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The ethics deficit in OSH monitoring technologies

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Abstract:	Wearable and implantable technologies that enhance human capacity have opened up new opportunities to go beyond the replacement of lost capabilities to the provision of capacities to predict and potentially influence individual behaviour. Technologies, currently present on construction sites, either monitor location and transmit safety, health and wellbeing information to a central point or gather bio-information on workers that can be read and interpreted to determine the physical and psychological stress states and ostensibly predict what may happen to the worker or how they may behave next; improving efficiencies. However, what appears absent is a sufficient exploration of the ethics underpinning the research and the morality in the application of these technologies in the industry, which may go well beyond the intent of the originators of the technology. Research into wearable and implantable technologies must take into consideration the broader impacts of the societal application of the work in the context of respect and equal consideration. This paper discusses how an international exercise, carried out to determine the extent to which researchers and contracting companies have examined the ethical and moral implications of the use of these technologies, discovered deficits in considering the impacts on worker competence, agency and reciprocity.
Additional Information:	
Question	**Response**
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KUDOS alt="Kudos Logo">	New technologies have impacts on society, and are often designed to have particular impacts. They also have unintended impacts, that is unintended by the researchers and developers. However once the technology has been developed and goes to market there are new and different applications that others can use the technology for, as indeed there may be longer term impacts unforeseen by either the developer or

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THE ETHICS DEFICIT IN OSH MONITORING TECHNOLOGIES

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Abstract

Wearable and implantable technologies that enhance human capacity have opened up new opportunities to go beyond the replacement of lost capabilities to the provision of capacities to predict and potentially influence individual behaviour. Technologies, currently present on construction sites, either monitor location and transmit safety, health and wellbeing information to a central point or gather bio-information on workers that can be read and interpreted to determine the physical and psychological stress states and ostensibly predict what may happen to the worker or how they may behave next; improving efficiencies. However, what appears absent is a sufficient exploration of the ethics underpinning the research and the morality in the application of these technologies in the industry, which may go well beyond the intent of the originators of the technology.

Research into wearable and implantable technologies must take into consideration the broader impacts of the societal application of the work in the context of respect and equal consideration. This paper discusses how an international exercise, carried out to determine the extent to which researchers and contracting companies have examined the ethical and moral implications of the use of these technologies, discovered deficits in considering the impacts on worker competence, agency and reciprocity.

Keywords: OSH Monitoring, Ethics, Privacy.

1. Introduction

This paper emerges from the recent developments of personal monitoring technologies on construction sites. In their general nature such technologies have evolved to the point of individual wearable (Parramore 2015, Andolpho and Sadeghpour 2015) and insertable technologies, (Heffernan 2017, Heffernan et al. 2018), including the use of RFID implants (Metz 2018, Bas-Wohlwert 2018). The science and technology behind such developments is well

understood and with appropriate testing can be implemented with a high degree of technological efficiency. What is missing from these developments, and where the literature review below illustrates, is a sound evaluation of the ethical and moral rationale for pursuing this course of action and the reasoning underpinning the justifications for its use, as well as an examination of the consequences, intended and unintended, of its use. It is however recognised that the researchers who authored many of the papers reviewed set out to detail their technological innovations and the specific use of them to improve health and safety and did not aim to explore the ethical and moral consequences, intended and unintended, of those technologies in use. It is nonetheless contended that there is an obligation on scientists to conduct such an evaluation on their work, (British Society for Social Responsibility in Science (BSSRS), 1975) as there is potential for an indirect but connected moral responsibility for the outputs of their inventions in use, (Floridi 2016).

Following the literature review is a critical discussion on those ethics and moral behaviours. In this section, without embarking on a major discussion on moral philosophy, it is nevertheless appropriate to establish the fundamentals of ethical and moral behaviour in order to place the application of monitoring technologies into a moral context. Ethics and moral behaviour are concerned with benefiting others, in particular and universally, and with improving the world within which each and all of us participates. At the least it involves not harming that world. There is an essential reciprocity to ethical thought and moral behaviour that is found universally in the Golden Rule of ethics to do to others what you would have them do to you (and its negative; do not do to others that which you would not have them do to you). This is a philosophically simplistic rule, but in respect of worker monitoring and surveillance it is appropriate to address the issue of reciprocity in the context of asking who monitors who, and why? This reciprocity is a foundation of the universality of moral behaviour, i.e., for a particular action to be considered morally good, it must be an action that can be capable of universal applicability in broadly similar circumstances. Thus, the behaviour of an agent acting in a particular way who does not accept reciprocity of the behaviour or holds that they are an exception and not subject to that action is behaviour that is morally questionable. This paper asks whether the ethics and moral content of the monitoring technologies in use or in their development from the perspective of

- the capacity of all parties to exercise autonomy in decision making and action;

- the reciprocal nature of the application and the technologies and the information garnered by them, and
- the degree of universality to which the nature of the application can be made

have been considered.

