

## Case study of an organisation trying to re-imagine its place in the supply chain: transformation towards industrial sustainability

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### Abstract:

**Purpose:** The paper identifies existing sustainability frameworks that help companies in decision-making, strategy and new thinking. The paper presents a case study to analyse the applicability of the different frameworks for planning for transformation towards industrial sustainability. The most popular frameworks such as cradle to cradle and the natural step are explored as an alternative design and production concept to the strategy of eco-efficiency.

**Design/methodology/approach:** The paper reports the results of exploratory case studies observed through document analysis and interviews.

**Findings:** The transformation to industrial sustainable system necessitates a fundamental redesign of products and the production system of industrial material flows within which they circulate. Cradle-to-Cradle design defines a broad framework for creating eco-effective industrial systems, but for businesses to put this framework into practice they need both the right technologies and the right strategies, which implies a need to collaborate with different actors & stakeholders across the system.

**Originality/value:** It was found that the framework of cradle-to-cradle design can help inspire new thinking and improve shared understanding through structured discussions with other actors in the system.

**Keywords:** Eco-effective, cradle to cradle, Industrial sustainability, whole system design

### 1. Introduction

Today, as a global community, we face serious challenges where demand for resources is outstripping supply and where emissions and waste have accumulated to levels that endanger our current quality of life. Sustainability can be described as an emergent property of a well-run or well-designed system. The natural world works in cycles, and in order to interact with these systems in a sustainable way, the redesign of the industrial system according to the paradigm of cyclical thinking is required [1]. In the current economic paradigm, growth is partly based on the deterioration of social and environmental systems. Senge [2] states that the un-healthiness of the world today is in direct proportion to our inability to see it as a whole. Organisations are focusing on sustainability as an objective, but

they are largely limiting their efforts to what can be done within the boundary of the firm [3].

Foresight [4] in a report named 'the future of manufacturing' predicts that in the period up to 2050, interactions between manufacturing and the natural environment will be subject to a number of powerful changes. Growing global populations will raise demand for resources, particularly as they become wealthier. Climate change is likely to increase the vulnerability of global supply chains. Consumers will call for products that meet higher environmental standards, and governments may increase their use of environmental regulations. It is stated that manufacturers will therefore need to strive for greater efficiency in their use of materials and energy, which will provide resilience to the resulting volatility in the price and availability of resources. Manufacturers will also need to explore new ways of doing business, for example by expanding into 're-manufacturing' of end of life products, or by producing increasingly robust products for 'collaborative' consumption by consumers. It is argued Industrial Sustainability will not be achieved simply by new technology: the configuration of the industrial system will need to change dramatically, introducing new concepts such as cradle-to-cradle [1,5], slow manufacturing, local manufacturing [6,7] and challenging today's business models [e.g. 8,9,10]. Society must also play a role [11], as we explore new forms of value. Following on from eco-efficiency and eco-factory programmes, those organisations, which seek to lead in this field, are already beginning to explore what the new shapes of the industrial system may be [12].

Industrial Sustainability will encourage new configurations of the industrial system. Organisations preparing for such a disruptive change lack understanding of where to focus efforts to improve the short to long term performance of industry and plan for transformation to sustainable industrial systems [13,14,15].

### **1.1 Research aims & objectives**

The aim of the research is to identify existing sustainability frameworks that help companies in decision-making, strategy and new thinking. And assess the applicability of the different frameworks for planning for transformation towards industrial sustainability through the lens of a case study.

