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Net Positive Manufacturing: A Restoring, Self-healing and Regenerative Approach to Future Industrial Development

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Abstract

In today's consumer driven society, manufacturers can exert unparalleled environmental, economic and societal influence, either for good or bad. The recent uncontrolled industrial growth within both developed and developing countries has resulted in significant damage to the environment in an attempt to sustain economic growth at any cost. In response, global sustainability initiatives, due to inherent and inevitable economic barriers, have often adopted a 'Less Bad' approach, which is based on meeting the demands of regional and national legislation and incremental efficiency measures. The benefits of such initiatives are now perceived as too small and too slow to tackle the needs of tomorrow. In this context, when 'Less Bad is Not Good Enough!', what should our aspirations and goals be beyond the scope of current sustainability strategies, methods, tools and technologies? At the heart of the proposed paradigm shift through 'Net Positive Manufacturing' is the ability of manufacturing businesses to adopt a restoring, self-healing, and regenerative approach and simply to put back more into society and the environment than what they take out. This radically novel vision for future industrial development presents a number of methodical, organisational, technological, as well as social and ethical research challenges which are explored in this paper.

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1. Introduction

Our society and environment are changing at an unprecedented rate. There is a growing body of evidence which increasingly points to serious and irreversible ecological consequences if current unsustainable manufacturing

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practices and consumption patterns continue. Fortunately, the United Nations Environmental Programme (UNEP) study entitled ‘Global Environmental Outlook (GEO-6): Regional Assessments’ indicates that it is not too late to reverse the worst impacts if consumers, industry and governments act now, citing the need for “enhancing sustainable consumption and production to reduce environmental pressures by addressing drivers associated with manufacturing processes and consumer demand” [1].

In this context, the escalating scale of the challenge ahead is becoming clear through a deeper understanding of the biophysical constraints of our planet. It has been estimated that by 2050 the global population will have risen to over 9 billion [2] and that greenhouse gas (GHG) emissions will have increased by over 50%, driven primarily by a projected 80% rise in global energy demand [3]. It has also been predicted that current reserves of copper, zinc, lead, nickel, tin, silver, and gold will almost be depleted by 2050 [4], and a study by Gardner-Outlaw and Engleman [5] states that by 2050 up to 4 billion people could live in areas facing water scarcity or stress. According to WWF and Global Footprint Network, by August 2 of this year (2017) humanity had used more from Nature than our planet can renew in the whole year. This means that the equivalent of 1.7 planets would be required to produce enough to meet humanity’s needs at current consumption rates [6].

The impact of manufacturing activities has, therefore, become an area of great focus and concern at all levels, from public through to industry, government and NGOs. A range of initiatives, investments and regulations have been put in place to mitigate the effects of manufacturing activities, however, at present these are at best just managing to slow down the rapidly intensifying environmental impact, as opposed to eliminating or reversing the damages caused, as depicted in Fig. 1.

The author’s previously reported research [7] proposed a scenario planning approach to understand the challenges and opportunities which lie ahead for future industrial development. In this research, by considering both quantitative and qualitative factors, a number of ‘SMART Manufacturing Scenarios’ have been defined to systematically identify the most influential factors affecting industry by 2050, and to mitigate against critical changes and disturbances through informed long term strategic planning activities [7].

The work reported in this paper aims to build upon this envisioning of the manufacturing challenges for 2050 through definition of a novel concept, entitled ‘Net Positive Manufacturing (*Net+ Man*)’, to better inform manufacturing companies about their wider impact and to provide greater insight into opportunities on how they can put more back into society and the environment than they take out. The *Net+ Man* concept is, therefore, not just about minimising the negative impacts, but also about redefining and re-structuring manufacturing so that all areas of society and the natural environment are demonstrably enhanced through industrial processes and systems. The initial part of this paper discusses the key learnings from the research on SMART Manufacturing Scenarios for 2050, and the latter parts present a number of methodological, organisational, technological, social and ethical research challenges to support the *Net+ Man* approach for future industrial development.

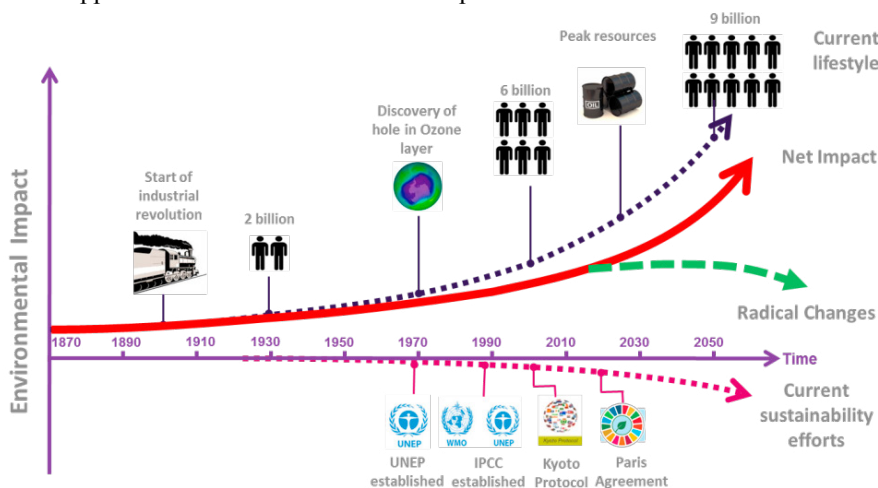


Fig. 1. The need for radical changes to eliminate or reverse the damages caused

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