Fashion Design for Holistic Systems

Jennifer Whitty

Abstract Fashion, like all ecosystems, is complex and dynamic. The fashion system comprises intangible, and tangible aspects, all of which have significant consequences. The linear structure of this system, used throughout the twentieth century—referred to as 'take, make and waste'—has set artificial boundaries and driven a wedge between players in this system. This has led to the global fashion, and textiles industry being one of the world's most polluting industries, and overshadows the potential of the fashion system as a powerful vehicle for social and environmental change. Design can be key to reorienting the fashion system and bringing the disparate parts together. Design research, and practice can generate new ways of understanding, being, and doing 'fashion' that acknowledges the complexities and the varieties of fashion(s) in an authentic twenty-first-century context. This exploratory design paper incorporates a multidisciplinary mixed methods approach, and a systems lens to the fashion system to examine the boundaries of conventional fashion practice, to encourage more complex interrelationships between, and around garments. The theoretical framework is informed by systems thinking, and a critique of the paradigm of growth, in conjunction with the 'four orders of design'. It invites us to ask, through design research, what a holistic, flourishing, responsible fashion and textiles system for the twenty-first century might look like, by widening the parameters of the fashion system in order to critically examine the tension between analytical and systematic thinking for fashion. This study acts as a catalyst for a conceptual model showing how the fashion system can reconnect, and fashion design can engage with a higher order of design to encompass sustainable practices.

Keywords Sustainable · Service · Fashion systems · Orders of design · Transition design · Fashion experience · Systems · Design systems

J. Whitty (✉)
Parsons School of Design, New York, USA
e-mail: whittym@newschool.edu
URL: https://www.linkedin.com/in/jennifer-whitty-5909231b

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1 Introduction

1.1 Situating the Research

The definition of a system, according to the key systems theorist Meadows [41, p. 2], is 'a set of things—people, cells, molecules, or whatever—interconnected in such a way that they produce their own pattern of behaviour over time'. The fashion system is one of the most complicated global supply chains, involving more than 60 million people, and moving tonnes of chemicals, water, crops, and oil across the planet [49, 57]. We have adopted the predominant method of reasoning of the 20th—analysis over synthesis—to understand and operate in this complex system. Analysis involves breaking the system down into its constituent elements through a process of reductionism, so it is simply a sum of these constituent elements.

In fashion terms, the constituent elements, and boundaries are exemplified by the reduced, linear, compartmentalised, 'take, make and waste' supply chain model [21]. This analytical model isolates, and spreads the three stages of the system across the globe. The first stage, 'take', involves the sourcing of fibre and raw materials in one place, before being transported to another place for the second 'make' stage for processing and manufacture. The elements are then taken to another place for finishing and sale before the final, third 'waste' stage where a garment reaches the end of its useful life.

Applying analytical thinking to break down a complex dynamic system such as fashion into a linear, compartmentalised model has led to disconnection across all stages of the fashion system. It also veils activities such as subcontracting to the point of disruption and disorder, as human rights and working conditions can operate below global standards, without visibility or penalty. This reduced model doesn't encompass the broad spectrum and diversity of activities that are the reality of the fashion system, such as the use phase, post-purchase phase, or alternatives to a garment becoming waste. Moreover, it suppresses everything this system could be—one of flourishing interconnectedness, transparency, feedback loops and harmony. In the words of Indigenous knowledge academic Yunkaporta [56, p. 4], 'viewing the world through a lens of simplicity always seems to make things more complicated, but simultaneously less complex'. Yunkaporta sees the desire to reduce things through analytical reasoning as part of the legacy of colonisation. As complex indigenous knowledge systems of nature were controlled, an impossible and unrealistic expectation of simplicity was chosen over wisdom and complexity.

1.2 Synthesis and Analysis

Synthesis and analysis both form part of a well-developed reasoning approach, but on the whole, highly interconnected dynamic systems are best suited to synthesis or systems thinking, rather than a reductive, analytic approach. An analytical approach

has been highly successful for the fashion industry in financial and production terms. It has accelerated mass manufacturing and growth at all costs, 'chasing the needle' across the globe for the lowest production costs in a race to the bottom, driven by hyperconsumption. This segmented approach has contributed to the brokenness of this system as a whole and an absence of values and ethics. Prioritising financial and manufactured capital in isolation, blatantly ignores the interrelationships and impacts on other forms of capital, such as human and cultural capital (Fig. 1) [48]. The effects of cost-cutting decisions include rampant low wages below living standards, unhealthy and dangerous working conditions, and forced child labour akin to modern-day slavery throughout these disconnected supply chains [32, 37].

This approach has enabled some key players in the industry to divide and conquer—to sequester parts in isolation without consequence or without motivation to build a dynamic, thriving system for all. These key players have neglected to ask what is right for each place, and each community, and understand all the outputs, inputs, and throughputs of this entire interconnected ecosystem. The reductionist paradigm systematically and inherently de-promotes the relationships between these components, and instead accelerates competitiveness across developing countries. Production swiftly moves on from place to place as wages, workers' rights and conditions improve, leaving behind a trail of social, human, and natural instability and devastation. A recent BBC investigation noted that low-cost clothing production had moved from Bangladesh to Ethiopia, where wages are a third of the previous rate [19] (Fig. 2).

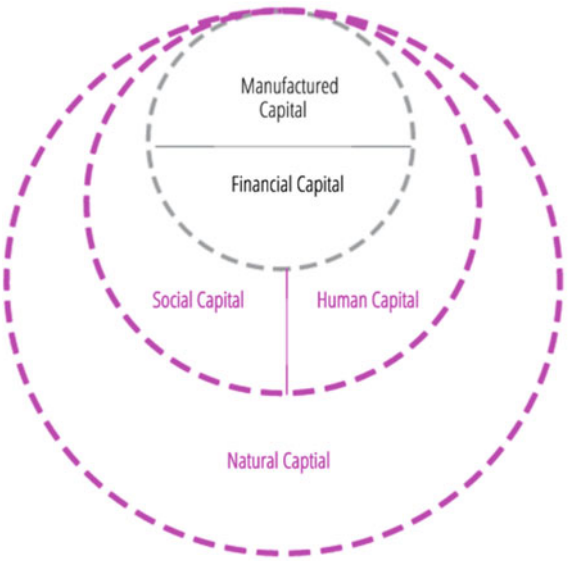

Fig. 1 Five capital model [48]