### **1.2 Research approach**

The research approach involves two key stages of development (Figure 1);

- Review of existing Industrial Sustainability frameworks available to business decision makers.
- Analysis of existing frameworks strengths and weakness through the lens of the case study

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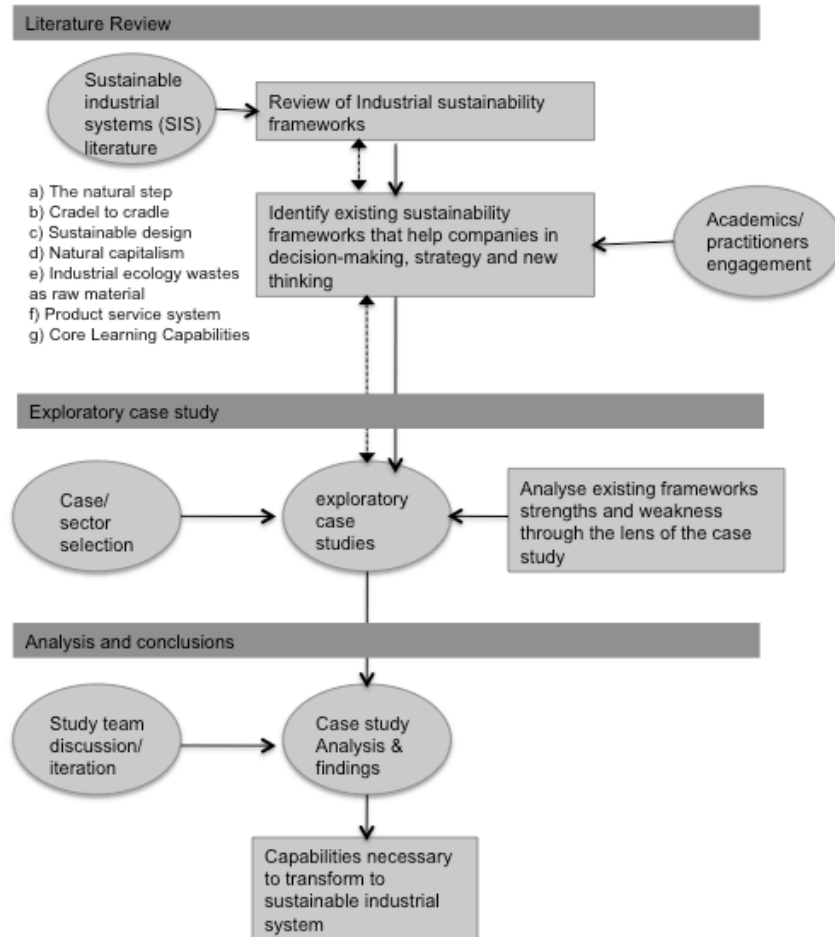
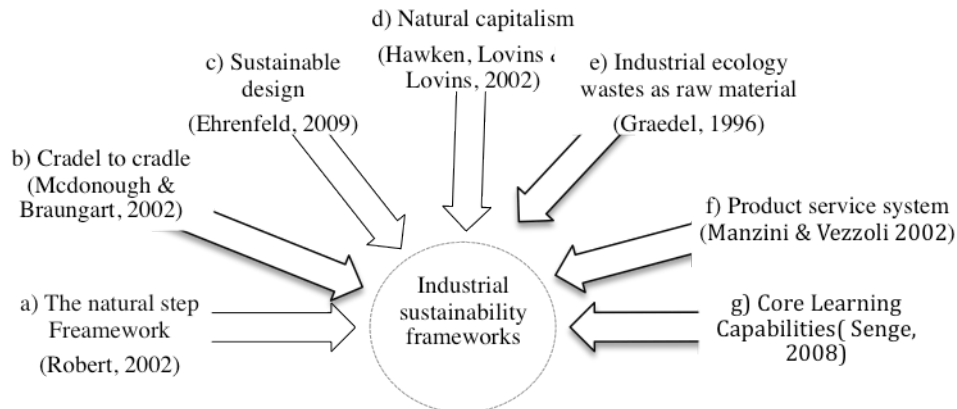


Figure 1. Research approach

## 2. Review of Industrial sustainability frameworks

Authors such as Ehrenfeld [16], Graedel [17], McDonough & Braungart [1], Robèrt [18] and Senge [19] have proposed a variety of mental models and frameworks to help industry understand what sustainability is, how it impacts upon the current industrial system and how the industrial system may have to change. This section discusses a set of frameworks available to business decision makers. The variety and content of frameworks being applied by firms that are active in the sustainability innovation space are reviewed (figure 2). Those who are starting companies or those inside established firms are taken as the target audience for these frameworks.