For the purposes of this paper, two forms of monitoring technologies are considered, wearable; i.e., devices that are worn by workers such as badges, RFIDs in hard hats, wristbands, biomechanics monitoring jackets, etc., and insertables; i.e., devices that can be inserted into the body such as RFIDs and bio-monitors. Integrated with these are sensor devices, RFID readers, ICT use monitors, video recording, etc.

2. The Intent Behind the Technology

It is virtually impossible to get to the original intent behind the Artificial Intelligence (AI)[1] technology invention, (other than as a means of extending human capacity to calculate and process data), since in the iterative design process the notion of what the technology can do and must do is evolutionary, often transcending the originators initial creative musings that drove the design process forward. Pick up any marketing or sales brochure and that will be the key 'takeaway', suggesting that the marketer exerts undue influence over the product in an effort to corner markets and maximise profitability. Those who take the invention and mould it into a product, which meets their needs see uses that fail to align with the original thoughts of the developer, (Solon 2017, Interguard 2018, Veriato 2018). As the product develops the benefits to the user, to wider society are sold to the buyer based more upon marketing viewpoints than on personal ideal, viewpoints that align with and service the "command and control" worldview of many employers and corporations.

Take for example, IBM's Watson 'intelligent computer system'. When, in 2011 it came to the public attention as the computer that won 'Jeopardy', a US based televised quiz show, what it was doing was some serious data mining. Watson uses a combination of natural language processing, hypothesis generation and evaluation and evidence-based learning, which in

[1] The term Artificial Intelligence is used here uncritically as it is not the subject of the research. Its use does not imply that the authors are in fact uncritical of it as a term or a descriptor of advanced computing capability.

combination and with frequent usage appears to get smarter when in reality it has the ability to store additional data extracted while processing for use in future iterations, hence appearing to get ‘smarter’. So-called artificial intelligence suggests an ability for computers to simulate human intelligence however, this high-speed manipulation of human derived data is not transferring cognitive task analysis from human to machine; that function remains within the purview of the human. When the Texas MD Anderson Cancer Center developed ‘Watson’ as its oncology expert advisor (Doyle-Lindrud 2015) it was loaded up with “millions of pages of medical literature and practice guidelines”, for which it has an ability to find the answer to complex questions with speed and accuracy and increasing confidence. Although the clinical experts [human] update Watson with latest clinical data and review diagnoses, it is easy to conflate the ultrahigh-speed logic processing power of computing with the thinking process of humans - but they are distinctly different. From a moral perspective it is conceivable that administrators could choose to ignore this central tenet and opt to see Watson as a means of reducing the number of oncologists on staff? The case for developing safeguards against such a scenario is highlighted just by the recent example where Watson recommended unsafe and incorrect cancer treatments, (Ross and Swetlitz 2018). Whilst it is argued that this problem was as a result of inadequate “training” of the system it nevertheless remains the case that human expertise is necessary for training and updating the inputs and ultimately for interpreting the outputs. Big data is capable of producing big error (Taleb 2013) and with more variables in a system the greater the number of spurious correlations that are possible and capable of rising to the surface.

Ambient intelligence (AmI), coined by Emile Aarts of Philips and adopted by the European Commission, though similar to AI is where myriad intelligent systems create an ‘enriched environment’; one that informs and directs the behaviours of its occupants (Augusto 2007). Even the pervasive and seemingly innocuous targeted social media advertisements treat people as ‘bundles of desire’ (Singer 2001, cited in Friedewald et al. 2006), “…diminishing people’s capacities of reasoned choice and thoughtful action.” In this respect we need only take cognisance of the use to which this type of technology was put in the 2016 United States of America (USA) elections, micro-targeting voters and providing them with “personalised” information designed to direct their voting choice in a particular direction. As smart homes