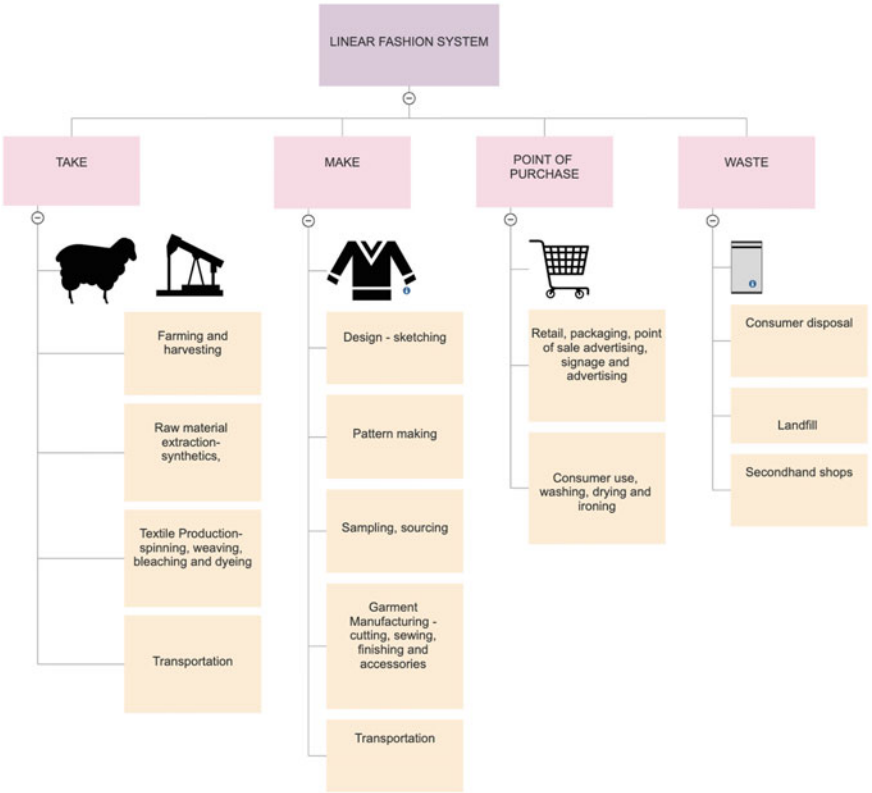

Fig. 2 A linear fashion system

1.3 A System Broken into Constituent Parts: A Contextual Review

The general process from clothing design to production follows discrete divisions of activities, and specialist skills from design, pattern-making, construction, production, and retail. The hierarchy, and separation of these processes has led to a cut-and-sew fashion system which is inherently wasteful, and ignorant of the context in which garments are created and used [51]. The act of garment cutting results in an average of 85% effective textile use, leaving the other 15% on the cutting-room floor [1, 51]. This waste is a production problem, seen as outside the narrow remit of design, and designers. Each stage of this hierarchical system is segregated, which leads to much virgin fabric being wasted while adhering to the growth paradigm's perpetual hunger for the new. We now have a global clothing production system that produces over 150 billion garments annually, which could provide 20 new items to every person on the planet, every year [15].

The division of labour has meant that designer responsibility typically begins, and ends with drawing a design for the garments to be crafted from new fabric [52]. Making the patterns, making the maker, cutting the fabric, and sewing the garment is all done by a series of discrete specialists, who are responsible for these stages in the fashion system, before the garment is ultimately sold. While designers' roles can vary depending on the scale of their organisation, on the whole designers rarely factor environmental or social parameters into their work. The garment is generally not designed in the micro-context of fabric dimensions or in the macro-context of limited natural resources, and clothing-driven pollution in our air and water [13]. This broken system supports an impulsive 'act now, think later' approach to design where surplus overproduction is accepted, as what doesn't get sold is secretly burned or buried. A report by the Ellen McArthur Foundation [22] estimates that one trunkful of clothing and textile materials is landfilled or incinerated every second. This mindset has led to a reduced sense of designer responsibility and integrity—responsibility that ends at the point of purchase, as garment lifespan is beyond their remit. The material waste, and negative impacts could be minimised or eliminated if the system for design and production was redesigned to become more integrated with the processes of nature. Wood (in Chapman and Gant [12], p. 111) writes that the use of resources in a holistic, circular, systems-based production-to-consumption system, could follow zero-waste systems that are found in nature (Fig. 3).

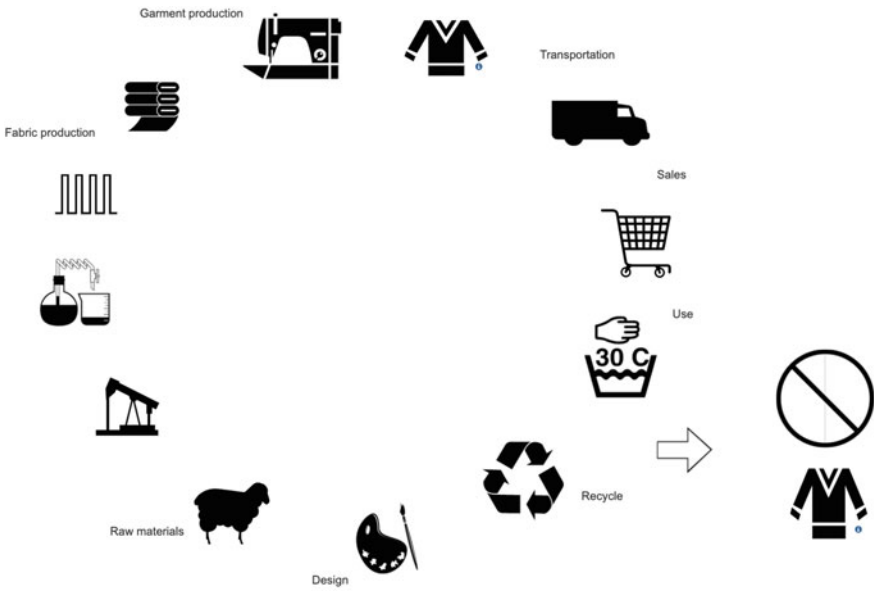

Fig. 3 Circular Systems [55]

2 Methodology

In keeping with its open interdisciplinary approach, this exploratory research incorporates a multidisciplinary mixed methods approach. Drawing upon multiple theories, philosophies, and knowledge from varied fields from across the fields of environmental studies, politics, science, history, philosophy [53], and economics [35] in addition to design research from across the field of design [39]—design thinking [10, 17, 44], fashion [51] and textiles in order to gain a comprehensive look at this topic on multiple levels. It follows a qualitative approach: historical and content analysis.

The theoretical framework for the research is informed by systems thinking [2, 21, 41] and a critique of the paradigm of growth, in conjunction with a Transition Design-led [34] exploration of sustainable fashion design (Fig. 4). The application of a systems lens to the fashion industry is in opposition to the mainstream reductionist view with the aim of replacing reductionism with expansionism—the view that everything is part of a larger whole and that the connections between all elements are integral.