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**Figure 2. Selected frameworks of Industrial sustainability**

#### **a) The Natural Step Framework**

Robèrt [18] defines a sustainable society as one where nature is not subject to systematically increasing;

- concentrations of substances extracted from the Earth's crust;
- concentrations of substances produced by society;
- degradation by physical means, and in that society,
- people are not subject to conditions that systematically undermine their capacity to meet their needs.

The framework also emphasises back-casting from the desired end-point (a sustainable society and industrial system) to create a programme of change.

#### **b) Cradle to cradle model**

McDonough & Braungart [1] proposed a cradle-to-cradle model as a specific form of Industrial Ecology, whereby they separate all materials into either 'biological nutrients' or 'technical nutrients'.

- Biological nutrients can be decomposed and allowed to re-enter the natural system,
- While technical nutrients should be kept within the industrial system and used multiple times.

The authors have proposed a number of techniques, which can be used to define, measure and implement cradle-to-cradle operations

#### **c) Sustainability by Design**

The relationship between people, products and the industrial systems that develop and deliver those products is explored by Ehrenfeld [16]. The author defines sustainability as 'the possibility that humans and other life will flourish on Earth forever. Ehrenfeld [16] proposed sustainability by design as a set of root causes of unsustainability. This includes the consumption culture and a poor understanding of the complex interactions between people, products and planet and seeks a balanced approach to achieve significant change, while holding onto the best of current systems.

#### **d) Natural Capitalism**

Hawken, Lovins & Lovins [20], draw a picture of the 'next industrial revolution' being based on four strategies:

- radically increased resource productivity,
- redesigning industry based on biological models with closed loops and zero waste,
- shifting from the sale of goods to the provision of services,
- reinvesting in natural capital.

They argue that the growing scarcity of natural resources will act as the catalyst for the next industrial revolution in a similar way that the scarcity of human resources drove the logic of the first industrial revolution.

#### **e) Industrial Ecology model**

Graedel [17] based on a comparison between industrial and natural ecosystems, Industrial Ecology seeks to position the industrial system within the ecosystem and to emulate that system's ability to use all its wastes as raw material for other life processes. In Industrial Ecology practice we already see many manufacturers using waste from others for their own processes.

#### **f) Product service systems (PSS)**

Many authors envisage the transformation of existing product-based production systems to systems based on delivering a combination of products and services (or services that provide access to products).

The concept of such product service systems is closely aligned with other business models, which reduce material consumption by increasing the information-density of products (where the market value comes to reflect the information, rather than the material content of the product). The primary logic is to sell the function valued by the end customer and remove the current link to ownership of products as the way to deliver value.

In most information intensive products the information content provides some additional service function; for example, the value of a mobile phone derives from its communications and other information services and such information systems now constitute a substantial part of the value of many other products, from domestic appliances to automobiles. In general the services or information added to a product contribute to its dematerialisation, reducing the amount of material required per unit of value [21].

A Product-Service System is defined as the result of an innovation strategy, shifting the business focus from designing and selling physical products only, to selling a system of products and services which are jointly capable of fulfilling specific client demands [22].

#### **g) Core Learning Capabilities for systemic change**

Senge [19] proposes 3 core learning capabilities; seeing systems, collaborating across boundaries and creating desired futures for systemic change. The author argues that these capabilities are needed for creating regenerative organisations, industries and economies and states and that if you take away one the whole fails.