become a reality, much as HAL in the film '2001: A Space Odyssey' controlled and interacted with the occupants, there is evidence that personal control of who we are as individuals and how we behave is being surveilled and manipulated as personal data is gathered via a "staggering level of corporate surveillance" through the growing range of seemingly innocuous and beneficial domestic technologies, (Hern 2018). Wright (2005) identified the dark side of ambient intelligence positing that "…*the enabling technologies [for personal data storage] can also facilitate monitoring, surveillance, data searches and mining*…". Many research projects, specifically in Europe, USA and Japan, since early 2000s have been focussed on and documenting case studies of appropriate and inappropriate uses of AI and AmI (Wright 2005), although not specifically linked to wearable or insertable technology for OSH purposes. Privacy Rights Advocates (PRC 2003) published a position statement calling on the restriction in the use of or extended distribution of RFID technology without an internationally agreed code of use; identifying both the necessary privacy restriction and the acceptable uses of the technology. However, Heffernan (2017) counters this as a myth arguing that RFID technology is limited in power and not able to collect data. This however ignores the fact that RFID technologies are currently in limited use, voluntarily, whereby employees can access buildings, log-on to computers or purchase items from vending machines via inserted RFIDs, (Metz 2018), or where some citizens in Sweden use inserted microchips to replace keys, credit cards and even rail tickets, (Bas-Wohlert 2018). Though not collecting data, these chips and RFIDs contain data which is readable and the reading devices relay that information to information stored on databases that update accordingly. On the other hand, wearable technologies that contain their own power sources are capable of collecting bio-data and transmitting it via wifi and bluetooth to computers, watches and fitness training equipment.

To date though, the concerns of bodies such as PRC that these technologies could be used to track and monitor workers in ways that infringe upon privacy and agency, is not being realised. The assumption is that artificial and ambient intelligence have been developed as technologies for good. The benefits serve to make our world safer, our lives easier and our free time more fluid, whether it is our workplaces anticipating our needs and delivering the controls to assure our safety, health and wellbeing, even before we are aware of the dangers, or our homes welcoming us safely back at the end of the day and connecting us via televisions, smart-hubs

and other devices to the internet and the world outside. However, it is important that the negative potentialities of the technologies are examined at the research stages and options for mitigating them developed, whether technologically, legislatively or simply through the rejection of the innovation as more likely to be harmful than beneficial. This requires that innovators are not simply clear on their own motives for developing these technologies, but that they are aware that the motivations of others who have control of the technology during or after development may be different. This review is not suggesting that developers do so with ill intent or that all those who bring the product to market do so with the intent of seeking or selling the means to maintain and strengthen control over an increasingly demoralised workforce, but there is evidence in some of the marketing materials examined that the potential for this is being realised. The marketing materials for one product, (Veriato 2018), argues that it has the capacity to detect and block unwanted employee behaviour, identify behaviour anomalies, track all employee activity and optimise procedures and productivity by a company. Similarly another, (Solon 2017), will photograph workers every ten minutes and track face-to-face encounters between workers, and for similar purposes, i.e., achieving a compliant workforce.

AI, discussed in 1956 by John McCarthy of Stanford University as the notion of machines emulating human thinking predates what was considered by Bush in 1945 and Turing in 1950. A long history of contemplating its 'societal value', Bush and Turin both held to the notion that machines could be programmed thus and while the idea has merit the crucial questions has to be; what function does AI have that Man cannot perform equally well and why are machines necessary to simulate particular human activities? At the heart of these questions lies the assertion that just because a machine can does not necessarily mean that a machine must.

Moreover, and perhaps more importantly do we fully understand the nature of human intelligence? And if we do not, how can we create an artificial version. The field of cognitive science, championed by Chomsky in the 1950s and 60s, challenged the limited behaviourist approach taken by psychologists of the day who's, rather simplistic paradigm; stimulus followed by predictable response, needed to give way to the complexity of the internal machinations of the human brain as it performs the simplest of tasks or decisions (Chomsky 1967). Cruickshank and Trivedi (2017), argue that technological innovations are giving non-human actors decision-making abilities that will profoundly disrupt the design process and consequently wider society,

exploring how the fundamental design assumptions need to be reassessed to address this evolving new materialism.