The conceptual framework is informed by design thinking research [8, 17] in conjunction with the 'our orders of design' (Fig. 5) as posited by Buchanan [9, 10]. According to Buchanan [9], the orders of design are:

1. Signs and symbols: communication, graphic design, editorial, etc.
2. Objects and artifacts: product design, fashion design, industrial design, etc.
3. Interactions and experiences: UX-UI (user experience, user interface design), service design, etc.
4. Systems: policy design, system design, industrial ecology, etc.

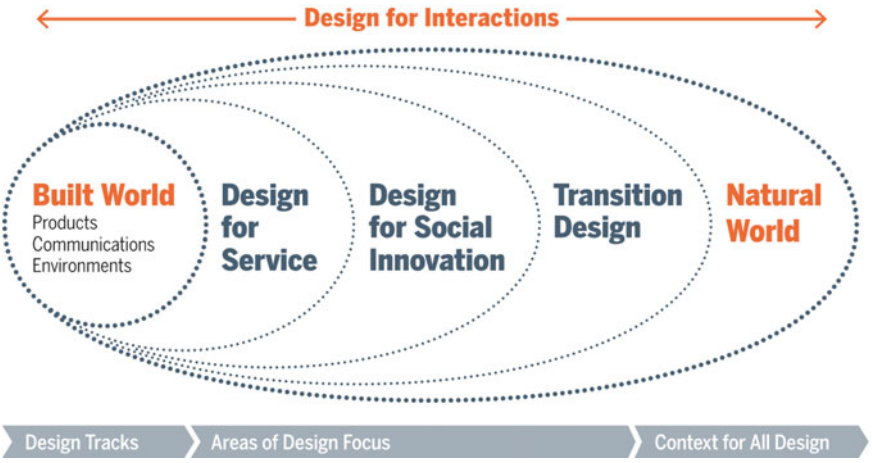

Fig. 4 Diagram of transition design [34]

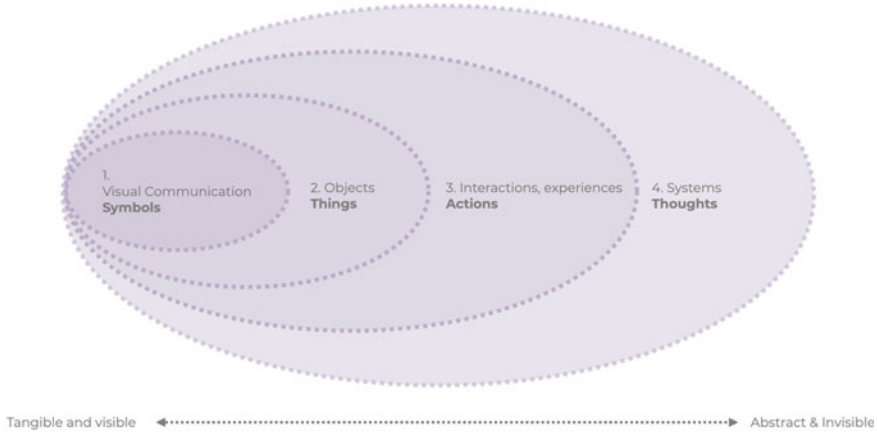

Fig. 5 Model of the four orders of design [10]

This research consists of three predominant methods: a literature review, a contextual review, comparative analysis and recommendations. A review of literature was undertaken pertaining to the entire context in which fashion exists while examining the roles of the fashion designer in industry and education. A contextual review was developed via a method of critique whereby the ethos and fashion practices undertaken are compared and contrasted according to criteria developed in the literature review.

3 The Limits to Growth: The Fashion System as a Subsystem of Our Ecosystem

An ecosystem is defined by Encyclopædia Britannica [23] as 'the complex of living organisms, their physical environment, and all their interrelationships in a particular unit of space'. The current fashion system was developed in the context of the socioeconomic system of Western consumer capitalism and globalisation of the late twentieth century/early twenty-first century where the default position has been overwhelmingly pro-growth, as it has been for over 200 years [42]. The 2018 UN climate report [31] states that we have approximately 12 years to make significant systemic and social changes to all aspects of human activity; or we risk catastrophic climate change. Growth can be beneficial for society but it can also create problems, particularly if it is not conscious or respectful of its context. This growth is exponential rather than linear, and the failings of applying an analytical approach to these dynamic systems are exemplified by our current environmental and social issues as the full context of our ecosystem and its subsystems—in which the fashion system and economy exist—are not acknowledged. The result is that the boundaries

of industries such as fashion have been largely ungoverned by ecological thresholds. In 2013 the world was confronted with the statistic that fashion is one of the most destructive industries in contemporary society [5, 15]. While the accuracy of this claim has since been disputed, it is difficult to be specific about data on an industry so globalised, complex and vast, connected as it is to the oil, petrochemical, agriculture, manufacturing, retail and shipping industries. This information provides us with an opportunity to be more vigilant regarding this seemingly harmless industry, and for the industry itself to begin to ask questions about its reliance on growth.

If we accept and understand the concept of systems thinking, that is, the idea that all human activity is interconnected and interdependent, we understand that there are limits or boundaries to growth in our finite ecosystem [18, 40]. The ability of this system to absorb waste and replenish raw materials is compromised by fashion overproduction and consumption. According to Meadows et al. [42] we have several options: to ignore and continue as usual; to create eco-efficient solutions that will solve problems in the short term; or to adopt a more strategic approach, addressing the underlying causes and changing the structure of the system. Yet despite the magnitude of these warnings, the fashion industry has opted for the second choice, continuing to operate with a twentieth-century reductive, anthropocentric, and technocentric mindset in a belief that scientific and technological advancements will create the required solutions—in other words, upholding the status quo by tweaking around the edges, amending things in isolation, and treating the symptoms, not the causes. For example, the Pulse Report from the Global Fashion Agenda [6, 7] attempts to improve the industry but neglects to accept the full context and the realities of the biophysical limits of our ecosystem. The report continues to advocate for a logic of growth with 'The Roadmap to Scale' of continued consumption, while not addressing the tensions and contradictions inherent in this approach in our bounded system (Fig. 6).

