Design Education Forum of Southern Africa

DE+AFRIKA+4IR+

DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

I think (sustainably) there 4IR: Exploring design thinking through a first principle approach in fashion praxis

Diandra Haupt, *Stadio*

Abstract

As fashion is becoming increasingly more inclusive of environmentally friendly fibres and sustainable textile solutions, consideration needs to be given to other applications of sustainable strategies within fashion design praxis (Gwilt & Rissanen, 2011, p. 57). Concepts such as design for sustainability, which centres on cutting waste, upcycling and fibre recycling strategies have become commonplace within the industry. A greater focus needs to be placed on developing new ways of clothing construction processes (Fletcher & Grose, 2012, p. 48). In order to address the wasteful nature of the conventional and linear fashion design and production process, designers need to adapt and cultivate new thinking processes that directly affect the phases they most actively participate in.

Through the lens of sustainability, Industry 4.0 falls behind in what is both possible and societally desirable (Ulrich & Gronau, 2020, pp. 110). The internet of things, artificial intelligence (AI) and big data analytics are at the forefront of the fourth industrial revolution (4IR), which has in effect neglected a more holistic and therefore sustainable approach (less technologically centred) towards human, technology and organisational processes (Ulrich & Gronau 2020, pp. 110). Looking at areas such as digital technology solutions and circular economy solutions and the relationship between the two, 4IR has the potential to align the United Nation's goals on sustainable development, while still supporting continued digital transformation within industries (Hoosain, Paul & Ramakrishna 2020, pp. 11). In order to cultivate this holistic approach consideration needs to be given to investigative processes in practice and how the relationship between the digital and sustainable can be aligned.

This paper emanates from a MA Design study that is nearing completion. The study uses a practice-led research framework with investigative methods such as, the think-aloud method and reflection cycles in order to apply a first principle design approach within fashion praxis. This first principle approach aims to address the limitations of the current linear design and production process, allowing for the implementation of sustainable strategies at the start of the design process by means of a design from principle approach (a set of principles that has been synthesised from the UN's sustainability goals, as well as various approaches to design thinking). This paper reflects on the potential of 4IR to be inclusive within this first principle design approach by reflecting on the value of a first principle approach and the potential of incorporating 4IR to advance the adoption of sustainable strategies. The concept of integrating the circular economy and 4IR emerging innovations offers the opportunity for creative and positive impact towards sustainability through aligned thinking (Hoosain, Paul & Ramakrishna 2020, pp. 14).

Keywords: *Aligned thinking, circular economy, fashion praxis, first principle, design approach*

Introduction

This paper aims to look at a first principle design approach within fashion praxis, which emanates from a current MA Design study that is nearing completion. This paper reflects on the inclusivity that the first principle design approach offers to align 4IR with sustainable thinking. Situated within fashion design praxis this first principle approach, addresses the limitations of the current linear design and production process. The focus of the first principle approach is to design from a set of principles that have been synthesised from investigating design thinking and aligning this to the UN's sustainability goals. Looking at the relationship between digital technology and sustainable strategies, 4IR could offer a means to further these goals alongside a creative and positive impact towards suitability (Ulrich & Gronau*, 2020, p*. 109).

Sustainable opportunities within the design process

The integration of sustainable strategies within the traditional fashion design process has not often been examined (Gwilt & Rissanen, 2011, p. 57), conventionally designers have viewed the concept of sustainability as an 'afterthought' to their fashion design praxis (Gwilt and Rissanen 201, p. 14). This poses a challenge and opportunity for the design and production team to integrate strategies that can influence the design and production process right from the start (Gwilt & Rissanen, 2011, p. 57). Gwilt (2012, p. 59) refers to Lawson (2006) who suggests that the traditional design process should be investigated and challenged, as designers need to be more inclined to adapt to a changing future industry (Gwilt, 2012, p. 59). According to Hoosain, et al. (2020, p. 109) 4IR could offer a means to align the goals of sustainable development with continued digital transformation, however, there should be a focus on how research and practice can implement this alignment and sustainability aspects can gain more influence in 4IR (Hoosain, Paul & Ramakrishna, 2020, p. 110).