3. Identifying the ethics deficit

A review of the literature on monitoring technologies was conducted specifically to determine whether the research identified and addressed the wider consequences of the uses to which the technologies could be put above and beyond their intended use. The review did not and was not intended to evaluate the suitability and efficacy of the technologies in their intended purposes, but primarily to ascertain whether the researchers, journalists and manufacturers adopted a consequentialist perspective and addressed the potential for abuse or negative outcomes of these technologies. To this end N=82 papers, articles and marketing materials were reviewed. The majority of the technologies developed were in respect of improving OSH in the construction industry and covered both wearable and insertable technologies and remote sensoring. Three research papers dealt with ethics as applied to technology in general and were included in the review as illustrative of the fact that the questions can be asked and addressed.

Ten reports were included in the review, illustrating that overarching bodies such as the European Union (EU) have broader and long-term obligations in understanding where technologies could and should go. Eight items of marketing literature, primarily online promotional materials, were examined. These related to monitoring office-based work-forces and promoted video, audio and ICT monitoring of workers. Though not related to construction OSH, the value lay in how the marketing of monitoring technologies could be tailored to employers' need for command and control of their workforce and for enforcing compliance with company rules.

The review considered the papers from the perspective of their authors consideration of their ethical and moral impact on individuals and society, including what potential for harm exists when the technologies are introduced, and whether the good intended by the developers and manufacturers sat within the milieu of universal ethical thought and good moral behaviour. The findings centred on the degree to which these issues were considered or discussed in each work, (see Table 1 for explanation of categories).

Not discussed	The issue was not raised
Touched upon	The issue was briefly mentioned/identified, but no discussion
Discussed	The issues were recognised and were discussed briefly
Discussed substantially	The issues were explored in a broad context of societal effects
Discussed in depth	The issues were contextualised within ethics and moral philosophy

Table 1: Explanation of selection categories

Of the 82 documents reviewed, 48 did not touch upon the ethical or moral implications of the technology, of which 29 were research papers. A further 14, of which 6 were research papers, touched upon the matter briefly, (Table 2).

Of the research papers, 6 discussed the matter of ethics of which 5 dealt with the subject substantially or in depth. These particular papers approached the subject primarily from an ethics perspective, focussing on the technology in general rather than specific innovations or products.

Five of 8 documents of research informed opinion touched upon or briefly discussed the moral implications. Of the 12 journalistic articles, 4 discussed the matter, though briefly.

Of the 10 reports reviewed, 3 from the SWAMI consortium of the European Commission and 2 published in the National Academy of Sciences health with the matter in a substantial manner.

Type of paper/article	Monitoring Technology	No. articles	Discussed in depth	Discussed substantially	Discussed	Touched upon	Not discussed
Journalism	Wearable, insertables, desk-top (ICT)	12	-	-	4	2	6
Reports	Wearable, insertables, desk-top (ICT)	10	-	1	4	4	1
Research papers (Journals & conferences)	Wearable, insertables, desk-top (ICT) & UAV (drones)	41	3	2	1	6	29

Type of paper/article	Monitoring Technology	No. articles	Discussed in depth	Discussed substantially	Discussed	Touched upon	Not discussed
Marketing Literature	Desk-top (ICT) and Other, such as breathalysers and touch-based sensors	8	-	-	-	-	8
Opinions	Desk-top (ICT) and Other, such as Artificial Intelligence in general	8	-	3	-	2	3
Other	Insertables & Desk-top (ICT)	3	-	2	-	-	1
	Total	82	3	8	9	14	48

Table 1: Content Analysis: Ethics discussed in range of Artificial Intelligence articles published in recent years.

None of the marketing materials dealt with the moral and ethical implications for the use products that they were promoting, and where they mentioned the benefit that the products offered, it was employer related benefits they described, even though the target of the products in use were employees. It is noted however that marketing materials are not generally designed to discuss the ethics associated with the product and an exploration of ethics and morality of marketing is more appropriate as a separate area of work. Nevertheless researchers would need to be aware of how their innovations and inventions are to be marketed once they are market ready.