3.1 Disengaged and Disconnected Consumers

The dominant industry model is one of mass production of low-quality, cheap clothing that is disposable and lacks transparency. Fashion designers have created a distance and a barrier between themselves and their users. Positioned apart, as 'experts' or gatekeepers of taste and style, they design on behalf of their wearers who rely on and trust their authority [36] and their design integrity. Fashion users are conditioned by this system to be passive, often kept in the dark about the impacts and true cost of these products on people and the planet. Consumers are buying more clothes than ever before, but the use time for wear and depth of engagement with these items is decreasing as almost half of what is purchased is thrown out every year [29]. The world is drowning in clothes that appear to have no meaning or sustained purpose beyond a few wears by their users. A UK study of almost 2,000 women over 16 years of age [3] found that the average garment is

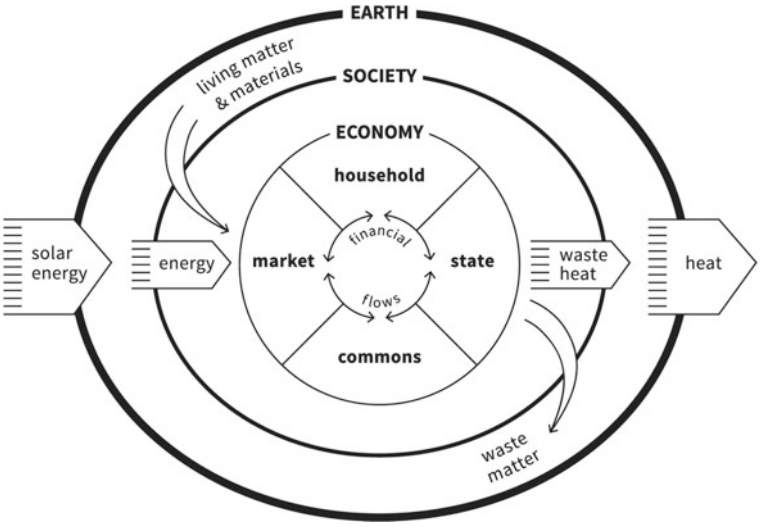

Fig. 6 Embedded fashion economy in our ecosystem. Diagram by Marcia Mihotich. Copyright © Raworth [50]

only worn seven times. Designers need to concede that the clothing produced in this system is failing people, as it is of little value or meaning to them. Fashion users/wearers demonstrate concern about ethical practices and environmental issues [46, 47], but this concern and awareness does not always follow through to action [47]. After experiencing decades of price conditioning, consumers cannot understand the higher cost of a sustainable garment, signalling a lack of awareness of the complexity of the fashion system. For Western consumers, the impacts of this industry are complex and difficult to comprehend, as these happen somewhere else, to someone else. Consumers have become detached, confused, and disengaged. As Fashion Revolution [25] proclaimed in its global campaign for transparency across the supply chain, 'Purchasing a garment means purchasing a whole chain of value and relationships'. Buchanan [10, p. 11] states that unless products—in this case, clothing—become part of one's life experience, they have little value or meaning. Activating consumer empathy and understanding of the people engaged in making their clothes or getting them involved as a fashion experience may indeed be a powerful method of connecting and interacting across this disconnected system.

An oft-quoted statistic in relation to product development is '80% of environmental impacts are determined in the design stage' [45] of a product. From a system thinking perspective, this raises many questions about the causality of decision-making in the design process. How much agency does the fashion designer have in making decisions about ethical practices, labour standards, material choice, and transportation? What if designers began to open up dialogue and communicate their actions with fashion wearers to create feedback loops for participation in environmental decision-making? Could designers extend their responsibility to

helping consumers understand the indirect implications of their actions within the system, and deepen the connection and relationships among designers, products, and fashion users?

3.2 *Limits to Design: Inward Practice*

According to Muratovski [44] there are essentially two approaches to design: the first as inward-looking practice for oneself, or the second as an externally driven approach—design for others. The majority of fashion designers, particularly at the high end of the market, approach fashion in the former manner. While the work is for an intended audience, it is essentially a form of personal self-expression and decisions are driven by the fashion designers' aesthetic choices [30]. This approach has restricted designers from applying their skills and knowledge across a wider range of activities or on systemic solutions, including services and systems that could address environmental or human rights issues [9, 43]. It has meant that the remit for design activities is narrow as fashion designers are not taught, encouraged, or empowered to explore the boundaries of their discipline. The majority of their work is spent on investigating form and/or technical application led by principles of aesthetic and economic factors. The standard method is often one based on intuition, practical knowledge, assumptions, and creative expression driven primarily by personal aesthetics [20].

Fashion designers are primarily concerned with 'designing'—often in the form of a drawing—discrete physical products that look 'good' within an infinite growth paradigm; that is, giving life to form with little consideration of where the material comes from, how it behaves in use, and what will happen to it after it is no longer desired. The designers' sphere of concern is primarily centred on what they are designing—the product and material—and not on whom they are designing for or with—the wearers and makers [39]. While the knowledge of creating physical artifacts is undeniably important, these garments are often made in isolation, without a connection to the end-users or the ecosystem of which they are a part [30].

The external approach as posited by Muratovski [44] positions design as a form of problem-solving, where the needs of others are at the forefront of the design intention and the outcome is driven by enquiry-led research rather than by taste or style. A research-driven, user-centred, problem-solving approach in terms understood by design thinking research [8, 17] is rarely part of fashion design. Instead, fashion designers stay within the narrow confines of the status quo for fashion, where they have been given permission for innovation to occur. For many fashion designers, their role consists of rehashing older styles, following the same well-worn linear path from idea to production/make to retail/consumption and, eventually, to waste [16].

As observed in my many years (2007–2019) of teaching design students across disciplines in interdisciplinary projects, there is a notable difference between

fashion designers and designers from other disciplines in their ability to engage their strategic mindset, question existing solutions, or understand and solve complex problems that have not been 'solved' already. Design students from other disciplines are attuned to and adept in this territory, engaging in 'solving' or 'seeking' practices, in contrast to fashion designers who are unfamiliar with this approach and rarely consider design in this way. Important shifts in design are taking place around the world, from 'product creation' to 'process creation' and from a 'field of practice' to a 'field of thinking and research'. As the approach for design shifts from problem-finding to problem-predicting, this raises concerns for the future of the fashion industry if its designers are not prepared or able to work in this way. It also raises questions regarding the relationship and responsibility of education on the current situation. If, as [44] asserts, the internal approach to design favoured by fashion designers limits their skills and ability to take a more strategic role in the formation of outcomes, one might well question how much this approach plays a role in current problems inherent in the fashion industry. The need for fashion designers to expand their problem-solving toolkit to incorporate design research and practice in the pursuit of better outcomes for all has never been so urgent and important.

4 Discussion

4.1 The Need for New Ways of Designing

Fashion design is as powerful as it is pervasive. It is everywhere, as everyone wears clothes. It has the potential to tap into the richness and complexity of its system to have real power and meaning, but it has lost its way. It has been forgotten that what is interesting is the interaction between 'things' and not the 'things' (in this case, clothing) in and of themselves.

The challenges facing humanity in the twenty-first century involve complex systems for which there are incentives from a sociotechnical systems perspective to transform all industries within parameters set by the United Nations' 17 Sustainable Development Goals [54]. Fashion designers must change the way they design so that they can reconnect fashion to its purpose and context—its interaction with people as both a social process and a material practice in our ecosystem.