### **3. Case study selection**

The review of the applicability of the industrial sustainability frameworks identified in (section 2.0) require focal firm engagement. Due to the complexity associated with the broad scope and data set to be reviewed, a case study analysis was deemed appropriate. As a research method addresses exploratory questions and aims to produce a first-hand understanding of complex phenomena.

This research is exploratory in nature, involving understanding of the applicability of framework to decision makers through the case study. The use of multiple data collection instruments within the research methods assisted with triangulation of data, thereby strengthening the largely qualitative outcomes of the research. Moreover, it supported the reliability and validity of the findings. The applied data collection tools include semi-structured interviews with open questions and documentation reviews. The interview template takes the form of a questionnaire against the industrial sustainability frameworks (research instrument). Interviews were conducted with a cross-functional group of senior management respondents of the focal firms, including senior management and environmental lead roles. The semi-structured interviews were conducted with the aim of gaining comparable views of competing company sustainability strategies based on emerging research into the creation and transformation to sustainable industrial systems.

All interview notes were sent immediately for comment, with further analysis fed back to participants. The approach was set up to ensure that there is both a discussion and consistent output across the case study firm. Finally, the data set was further reviewed against secondary data from published reports. The epistemological positioning of the research and case study protocol used in this research meet the validity strategies suggested by Creswell and Miller [23] including triangulation, member checking and the audit trail.

The case study chosen to review the industrial sustainability frameworks had unique business strategies, with complex multi-domestic footprints and some level of published sustainability credentials (i.e. that might support advanced sustainability performance). In addition, data availability and accessibility were determinant factors in the case selection process

#### **3.1 Case study analysis and findings**

The results of an exploratory case study observed through document analysis and interviews are presented (section 3.2). In this section we explain the company background, why the organisation is making the transformation, what is it actually doing and how it finds out what the possibilities are? Based on this, the paper then

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presents an analysis of strengths and weakness of popular industrial sustainability frameworks in terms of their ability to explain and encourage transformation toward industrial sustainability (section 3.3).

### **3.2 Case company findings**

The company selected has looked into the future and identified the need to change, and targeted key aspect of their business for change, hence was selected in this study.

The case company, Expo Industrial Group [24] is a merchandise brand labelling and packaging manufacturer with its manufacturing base in South East Asia (Sri Lanka, India, Bangladesh) and product development offices in United Kingdom, United States of America and Hong Kong, supplying to global apparel and retail EU & US markets. The company has taken action in areas such as product innovation focusing on product design, employee care, logistics truck sharing initiative, building eco-factory, complying with global standards such as ISO 9001 quality management systems, ISO 14001 environment management system, SA 8000 social accountability systems, collaborating and working together with supply chain partners on system-level strategies. The company recognises that they are at the early stages of a long journey.

#### **a) Why the organisation is making the transformation?**

##### **- Leadership & culture:**

The Company understands the significance of building the business with socially and environmentally sound behavior, which is critical to its success. Being a family owned business, a group-wide dedication to meeting corporate and social and environmental responsibilities is at the core of the company.

##### **- Customer expectation:**

The Company recognised that their customer expected them to address their environmental impact as part of 'business as usual'. This meant buyers and supply chain partners had to work together in partnership to combat climate change, reduce waste and safeguard natural resources. Buyers assess progress through implementation of sustainability supplier scorecard initiatives, which is targeted to improve key environmental sustainability indicators (energy, water, emissions, waste) and social indicators (employment, wages and benefits, health and safety, equal opportunity, stakeholder involvement). It is found the initiatives encouraged the sharing of ideas and capabilities to improve sustainability performance to deliver more sustainable products and services. Overall the sustainability programs resulted in bottom line saving.