4. Ethics in OSH monitoring technologies

4.1 Are they beginning from the right thought?

The use of technology to track and monitor worker behaviour, position, and movement inherently assumes that worker behaviour, position, and movement are a problem, or the most important problem, that needs to be “controlled”. Modern occupational safety management is moving away from the traditional focus on the worker as a problem and shifting to views that embrace performance variability. And while fatal incidents from work-related incidents or ill-health are still extremely high globally, at the local level, i.e., on-site, they can be perceived to be a rare event and workers tend to overcome the numerous blunt deficiencies in their workplace, reflecting upon them as resulting from poor design, inadequate planning,

substandard work conditions, tighter scheduling, communication issues, a fragmented construction industry. Exploring the underpinning themes of resilience engineering and complexity in the construction industry, the resilience agenda, for instance, argues for a focus on the study of 'normal work' more appropriate than safety's traditional focus on failures and accidents (Bergström et al, 2015), which have traditionally viewed the worker as the starting point for intervention. For example, Yu et al., (2017) begin their paper with "*Construction workers' unsafe behaviour is one of the main reasons leading to construction accidents."* They then cite Li et al. (2015) who claim that *"Approximately 80% of all accidents on construction sites are caused by unsafe human behaviours"*. This behaviourist mindset assumes there is but one cause for every accident/incident, which goes against modern safety thinking. Worker behaviour is simply the last opportunity. The notion that worker behaviour is the primary and often the sole cause of accidents, implicit in the case for enhanced worker monitoring fails to recognise modern approaches to accident causality.

The use of wearable and insertable technology to monitor and track workers may also have a negative effect on safety management and safety culture. Hovden et al. (2010) provide an example of using cameras to monitor work for decision support in the Norwegian offshore oil and gas sector. They acknowledge that "*monitoring may lead to workers feeling uncomfortable at being evaluated all the time and even result in a sense of mistrust*" (pg. 952). Choi et al. (2017) surveyed building construction workers to assess the determinants for their wearing smart vests which show location and wearable health technologies. The results show that workers' concern about privacy is an obstacle to introducing the smart vest in construction sites. They found that workers could be reluctant to reveal their location because the location information can be used for monitoring their idling time. However, neither study elaborates on the potential negative effects.

In the debate or discussion over the ethics involving OSH monitoring technologies, it appears that there is a fundamental yet arguably vital question which has failed to materialise, and thus been left unanswered; that question is – "do OSH monitoring technologies actually meet the needs and wants of workers?".

Much of the literature, when discussing the "benefits" that the technology may bring to the workplace, generally implies and assumes that such benefits will automatically benefit the

workforce — but is this the case? Indeed, it appears that a major flaw in much of the literature reviewed, is that it fails to initially ask workers what they think is needed to make their workplaces safer. The concept of consultation and discussion with workers, over not just the introduction of monitoring technology, but also the basic questions of what can be done better, to make their job healthier and safer, is missing in much of the literature. This suggests that the literature on the topic may be flawed, in that a key stakeholder has been ignored in a potential rush to both publish the research, develop the product and get it to market. Failing to discuss with workers, their needs and requirements, the premise upon which the introduction of any type of OSH monitoring technologies are founded could potentially be seen to have ulterior motives; financial, commercial or others as is the case with other monitoring technologies, (Solon 2017 and Veriato 2018). If this is the case, such motives may lie in a power base of control and manipulation of a submissive workforce, rather than supporting and listening to a workforce that is trying to meet organisational goals without compromising their own safety, health and wellbeing? Surveillance, if that is what the technology becomes, is a function of power that continually polarises between power enhancement and powerlessness (Foucault cited in Parramore 2015). This is where true consultation and honest and equitable discussion with the workforce, over the introduction of any type of monitoring technology, would appear crucial.

Whilst such a question may well take us off track in terms of reviewing the literature on the ethics involved in monitoring technology, it is perhaps well founded when very little of the literature directly refers to the needs and wants of workers when it comes to the introduction of any type of OSH monitoring technology. Globally, Respect for People is a well established concept and a developing practice in workplaces that emphasises cooperation with and respect for workers through their full participation in the running and improving of their workplaces, (Cardon and Bribiescas, 2015). Consequentially the issue of moral responsibility for the use of technology is has a direct impact on whether this principle is being promoted or negated.