The framework for design has expanded in the twenty-first century, as all designers will need to learn to operate in a cross-disciplinary way to collaborate with non-designers, conduct research, and make informed decisions in a systematic manner. As Muratovski [44, p. xxii] declares, 'In the twenty-first century, design involves a wider range of challenges than typical of design in the twentieth century, and a wider range of goals. Design also involves a broader context and greater complexity'. In this complex environment, the boundaries, expectations and audience for 'creative outcomes' are blurred, reimagined, and redefined [28]. An

examination of the fashion industry reveals that it meets the definition of a 'wicked problem' [9], as a series of interconnected problems, with significant economic and environmental responsibility, multiple opinions, and incomplete or conflicting knowledge.

This leads us to ask: is it time to examine the boundaries and context for fashion to reconsider its 'outcomes' and purpose? Irwin [33, 41] posits that 'the transition to sustainable futures calls for new ways of designing that are based upon a deep understanding of how to design for change and transition within complex systems'. Theories of Transition Design are essential for designers to build the necessary skills, literacies and mindsets required to confront twenty-first-century global challenges. According to Buchanan [10, p. 12], 'The idea or thought that organises a system or environment is the focus of fourth-order design.'

This research asks, in this time of transition: Can we apply a systems approach to fashion design toward a more expansive view of fashion (Fig. 7)? Can we move towards a higher order of design such as action and experience, environment and systems, oriented for and with engaged wearers and users? Can this be done with the aim of creating, as Fletcher [27] describes, a new narrative for a more open, diverse, resourceful, emancipatory, and holistic fashion and clothing system that helps wearers understand the true cost of clothing?

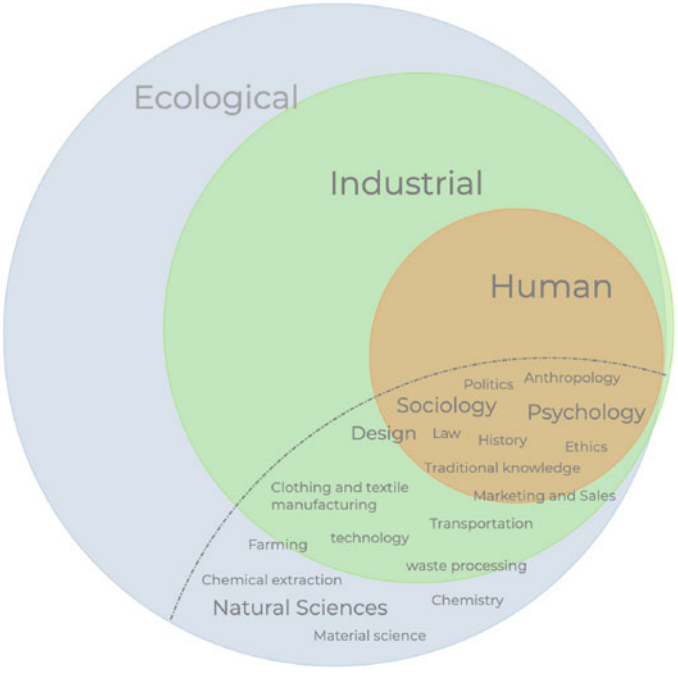

Fig. 7 An expansive view of fashion [55]

4.2 *Fashion Design as Action and Interaction, Forging Empathy and Engagement*

Philosopher Soper [53] claims that humans do not have an innate impulse to consume, but instead have an urge to connect, to relate to one another, to be creative and to be productive. Tapping into these values and drivers rather than ones of novelty could provide an impetus to engage consumers in alternatives to contemporary resource-intensive consumption systems. Chapman [11] sees garment waste as a symptom of expired empathy.

Bengtsson [4, p. 89] asserts that a product designer is at his or her best when they perform like a 'behavioural scientist' winning our trust and love as 'they focus on what is to be human'. He identifies two different schools of design: those who choose to focus on the noun, that is, 'the glass' or 'the garment', the second-order of design [9]; and those who prefer the verb, that is, to drink' or 'to wear'—the third order—as a driver for design. This aligns with contemporary fashion theorists such as Entwistle's [24] interest in 'new materialism' as a tool to address specific sociocultural concerns as a philosophical framework on embodiment, and the materiality of the human body. This framework helps to understand fashion and dress as a situated bodily practice. It provides another way of considering it beyond the noun, the object, or the dress in isolation, by reasserting the importance of the bodily 'experience': how clothing enables us to move, feel, interact and perceive the world.

Fashion designers have predominantly adopted the first school of design, focusing on the noun and designing the product in isolation based on aesthetic values, with little insight or empathy for human behaviour and interaction with clothing. Fashion designers do not deeply consider the 'craft of use' [27]—the lived, real experience of fashion, the act of wearing and 'being in a garment'. When human behaviour has been examined for fashion, it is normally directed towards exploiting our ability to buy the next item, not to keep it, wear it, and have a fulfilling fashion experience.

At a time when consumers are wearing their clothing for less time than ever before, we must acknowledge that the lack of consideration of the use phase contributes to this situation. If we consider fashion from the more complex, higher orders of design from the perspective of interactions, experiences, and systems to address what makes a product/garment useful, usable and desirable, and then engaged user-centred methods, fashion designers could become more attuned, empathic designers, and discover an integrated new understanding of what fashion could be. This may be able to deliver prosperity for all.

Through design, people can align their actions with their values, and see the bigger picture [14] to encourage more complex interrelationships with and around their garments. Kate Fletcher's research project, 'Local Wisdom' [26] sought to flatten the hierarchy of the current system by examining the role of 'non-professional' user-makers and how they can contribute to the fashion system without relying on the professional skills of designer/producers.

Changes in function or purpose can be profound. If the purpose of fashion and the mindset of fashion designers can be shifted towards behaviour, and the action of wearing, this could lead to fresh thinking around sustainability, to an expanded view of fashion that really fulfills us and equips us for living.

5 Recommendations

This study is meant to act as a catalyst for a conceptual model that aims to reconnect the fashion system, and engage fashion design with a higher order of design to align with sustainable practices. In order to shift the fashion system, we must acknowledge it as part of an ecology of sustainable practices that are evolving and dynamic.

The following recommendations follow an approach as posited by key systems theorists such as [2] in order to develop a systems mindset for the fashion industry:

1. Interconnectedness (Fig. 8): This requires a shift from the 'mechanical worldview' of the fashion system as being linear in order to confront its reality as a dynamic, chaotic, interconnected array of relationships and feedback loops that occur before, during, and after a garment is created. Levelling the inherent hierarchies and discrete skill sets that restrict innovation, creativity, and responsibility across the entire fashion system and beyond will provide opportunities for investigation and for new modes of practice.