The fashion design and production process, according to Gwilt (2012, p. 39), can be systematised as a sequential series of activities and phases that is evident within various sectors of the fashion industry. These activities and phases have been well documented through various educational texts, thus indicating a generic design process. This process consists of five distinct phases; the research and analysis phase; synthesis phase, selection phase; manufacturing phase and distribution phase. Within each of these phases, there are specific activities and tasks and the responsibility of each fall to a specific member of staff, department or facility involved within this process. The divisions of these duties, as outlined by Gwilt (2012, p. 40), are dependent on the production; and hence company scale, the larger the company, the less reach the designer has. The influence of the fashion designer across these phases' also changes accordingly, their duties within a larger setting, becoming more well defined and restricted to the starting phases of this linear process (Gwilt, 2012, p. 40).

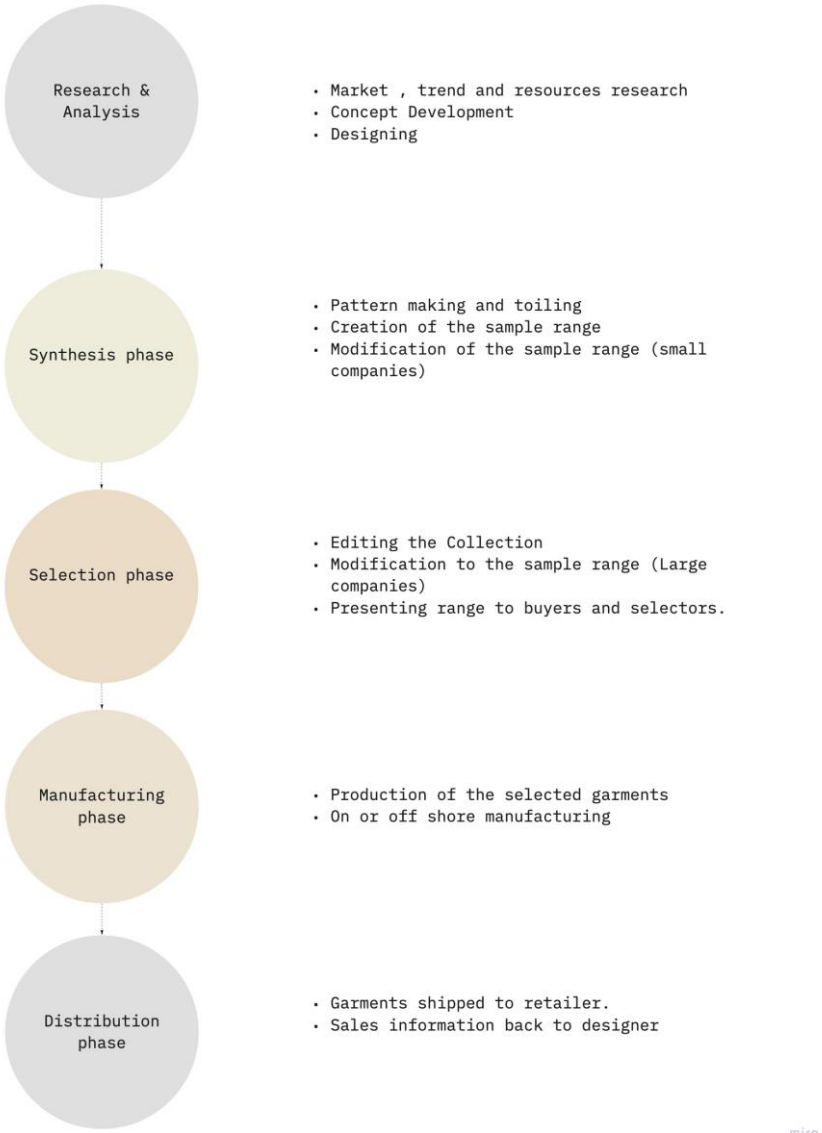

Figure 1: Five phases of design and production (Gwilt, 2011, p. 61)

The design of sustainable fashion necessitates that we garner more knowledge about; and show more support for sustainable systems of production (Fletcher, 2008, p. 4). There is no quick fix to the complex issues this presents and therefore no easy solution to attain the perfect garment, which is able to function within the sphere of sustainability (Fletcher, 2008, p. 42). Rather addressing these problems requires a combination of 'creativity, mindfulness and information about the processes' approaching the problems from a life cycle point of view (Fletcher, 2008, p. 42). An opportunity lies in re-evaluating the design process, investigating alternative methods of design and production, and challenging the conventions of this process (Gwilt, 2012, p. 12). The wasteful nature of the fashion system is a direct result of the conventional design process (McQuillan, 2011, p. 85). Hierarchical processes within this linear design system entails design, pattern cutting, construction and production, which has substantial wasteful side effects. To change the wasteful nature of the conventional fashion design and production process, designers should adapt and cultivate new thinking processes that directly affect the phases they most actively participate in.