Whilst some authors refer to concepts such as trust and fairness (Westin 1992) they do so in the overall introduction of the technology, rather than being clear about whether the technology was required in the first instance. Kortuem et al. (2007) made a strong case about how “technology models have a strong influence on the linkage between technology and the

organisation…" (p.465), but failed to mention if the workforce actually agreed to any such sensor technology being utilised or introduced in the first place. O'Connor (2016) claimed that wearing safety technology can actually help employees stay safer in dangerous environments by providing "real-time" alerts to both workers and management. However, such a claim would appear to rely on two variables. The first variable is the employment relationship (and the potential power imbalance) at the workplace. In simple terms, will managers or workers actually feel compelled to stop work and therefore halt production due to a 'danger zone' being reached; and/or will a worker feel comfortable and confident enough to stop work based only on the technology - without potential adverse employment ramifications; especially if they get it wrong. There is a potential for a taught helplessness syndrome emerging from this type of technology where workers rely on it to inform them rather than on their own observations and judgement. Conversely if the worker, in the absence of an "alert" relied on direct observation to stop work, how would this be interpreted by management? The second variable would also appear to rely upon the geographical layout of the work environment and the entire communication process and procedures undertaken during the monitoring. Such unknown, uncontrolled, unregulated and potentially unenforceable variables arguably make O'Connor's (2016) claim somewhat problematic.

There is no doubting the capacity of monitoring technology to collect 'data' – however, perhaps we should first be asking what is the data to be used for? Will it be used for the overall improvement of the health, safety and well-being of workers, or will it primarily focus on increasing the overall performance and productivity of an organisation – with workers' safety, health and wellbeing merely a welcome, but secondary consideration or by-product? Perhaps this is what lies at the heart of the ethical discourse and what is absent in the research when exploring the development monitoring technology and what it might bring to the workplace. In the 1970's, the BSSRS had made the case that scientists could not justifiably stand outside the world in which their discoveries and inventions were being used and absolve themselves of any moral responsibility for how others used their works.

4.2 Moral Responsibility

As originally developed the panopticon was designed to monitor workers with the objective of improving productivity and ensuring for the employer maximum and efficient output from the labour force, where the observed [the worker] is the information provider, not a part of the communication process. In that respect it was clearly an instrument of power; not one that gave power but one that arose as a result of the social/ power relations that existed in the 19th century where employers already exercised near absolute power over their workforce. In the 21st century use of monitoring technologies employers not only can visually watch and record the behaviours of their workforces (Solon 2017, Veriato 2018), but have also the means of extracting speech features and non-linguistic social signals whilst ignoring the words themselves from face-to-face interactions between employees, (Wu et al, 2008, Olguín et al, 2009, Waber et al. 2007). In such an environment workers who are monitored may behave in ways expected of them by the monitors or in a manner which they believe is expected of them, and not necessarily in accordance with their own competence or moral judgement. This power is tremendous and as it grows reinforces the sense of powerlessness and of disrespectedness of the workforce, (Foucault cited in Parramore 2015). Botan (2009), describes the sense of loss of privacy, certainty about their job roles in the workplaces, self-esteem and workplace communication experiences by many of the 40 million plus American workers who are surveilled at work.

Parramore (2015), in a comprehensive journalistic article describes the sense of futility of young workers growing up in a digital environment and a world with low employment prospects as having little choice but to accept workplace monitoring despite its dehumanising effects that stifle creativity whilst encouraging suspiciousness and expectations of dishonesty. These technologies, irrespective of the intentions of their inventors and developers, as previously discussed, have the tendency to limit human perceptions of the complex ways they; the technologies, serve and disrupt power (Green 1999) as they limit and close down individual agency. Within that complexity the universality of moral behaviour is deconstructed and particularised to where the agent fits in the social matrix and the contingent power and control they are able to exercise. The moral potential the technologies is not to be assessed and judged on the intent of the developers but rather on the capacity for the technology to be used by other

agents in ways unintended or unforeseen by their developers. Floridi (2016) has described a model of distributed moral action (DMA) and responsibility (DMR) in relation to actions that result in harm to a third party (morally negative) in which the chain of causation is itself morally neutral; Floridi's diagram illustrates. In this model the actions and consequences of each agent in isolation from all others does not lead to the distributed moral action (DMA) outcome. It is only when the actions and consequences of all agents combined that lead to the DMA outcome that each and every agent can be held to be strictly morally accountable/liable without there being necessary culpability

The literature, particularly marketing materials and journalistic reporting, illustrates enough examples of technology being put to use in the services of companies; owners, shareholders and executives, to the detriment of the workers. Yet the research literature is silent on the moral potentialities other than by implications that the technology is designed to meet the legal (and by extension, moral) obligation of employers to provide safe and healthy workplaces. In a counter-narrative Heffernan (2017) blames Hollywood's ill-informed commentary on keeping the technology immature and the public fearful of progress and suggests that ethical considerations should be defined but not until logical fact-based debates take place, although Floridi (2016) has gone some way towards establishing this. Her colleagues at the Microsoft Research Centre for SocialNUI (Heffernan et al 2018) suggest that people are comfortable with insertable health technologies and body modifications all of which, they claim, suggests a strong sense of personal agency and choice. This however is countered by Botan (2009) who reports workers' sense of loss of privacy, self-esteem, and certainty of their workplace role. The difference in perspective may stem from difference between those who choose insertables or wearables over those who are compelled to have them.