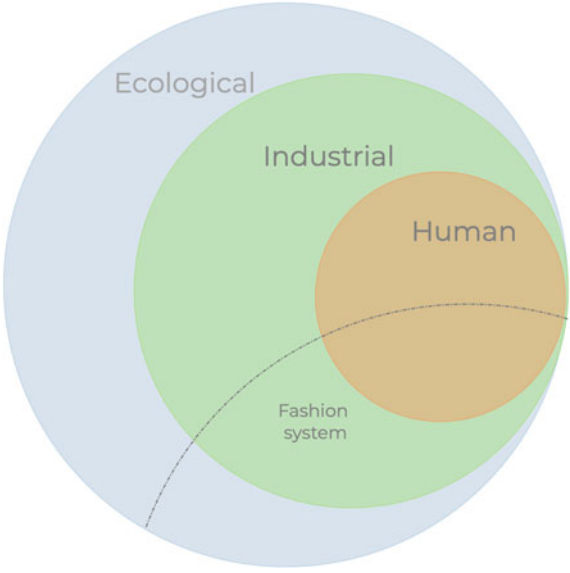

Fig. 8 Interconnectedness [55]

2. Synthesis (Fig. 9): Synthesis means being able to see the relationships and the connections of the entire fashion system as a whole, not as a discrete set of activities that become myopic, losing perspective on the ultimate goal of the lived, real experience of fashion in our ecosystem. The fashion designer as a key player can advocate for change and synthesis throughout a garment's life cycle, and can also challenge conventional ideas about the work of a designer as not simply designing clothing, but rather arranging entities/textiles into sets of relations [38].
3. Emergence (Fig. 10): Emergence refers to the outcome of the synergies of the parts; of things interacting together. This could mean many things in fashion, such as broadening the education and remit for designers to understand the interlocking complexities of human and social behaviour, from behavioural sciences, technology, and business. It could also refer to the new synergies that could occur if environmental or ethical issues form a part of the design and production process or fashion design brief. Challenging conventional ideas is not so much concerned with designing clothing, but rather on arranging entities/textiles into sets of relations [38].

Fig. 9 Synthesis of fashion system and roles [55]

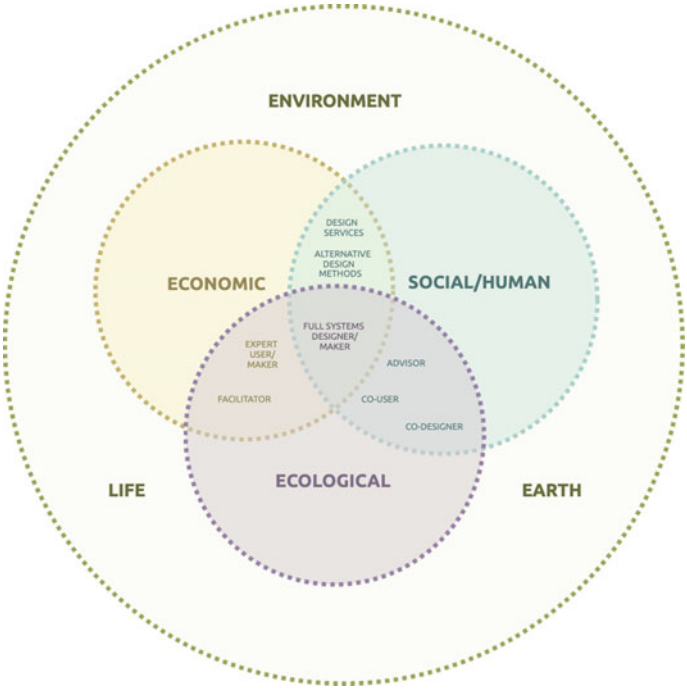

Fig. 10 Emergence [55]

4. Feedback loops (Fig. 11): Much rich engagement and connections across the fashion system have gone unnoticed and are not harnessed for the value they have for the system as a whole. First, the system needs to observe and understand this information and then intervene in feedback loops that recognise when they are *reinforcing* and *balancing*. An alternative fashion system could ignite higher levels of design such as action and experience, environment and systems, if it created stronger feedback loops which could result in greater collaboration of individuals and designer/makers in conjunction with fashion users. Designers could learn from people via 'local wisdom' [26], reflecting and reconceptualizing the role of the designer in a future fashion industry.

Causality (Fig. 12): With the perspective of causality, fashion will start to consider its agency and impacts. Consider the entire lifespan of a garment, traditionally designed with a built-in obsolescence, instead designed to last beyond a season for a deeper, longer engagement. This would be a major rethinking of how the fashion industry works and would shift the general public's expectations of and engagement with fashion. This could also shift industry concerns from purely monetary to other forms of capital, such as human, cultural, and environmental.

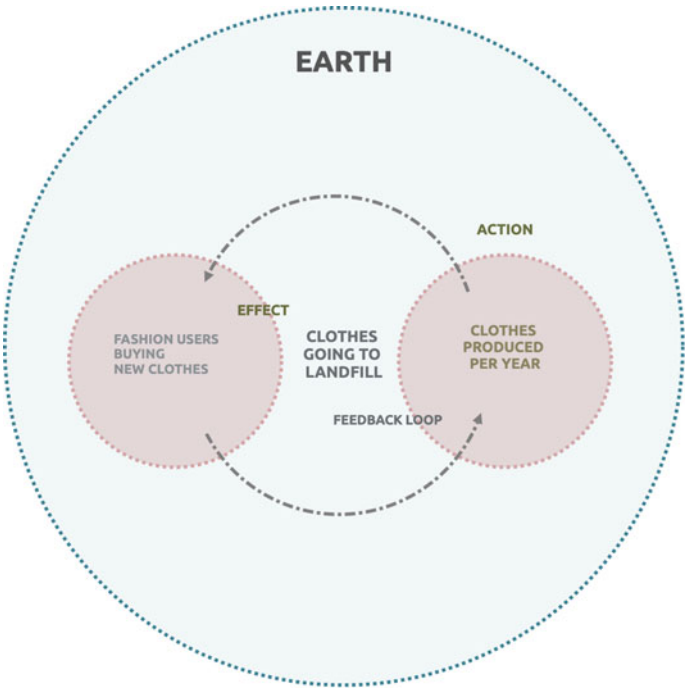

Fig. 11 Feedback loops [55]

Systems Mapping (Fig. 13): If fashion designers can identify and map the elements of 'things' within its system, they can understand how these interconnect and interrelate. This will lead to unique insights and discoveries that can be used to develop interventions, shifts, or policy decisions that will dramatically change the system. An example of this is the zero-waste fashion movement. Designers have examined and mapped part of the production process to develop a fusion of approaches between three-dimensional forms, virtual avatars, and two-dimensional pattern-making until fabric waste is minimised. This is a point of reference from which to consider how designers, working at all levels of the industry, can rethink their role and behaviour in the context of the system and sustainable design strategies.