Designing from first principles

Designing from first principles can be seen as a means of generating good or successful designs and is often commended for achieving creative designs (Cross, 2006, p. 54). The difficulty that this approach to design poses is identifying what the first principles might be in any given design situation, whether artificial or natural (Cross, 2006, p. 54). According to Dorst (2006, p. 24) consideration needs to be given to what the end solution of the design needs to achieve, the freedom lies in how one gets to the solution. This is supported by Cross (2008, p. 76) who suggest that one should consider the conceptual boundary that is used to define the function of the product as a way to create impactful designs.

Any meaningful understanding of design is centred around the concept of designing from first principles (Cross, 2006, p. 54). It stands to argue that designing takes place by identifying requirements or desired functions, and the form of the structures taking shape based on these established requirements. The function of a product that needs to be designed, should not be seen as a static concept, but is rather something that develops and evolves during the course of the design process (Cross, 2006, p. 54). Cross (2008, p. 78) looks at a similar approach to design through the function analysis method, where the purpose of the method is to concentrate on what needs to be achieved by a new design and not how it needs to be achieved.

First principles and sustainability

Sustainability can be viewed as the concept that underpins the process of sustaining current resources, which are limited, in order to ensure future generations are able to maintain favourable living conditions and meet their needs for said resources (Bervar & Bertoncelj, 2016, p. 243). This definition is supported by various scholars, as well as the Brundtland Report (UN, World Commission on Environment and Development 1987, p. 43). The definition for sustainable development, which is used interchangeably with sustainability, presupposes the importance of development rather than focusing on implementing strategies that maintain current conditions (McKenzie, 2004, p. 2). Sustainable development can further be assessed through the intersection of three interrelated concepts, economic, social and environmental systems (Barbier & Burgess, 2017, p. 3).