In a Kantian worldview, moral responsibility for moral behaviour and outcomes resides with the individual agent consciously and freely acting. But in the complexities of an interconnected and globalised world moral responsibility for outcomes may not always be simplified to the actions of individuals alone but are the consequences of multiple agents as necessary contributors to the moral action. Floridi's (2016) concept of distributed moral action recognises the input of all agents to an action and ascribes moral responsibility to those whose input is necessary and

without which the action could not occur; (distributed moral responsibility, DMR). Thus, the developers of the technologies ought, of moral necessity, extrapolate, explore and analyse the potential consequences of their creations should they be put to uses other that which they intended and ask whether their product is fundamental to the outcomes examined.

5. Conclusions

It should be borne in mind that this exploration is not some 'Luddite' treatise, however the intent behind that was to expose the fraudulent manipulation of 19th century workplace practices, so maybe a word of warning or caution is not so remiss at this juncture. Nevertheless, the authors do hold that there is space for AI/ AmI in the world of work, however the need for it must fit within the realm of expanding workers competence and their personal control of workplace operations. It is clear from the analysis of the published research literature to date that little evidence exists of placing the worker at the heart of the issue and therein lies the problem. The abilities of the so-called AI/ AmI emerging technologies no doubt offer opportunities' so vast that we have yet to perceive of them all and yet if we consider only the technology and mistakenly refer to it as artificial intelligence we perceive of a world where Man, the 'organic machine' can simply be replaced by more reliable and more easily expendable configuration of nuts and bolts and computer chips.

This review has uncovered a gap in research thinking; the 'ethics deficit'. Central to ethics decision making and moral behaviour is the notion of Agency - of autonomy in both thought and action. To be held accountable for an action the agent, the person carrying out the action, must not be compelled or constrained by forces beyond their control to carry out the action, or to not act, in a particular way. The degree to which any individual agent is free to decide and act corresponds to the effective degree of accountability that can be demanded of them. Ultimately the removal of the freedom to choose or not choose must equate to a negation of agency and thus to a negation of accountability. In the 2010s the position of the BSSRS (1975) on individual and collective scientific responsibility for their discoveries and inventions remains valid and when the consequences of monitoring and surveillance technologies are demonstrably contributing to and maintaining a dehumanised workplace, it is incumbent upon researchers to recognise and accept the necessity of their moral distributed responsibility for such outcomes.

If we are to expand the development of wearable and insertable technology to truly enhance and improve working conditions then the needs of and respect for the workers must be the principal consideration. As researchers, going forward, there is a need for a conversation to be had with those impacted by and who will likely benefit from the enhanced designs; the workers. And most definitely, as privacy rights advocates have suggested, there has to be an internationally agreed code of use; identifying both the necessary privacy restriction and the acceptable uses of the technology.

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Not discussed	The issue was not raised
Touched upon	The issue was briefly mentioned/identified, but no discussion
Discussed	The issues were recognised and were discussed briefly
Discussed substantially	The issues were explored in a broad context of societal effects
Discussed in depth	The issues were contextualised within ethics and moral philosophy

Table 1: Explanation of selection categories

Type of paper/article	Monitoring Technology	No. articles	Discussed in depth	Discussed substantially	Discussed	Touched upon	Not discussed
Journalism	Wearable, insertables, desk-top (ICT)	12	-	-	4	2	6
Reports	Wearable, insertables, desk-top (ICT)	10	-	1	4	4	1
Research papers (Journals & conferences)	Wearable, insertables, desk-top (ICT) & UAV (drones)	41	3	2	1	6	29
Marketing Literature	Desk-top (ICT) and Other, such as breathalysers and touch-based sensors	8	-	-	-	-	8
Opinions	Desk-top (ICT) and Other, such as Artificial Intelligence in general	8	-	3	-	2	3
Other	Insertables & Desk-top (ICT)	3	-	2	-	-	1
	Total	82	3	8	9	14	48

Table 1: Content Analysis: Ethics discussed in range of Artificial Intelligence articles published in recent years.