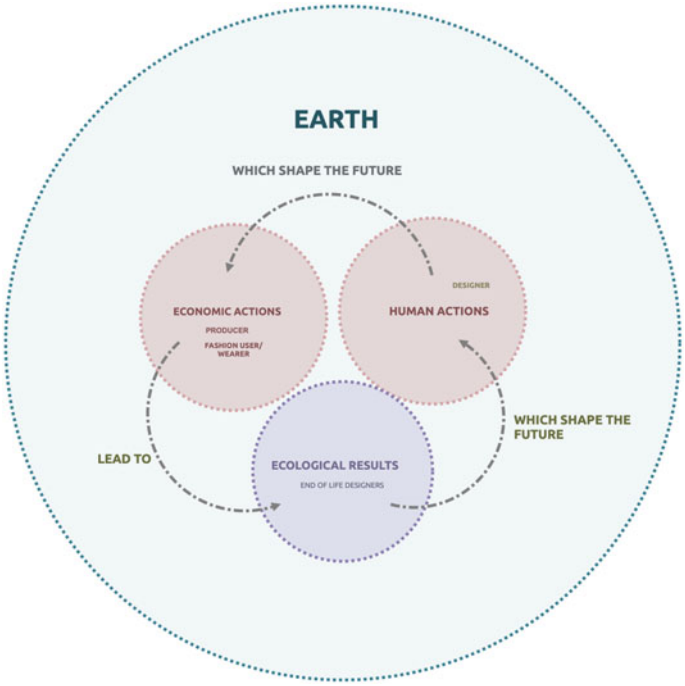

Fig. 12 Causality [55]

6 Conclusion

Systems thinking, while not a new concept for design, has significantly changed its focus in the twenty-first century from one of material systems—systems of 'things'—towards human systems and the integration of information, physical artifacts, and interactions in environments of living, working, playing, and learning [10]. It is the distinction between our traditional method of analytical reasoning and the alternative method of synthesis that forms the foundations of system thinking. We have made significant breakthroughs and leaps in progress by applying analytical thinking to human endeavours, looking through a microscope at the world, but we need to remember to shift that view to the perspective that a telescope brings to observe all the infinite possibilities of space and the universe. As Manzini [39] notes, in this time of profound change we are compelled to look at our context and consider how we, as individuals and collectives, can use our creative capacities. Fashion needs a period of self-reflection and radical change that systems thinking

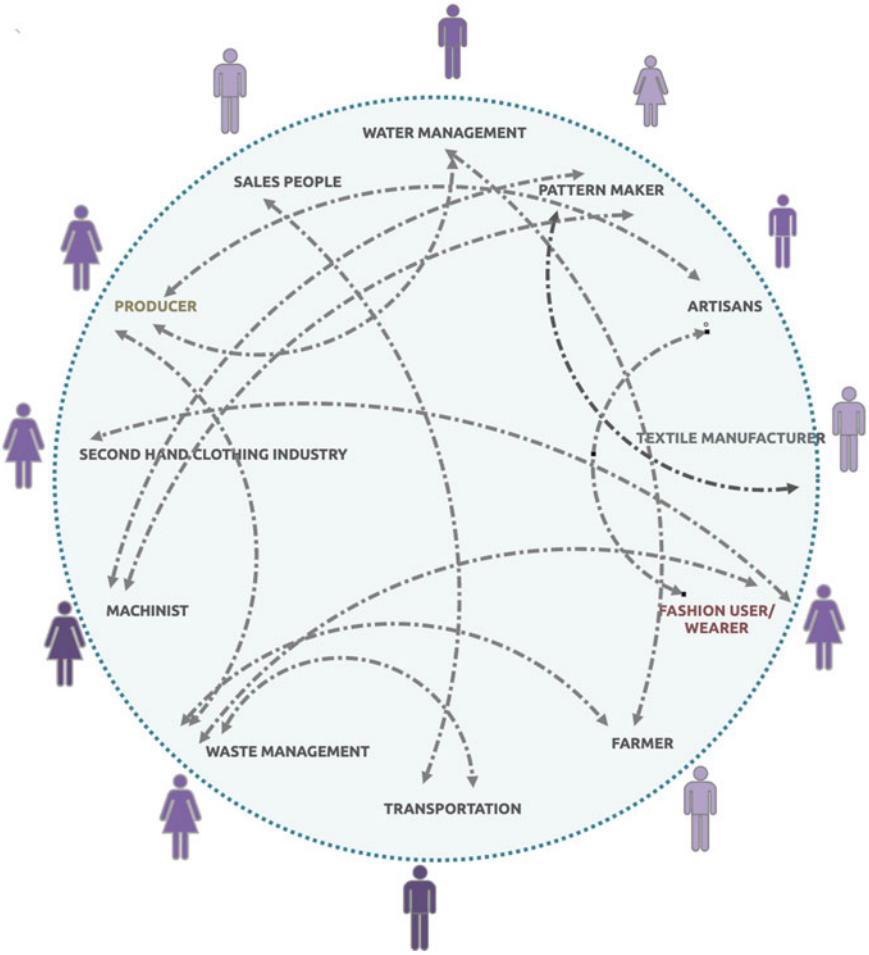

Fig. 13 Systems Mapping [55]

can bring, in order to remain relevant in the twenty-first century and to move away from a linear economy towards a circular, regenerative economy based on feedback-rich flows. The future of the fashion system is ripe for new modes of practice that challenge the dominant logic and the relationships among the designer, producer, and consumer.