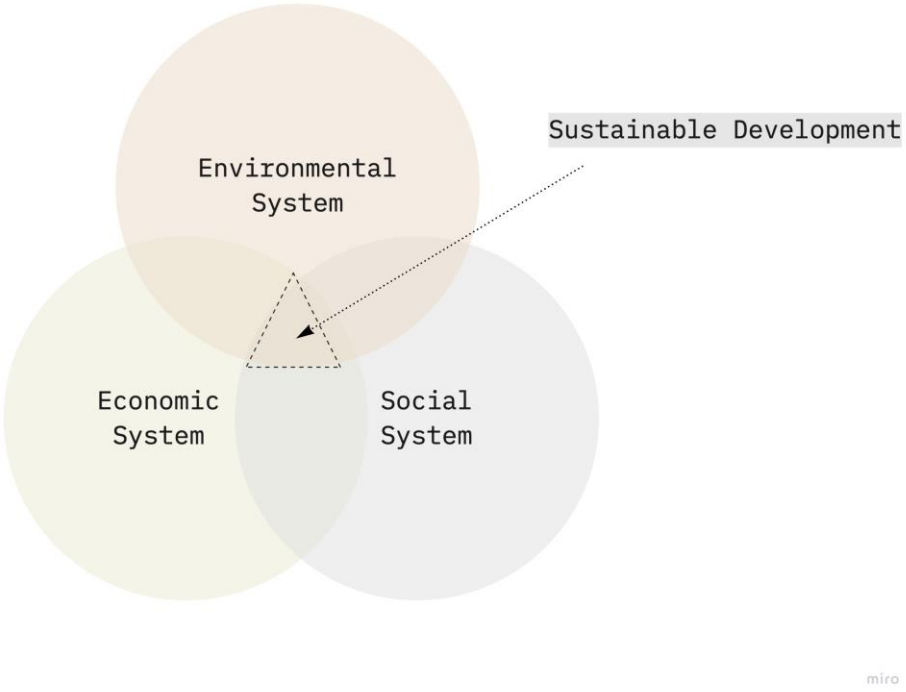

Figure 2: Diagram adapted from Barbier & Burgess, 2017, p. 4

Barber and Burgess (2017, p. 2) state that the objective of sustainable development is a continuous trade-off between these systems by means of an adaptive process. This is supported by Vreja & Balan (2020, p. 1108) that state the three areas of action need to tackle simultaneously, as neglecting one of the pillars will lead to the unfulfillment of the sustainability goal. For example, focusing on only economic growth while neglecting environmental concerns can create additional cost to counteract the environmental impacts, thus resulting in the economic benefits becoming null and void (Vreja & Balan, 2020, p. 1108). There is no clear guidance as to how this adaptive process would need to navigate the tradeoffs between the economic, social, and environmental systems (Barbier and Marandya, 2012, p. 38). However, they need to be balanced, focus on improving one system, while neglecting the others will not result in a sustainable outcome (Barbier and Burgess, 2017, p. 5). This adaptive system, however, shows sustainable development to be at the intersection of the three interlinked systems and their goals (Barbier and Burgess 2017, p. 3).

The UN Sustainable Development Goals (2015) are 17 goals that are interlinked, with the purpose to achieve sustainable development. During the development of the SDGs, the three pillars were explicitly embedded within the formulation of said goals (Purvis, Mao & Robinson, 2017, p. 672). The UN agenda highlights the interlinked and integrated nature of the SDGs that is vital to the success of sustainable development (Barbier & Burgess, 2017, p. 2). The SDGs form a blueprint for a more sustainable future and look at the major global issues we face (Ulrich & Gronau, 2020, *p*. 1). By using the 17 SDGs that are underpinned by the pillars of sustainability, the first principle design approach is situated within a framework that is informed by core sustainability goals, that become the identifying requirements or desired functions of the design (Cross 2006, p. 54). As Gwilt (2012, p. 20) suggests, the designer needs to consider the intended purpose of the garment and establish the sustainable strategies at the start of the design process. The first principle design approach allows the designer to

consider the key sustainability requirements or characteristic that the design needs to align to, which directs the final structure or outcome of the design.

4IR and sustainability

The concept of the circular economy is an alternative to our current linear and conventional concept of "take, make, and dispose" (Hoosain, Paul & Ramakrishna, 2020, p. 7). Ideals such as "designing out waste and emissions", "keeping goods and materials in operation", and "regenerating natural systems" are all concepts that underpin a circular economy. Bringing together 4IR digital technologies and the circular economy concept will allow for global growth through sustainable practices and ensure that this development is aligned to that of the SDGs (Hoosain, Paul & Ramakrishna, 2020, p. 7).

This alignment might most strongly be seen in the economic and environmental pillars of sustainability, 4IR is reflected in areas such as productivity, as well as a more pressing concern for the environment, through the development of eco-friendly technologies and practices (Vreja & Balan, 2020, p. 1112). With regards to the social dimension of sustainability and 4IR, we look at the ability to improve the life of individuals through aspects such as high-end devices and goods or even unprecedented ways of communicating, labour protection, or the need for social identity (Vreja & Balan, 2020, p. 1112). Industry 4.0 has the potential to inform sustainability goals through the application of intelligent digital technologies and optimisation of products and resources (Ulrich & Gronau, 2020, p. 115). A stronger focus should be placed on investigating how Industry 4.0 can contribute to the realisation of the United Nation's sustainability goals beyond that of energy efficiency and working conditions (Ulrich & Gronau, 2020, p. 115).

The World Economic Forum has characterised the fourth industrial revolution as a period in time where the lines between physical, digital, and biological fields are being blurred (Adelowotan, 2021, p. 41). 4IR provides not only an opportunity to advance the UN'S sustainability goals further through the alignment of digital technology with sustainability but also provides a means for the African continent to reinvent skills, labour, and production practices (Adelowotan, 2021, p. 41). According to Adelowotan (2021, p. 42) Africa will have one of the largest workforces globally, a workforce that will need to be equipped with the relevant skills on digital and technological innovations. These digital technologies will also encourage entrepreneurs to develop products and models that will directly affect this workforce and the economy (Adelowotan, 2021, p. 42).