Reviewer Comments and responses

Editor comments: Thank you for this article - it is interesting and undoubtedly will contribute to the increasing ethical debates our industry is engaging with, not just in safety & wellbeing. Your two reviews are below. They are not extensive but do make some quite pertinent comments that perhaps require some thought before amendments are made. Reviewer 2 (who happens to be something of the expert in wearable & insertable technology - I was very pleased to see their review) makes some interesting observations, most of which I hope you can engage with. Note, however, that this reviewer is calling for examples of insertable technology - the reviewer claims none such exist but to include an example if there is.
Reviewer is incorrect in this, as insertable technologies exists not least the use of RFIDs which to date are being used voluntarily in some workplaces. Citations refer to these , especially Heffernan et al.

This may contravene the journal's new policy on avoiding the mentioning of proprietary products. This means that we may have to remove the reference to 'Fitbit' - though please make a case for it if you wish to retain it.
Proprietary names removes

Both reviewers comment on the style of the writing - Reviewer 1 considering it informal, reviewer 2 considering it journalistic. On the whole I think I agree - Examples of this could be "By any stretch of the imagination" (page 7); "Right!" (page 7). Additionally, try to avoid a polemical style also in what is a peer-reviewed paper; on the whole my view is that this should not be necessary to emphasise the points you are making.
Informal style amended

(Incidentally, it makes the reviewer & editor job much easier if you can include page numbers and even line numbers in your manuscript).
Would have been happy to oblige with this request but my software doe snot have this feature

Please consider the annotated copy of your manuscript from Reviewer 1.
Comments accepted

I look forward to seeing the revised article. The decision here is B2 which means it ordinarily will go for review again.

Reviewer #1: The article is well written. However, informal language or terms must be removed from the it. In addition, any word that is likely to be interpreted as emotive should also be removed.
Informal style amended

There is a notion that must be highlighted in the discussion. It is missing from the article. The notion of respect for people do make the construction site safer. Either from the Kantian perspective or from pure ethical reasoning perspective, the notion of respect for people is also central to the argument in the conceptual article. The authors should consider it and other suggestions in the annotated article.
This has now been included

Reviewer #2: There are two main things missing from this paper. The first is a discussion or disclaimer around the fact that the papers you are criticising for not including ethical elements (for being ethically deficit!) were not trying to look at ethics. This is perhaps a gap you can fill and maybe that is what this paper is doing - positioning your group to research the ethics if no one else is doing it. Just make it clear that ethics was out of scope for many of the other papers, not they they are ethically deficit.
This has now been included

Second main problem for me is that you are speaking of the ethics of technologies, while you really should be looking at the ethics of monitoring and tracking. The technology may enable some of these, but it is the actions that should be ethically debated not the technologies. If a new technology (perhaps one we haven't even dream of yet) comes along this current discussion will no longer be relevant.
This has now been explained

Reads somewhat journalistically at times with rhetorical questions and far too many exclamation points.
Informal style amended

There are no companies currently (known) to be using insertable technology to monitor and track workers. If the author knows of examples where this is demonstrably happening they should be included in the paper. accepted, but the potential to use existing voluntary insertables technologies for OSH purposes exists.

You mention "currently wearable but potentially insertable, such as "Fitbit" that collects bio-data and transmits via wifi and bluetooth to computers" which is unsupported at best, fiction at worse. Reviewer incorrect in this, as many sports devices, health monitoring etc. such as Fitbit transmit via wifi and bluetooth to other devices. I for example use a heart monitor that transmits biodata to my watch and to the fitness machines in my gym. These are common. You need examples or to make it clear that you are speaking of futuristic technologies that may never come to fruition.

The Watson example is interesting. There is a recent example where it was giving un-safe advice which would strengthen the argument that it cannot replace staff but can aid well educated staff (https://www.telegraph.co.uk/technology/2018/07/27/ibm-watson-ai-criticised-giving-unsafe-cancer-treatment-advice/)
accepted and point made clear in the text.

Minor issues:
The sentence "Her colleagues at the University of Melbourne (2018)" does not make it clear who you are referencing.
accepted and corrected

Minor formatting issues e.g. Page 4 dot point 3 changes font.
accepted and corrected

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