References

1. Abernathy FH, Dunlop JT, Hammond JH, Weil D (1999) A stitch in time: lean retailing and the transformation of manufacturing—lessons from the apparel and textile industries. Oxford University Press, New York
2. Acaroglu L (2017) Leyla Acaroglu. https://www.leylaacaroglu.com/writing-by-leyla//tools-for-systems-thinkers-the-6-fundamental-concepts-of-systems-thinking. Accessed 10 Jan 2019
3. Barnardo's (2015) Once worn, thrice shy—British women's wardrobe habits exposed! http://www.barnardos.org.uk/news/press_releases.htm?ref=105244http://www.barnardos.org.uk/news/press_releases.htm?ref=105244
4. Bengtsson S (2013) IKEA the book: designers. Products and other stuff, Arvinius, Stockholm
5. Boggon C (2019) How polluting is the fashion industry? Ekoenergy. https://www.ekoenergy.org/how-polluting-is-the-fashion-industry/
6. Boston Consulting Group (2018) Pulse of the fashion industry report. Global Fashion Agenda. https://www.bcg.com/2018-pulse-of-the-fashion-industry
7. Boston Consulting Group (2019) Pulse of the fashion industry report. Global Fashion Agenda. https://www.bcg.com/en-us/2019-pulse-of-the-fashion-industry
8. Brown T, Katz B (2009) Change by design: how design thinking transforms organizations and inspires innovation. Harper Business, New York
9. Buchanan R (1992) Wicked problems in design thinking. Des Issues 20(2):5–21
10. Buchanan R (2001) Design research and the new learning. Des Issues 17(4):3–23
11. Chapman J (2005) Emotionally durable design: objects, experiences and empathy. Earthscan, London
12. Chapman J, Gant N (eds) (2007) Designers, visionaries and other stories: a collection of sustainable design essays. Earthscan, London
13. Charter M, Tischner U (2001) Sustainable solutions, developing products and services for the future. Routledge, London
14. Common Cause (2011) The common cause handbook. Public Interest Research Centre Ltd., London
15. Conca J (2015) Making climate change fashionable: the garment industry takes on global warming. Forbes. https://www.forbes.com/sites/jamesconca/2015/12/03/making-climate-change-fashionable-the-garment-industry-takes-on-global-warming/#21d1c4e079e4
16. Cross N (2006) Designerly ways of knowing. Springer, London
17. Cross N (2011) Design thinking: understanding how designers think and work. Berg, Oxford
18. Daly HE (1996) Beyond growth: the economics of sustainable development. Beacon Press, Boston
19. David D (2019) The real price of buying cheap clothes. BBC news. https://www.bbc.com/news/business-49248921
20. Dormer P (ed) (1997) The culture of craft: status and future: studies in design. Manchester University Press
21. Ellen MacArthur Foundation (2015) Our mission is to accelerate the transition to a circular economy. https://www.ellenmacarthurfoundation.org/
22. Ellen McArthur Foundation (2017) A new textiles economy: redesigning fashion's future. https://www.ellenmacarthurfoundation.org/publications/a-new-textiles-economy-redesigning-fashions-future
23. Encyclopaedia Britannica (2020) Ecosystem. https://www.britannica.com/science/ecosystem. Accessed 3 Feb 2020
24. Entwistle J (2015) The fashioned body: fashion, dress and modern social theory, 2nd edn. Polity Press, Cambridge
25. Fashion Revolution (2019) Consumer survey report. https://www.fashionrevolution.org/
26. Fletcher K (2011) Local wisdom. http://localwisdom.info/
27. Fletcher K (2016) Craft of use. Routledge, London

28. Friedman K (2012) Models of design: envisioning a future design education. Visible Lang 46 (1–2):132–153
29. Greenpeace (2017) Why we should make something instead of going shopping. http://m.greenpeace.org/international/en/high/news/Blogs/makingwaves/why-we-should-make-smthng-instead-of-going-sh/blog/60661/
30. Gwilt A (2012) Integrating sustainable strategies in the fashion design process: a conceptual model of the fashion designer in haute couture. School of architecture + design portfolio of design and social context. RMIT University, Australia
31. Intergovernmental Panel on Climate Change (IPCC) (2018) Special report: global warming of 1.5 °C. https://www.ipcc.ch/sr15/
32. International Labour Organisation and Walk Free Foundation (2017) Global estimates of modern slavery: forced labour and forced marriage. ILO Labour Office, Geneva
33. Irwin T (2011) Design for a sustainable future. In: Hershauer, Basile, McNall (eds) The business of sustainability, vol 2. Praeger, Santa Barbara, CA, pp 41–60
34. Irwin T (2015) Transition design: a proposal for a new area of design practice, study, and research. Des Cult 7(2):229–246. https://doi.org/10.1080/17547075.2015.1051829
35. Jackson T (2009) Prosperity without growth: economics for a finite planet. Earthscan, London
36. Krippendorff K (2005) The semantic turn: a new foundation for design. CRC Press, New York
37. Labour Behind the Label (2019) Report: tailored wages UK 2019. http://labourbehindthelabel.net/wp-content/uploads/2019/06/TailoredWagesUK-Short.pdf
38. Latour B (2005) Reassembling the social: an introduction to actor-network theory. Oxford University Press
39. Manzini E (2015) Design when everybody designs: an introduction to design for social innovation. MIT Press, Cambridge, MA, pp 241
40. Meadows DH (1992) Beyond the limits confronting global collapse. Chelsea Green Publishing, Hartford VT
41. Meadows D (2009) Thinking in systems: a primer. Earthscan, London
42. Meadows DH, Randers J, Meadows DL (2004) Limits to growth: the 30-year update. Chelsea Green Publishing, Hartford, VT
43. Morelli N (2002) Designing product/service systems: a methodological exploration. Massachusetts Inst Technol Des Issues 18(3)
44. Muratovski G (2016) Research for designers: a guide to methods and practice. Sage Publications, London
45. National Research Council (1991) Improving engineering design: designing for competitive advantage. National Academy Press, Washington, DC
46. Nielsen Global Survey of Corporate Social Responsibility and Sustainability (2015) Green generation: millennials say sustainability is a shopping priority. https://www.nielsen.com/us/en/insights/article/2015/green-generation-millennials-say-sustainability-is-a-shopping-priority/
47. Nosto (2019) Consumer survey: sustainability in fashion retail. http://pages.nosto.com/rs/339-ZHG-780/images/EN-Sustainability-Summary-2019%20%281%29.pdf
48. Porritt (2005) Capitalism as if the world matters. Routledge, London
49. Raghuwanshi S (2019) How fashion industry sustainability impacts global supply chain? Esgrobo. https://esgrobot.com/how-sustainable-fashion-impacts-global-supply-chain/
50. Raworth K (2017) Doughnut economics: seven ways to think like a 21st-century economist. Random House, New York
51. Rissanen T (2015) From 15% to 0: investigating the creation of fashion without the creation of fabric waste. Creativity: designer meets technology conference, Copenhagen
52. Sinha P (2002) Creativity in fashion. J Text Apparel Technol Manage 2(4). www.tx.ncsu.edu/jtatm/volume2issue4/…/sinha/sinha_full_25_02.pdf
53. Soper K (2011) Relax: alternative hedonism and a new politics of pleasure. Red Pepper. http://www.redpepper.org.uk/relax-alternative-hedonism/

54. United Nations (2020) The 17 goals. UN department of economic and social affairs. https://sdgs.un.org/goals. Accessed 19 Jan 2021
55. Whitty J (2021) Fashion design for holistic systems, In: Muthu S, Gardetti (eds) Sustainable Designin Textiles and Fashion, Springer- Nature Publications, Singapore
56. Yunkaporta T (2020) Sand talk: how indigenous thinking can save the world. The Text Publishing Company, London
57. Zoltkowski A (2017) What on earth is a clothing supply chain? Good on you. https://goodonyou.eco/what-is-a-clothing-supply-chain/

Jennifer Whitty is an Assistant Professor of Fashion Systems and Materiality, at Parsons School of Design, New York, where she is also the Coordinator of the BFA Fashion Systems and Society Pathway, and the Coordinator and Course Lead for a new certificate in 'Sustainable Fashion' for continuing education. As an educator, researcher, designer, facilitator, and writer with over a decade of global experience in the field of sustainable fashion design. Her work aims to usher in a new era of deep systemic change for fashion in mindsets, models, and systems that is expansive and diverse, rooted in social and environmental justice.