The first principle approach within fashion design praxis allows for 4IR to be included within the design process, the framework, which is informed by the UN sustainability goals allows for 4IR practices to be easily aligned. As discussed by (Hoosain, et al., 2020, p. 7) 4IR, that is aligned to the UN's sustainability goals will allow for global growth as well sustainable development. This might offer an opportunity for fashion praxis to better achieve a sustainable outcome and advance the first principle approach through the inclusion of 4IR. Technologies such as AI, for example, can act as an enabler towards a transition to a circular economy, as well as advance processes that are aimed at solving human problems identified in the UN's Sustainability goals (Hoosain, Paul & Ramakrishna, 2020, p. 12). By designing from a set of principles and aligning this principle approach to 4IR technologies, the goal to achieve a sustainable outcome within the fashion process, could be advanced.

Practice-led application of the emerging design approach

Within the sphere of practice-led research, it has become a pressing concern to develop sustainable strategies through design (Spalwa-Neyman, 2013, p. 2). Terry (2018, p 1) states that Wicked Problems are problems that are "systems problems" that require new problem-solving approaches as they exist within large social systems. A new "design-led approach" is therefore required to confront these complex wicked problems we are faced with during the twenty-first century (Terry, 2018, p. 1). The MA study that informs the first principle design approach makes use of a practice-led research approach or rather as coined by Terry (2008:1) design-led approach where the research "primarily leads to the new understanding of the design practice itself" (Muratovski, 2016, p. 11).

Candy (2006, p. 3) describes practice-led research as "a process that is concerned with the nature of practice and leads to new knowledge that has operational significance for that practice". Smith and Dean (2009, p. 7) refer to practice-led research knowledge value lying in both the work of art (artefact) as a form of research, as well as the documentation of the process of creating the artefact. This is further supported by Cross (cited in Farber & Makela, 2010, pp. 11-12) that the knowledge of design that can be found within people, processes, and artefacts, can be gained through not only the process of design, and making, but also through the reflection on these processes. Makela (2007, p. 158) suggest that the artifact, as an object produced through the research process, becomes a method of "collecting and preserving information and understanding".

Design-led research within a qualitative paradigm, is defined by process rather than output (Muratovski, 2016, p. 36). During the process of applying the first principle framework, the most important finding from the process of design-led research, was the challenge the new approach posed to traditional thinking, as well as the conventional design process. During the prototyping phase of the study the practitioner-researcher investigated the outcome of the first principle design approach, through the application of zero waste patternmaking. The challenge lay in discarding traditional linear design processes and adapting to a purely principle focused approach. Aesthetic components of the garment design, such as a defined apparel category, as well as a set design blueprint (in terms of proportion, shape, and garment details) became a secondary element that was influenced by what the intended purpose/function of the garment was, as it aligned to the selected first principles.

Within practice led research, the researcher forms an integral part of the research, actively participating in the epistemological process and not merely becoming an observer. The new knowledge is therefore created through the researcher's interaction with the research process, which becomes explorative and self-reflective. Candy (2006, p. 3) suggests that it is not necessary to include an artefact within practice-led research, the MA study, that informs the first principle design approach, aims to apply the newly synthesised design-process to the development of a series of artefacts or rather prototypes by employing the practice of Zero Waste pattern making. The prototypes are created to aid in the reflection process of the study; therefore, the new knowledge creation lies solely in the process, with the prototype aiding in the reflection of the process.

The first principle design approach places emphasis on the garment's alignment to the developed first principle framework more than the aesthetic outcome thereof. The practitioner-researcher's role during the process was to identify the specific principles that they would align to their design and hence starting their design process from this blueprint. The outcome of the design is therefore dependent on how the aesthetic elements of the garment work in support of this blueprint. This is contradictory to the traditional linear approach where the outcome of the design is used as the starting blueprint for the design

process. Sustainable design within fashion praxis should be informed by a life cycle point of view that will create impactful designs that consider the conceptual boundary of the product to define its function (that of sustainability).

Conclusion

This paper aims to reflect on the development and exploration of a first principle design approach which has the potential to include 4IR technologies to advance the adoption of sustainable strategies at the start of the design process. The first principle design approach which emanates from a first principle framework, advocates for design to take place by identifying requirements and desired function that guide the form of the design outcome. By means of synthesising a first principle framework, based on the UN's sustainability goals, the desired requirements are informed by the three pillars of sustainability, economic, environmental and social sustainability.

