education cannot ignore the realities of the global market, but nor can it surrender to global commodification'. An exclusively economic view of employee development would be too narrow to produce a comprehensive understanding of the role that employee development can play in well-being enhancement as well as unemployment and inequality reduction (Powell and McGrath 2014). Therefore, emphasis should be placed on the fact that a flourishing economy is a means to human ends, and not the ultimate end.

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