Although there is no quick fix to the complex issue we face with regards to sustainable design, an opportunity lies in re-evaluating the design process. According to Gwilt (2012, p. 12), challenging the conventions of the fashion design process and investigating alternative methods of design might open up a means of achieving alternative methods of design and production, that challenges the wasteful nature of the conventional design process (McQuillan, 2011, p. 85).4IR could offer a means to align this synthesised first principle framework to that of global growth, through investigating intelligent digital technologies, that can assist in further aligning design processes to that of the SDGs. The nature of designing from first principles, that of championing a conceptual framework as a starting point, allows for the inclusivity of 4IR to be incorporated within the first principle design approach as an integrated aspect of the final design outcome.

References

Adelowotan, M, 2020, 'Towards ensuring the sustainability of South African small and medium enterprises in the fourth industrial revolution era', *Eurasian journal of business and management,*'9, no.1, pp. 38-46.

Barbier, EB & Burgess JC 2017, 'The sustainable development goals and the systems approach to sustainability', *International Economics Discussion Paper*, vol. 28, pp. 1–24, doi: 10.5018/economics-ejournal.ja.2017-28

Barbier, EB & Markandya, A 2012, *A new blueprint for a green economy,* Routledge/Taylor & Francis, London.

Bervar, M & Bertoncelj, A 2016, 'The five pillars of sustainability', in *Economic, Social, Environmental, Cultural and Security Aspects, Management International Conference* 2016.

Candy, L 2006, 'Differences between practice based and practice-led research', https://www.creativityandcognition.com/research/practice-based-research/, viewed 12 June 2018

Cross, N 2008, *Engineering design methods: Strategies for product design*, John Wiley & Sons.

Cross, N 2006, *Designerly ways of knowing*, Springer Science and Business Media.

Dorst, K 2006, *Understanding design*, BIS Publishers, Amsterdam.

Farber, L & Mäkelä, M 2010, 'Exploring through practice: Connecting global practice-led research approaches with South African production', in L Farber (ed.), *On making: integrating approaches to practice-led research in art and design.* University of Johannesburg, Johannesburg, pp. 7-18.

Fletcher, K 2008, *Sustainable fashion and textiles, design Journey*, Earthscan, London,

Fletcher, K & Grose, L 2012, *Fashion & sustainability, design for change*, London, Laurence King Publishing.

Gwilt, E 2012, *Integrating sustainable strategies in the fashion design process: A conceptual model of the fashion designer in haute couture,* RMIT University.

Gwilt, E 2011, *Producing sustainable fashion, points for positive intervention by the fashion designer: Shaping Sustainable fashion, changing the way we make and use clothes,* Alison Gwilt & Timo Rissanen (eds), Earthscan, London.

Hoosain, M & Paul, B & Ramakrishna, S 2020*, '*The impact of 4IR digital technologies and circular thinking on the united nations sustainable development goals' *Sustainability,* vol. 12 pp. 1-16

McQuillan, H 2011, *Zero-waste design practice: Strategies and risk taking for garment design: Shaping sustainable fashion, changing the way we make and use clothes,* Alison Gwilt & Timo Rissanen (eds), Eartscane, London.

Muratovski, G 2016, *Research for designers, a guide to methods and practice*, Sage, London.

Purvis, B, Mao, Y & Robinson, D 2018, 'Three pillars of sustainability: In search of conceptual origins', in *Sustainability Science.*

Rissanen, R 2007, 'Types of fashion design and patternmaking practice'*, Proceedings of the NORDES Nordic Design Research Conference*, http://www.nordes.org/opj/index.php/n13/article/view/185/168

Smith, H & Dean, RT 2009*, Practice led research, research-led practice in the creative arts*, Edinburg University Press, Edinburgh.

Splawa-Neyman, T 2013, 'Making as using: Design research that deciphers value', *Proceedings of the NORDES Nordic Design Research Conference*, https://archive.nordes.org/index.php/n13/article/view/329/309

Terry, I 2018, 'The emerging transition design approach', in *Design research society catalyst*.

Ullrich, A & Gronau, N 2020*, Time to change: Considering the fourth industrial revolution from three sustainability perspective's,* Department of Business Informatics*,* University of Potsdam, Germany, pp. 109-116.

Vreja, L & Balan, S 2020, 'The fourth industrial revolution and Sustainability', *Proceedings of the 14th international management conference* Bucharest Romania, pp. 1103-1113.