**b) What is it actually doing?**

**- Partnerships & innovative business models:**

The company introduced an innovative business model 'in-house printing', through partnerships and collaboration with the customer to manufacturer on demand with no additional buffer stock. The company worked together with the clothing manufacturer and buyer to produce only the required amount of packaging and labeling. By offering and investing in in-house print solutions i.e. setting up print centres at the customer premises and synchronising the production plans of both parties through integration of ERP systems. The company was able to manufacture labelling on demand instead of manufacturing according to forecast; this initiative resulted in elimination of excess buffer stock in production. The strategy has proven to provide long-term value, reduce material wastage, lead-time significantly and improve speed.

The company has taken the lead in implementing Initiatives such as truck share with the aim to eliminate empty miles. Through sharing delivery schedules, working in partnership with different suppliers who required delivery on the same route and installing GPS tracking devices on the trucks.

It is found the implementation was possible by overcoming the behaviour of being reluctant to experiment with new or unknown technologies, partnering with new actors and initiating voluntary partnership programs that create a win-win.

**- Eco Factory & seeing waste:**

The company has invested in building a 120,000 sq ft factory to LEED Gold standard (Leadership in energy and environment design). Implementing manufacturing best practices such as lean, 5S Japanese improvement process (Sorting 'Seiri', Streamlining 'Seiton', Systematic Cleaning 'Seiso', Standardise 'Seiketsu', Sustain 'Shitsuke'), investing in waste minimisation and prevention projects and creating employee awareness and care for workers. It is found by implementing above the company has been able to create a work culture to achieve zero waste to landfill, achieve reduction in carbon emissions, energy saving and water consumption. The employees are constantly invited to be a part of the innovation process. It was observed the Innovation and creativity were highly prized in the company. Solutions from co-workers that improved the company's operations were standardized throughout the organization and the employee rewarded. Shop floor worker were invited, equipped and supported to try and put forward new solutions by top-level management.

Complying with global standards such as ISO 9001 quality management systems, ISO 14001 environment management system, SA 8000 social accountability systems. It is found has provided the practical tools and procedures for tackling many of the manufacturing challenges to improving the workflow. The International Standards is found to aid optimise operations and therefore improve the bottom line. It is found to improve quality and enhance customer satisfaction. It has helped communicate and prevent trade barriers and open up global markets and increase productivity and competitive advantage.



The green factory to people friendly manufacturing plant has resulted in benefits in both top and bottom line performance, through effective cost and waste management and higher productivity.

- **Product Innovation:**

The company through innovative product design has been able to work closely with its customer to reduce the amount of packaging required. It is found the company by collaborating with a chemical company was able to access the knowledge necessary to produce recyclable packaging to the retail industry. The chemical company was able to provide solutions to replaced non-recyclable lamination in packaging with water base barrier coating so that it is recyclable and biodegradable.

- **Social outreach program:**

The company in partnership with the federation of wildlife conservation (FWC) in Sri Lanka, through the launch of a campaign dedicated to raising public awareness is focused on preserving the Island's lush natural heritage. Having identified the need to educate, inspire and activate the public, the Group is part of a project that includes the Ministry of environment, Ministry of education, the Ministry of highway development and the FWC.

- **Shared vision, common understanding and joint action:**

The company engages with industry affiliations such as the 'Sri Lanka Apparel' to create a common vision and take collective action to position Sri Lanka's apparel Industry as a preferred ethical apparel sustainable sourcing destination on the global sourcing map and transform the industry from a manufacturer driven business mindset to an end-to-end fully integrated apparel solutions provider.

Visionary leaders, decision makers and entrepreneurs representing the value chain engage to take action at Industry level with one voice, give guidance and share best practices throughout the supply chain. It is found the uniqueness of the industry affiliation is that for the sake of the industry progress, conflicting interests are managed internally through discussion, and though individual companies are competing with each other, as one voice they are able to recommend needs to policy makers, and are able to set a common vision for the industry to work towards and share best practices and develop the capability of the sector at a country-level. It is found affiliations aid and provide the platform to bring together actors in a pre-competitive space and drive systemic change with a common understanding and collective vision.

**c) And how does it find the possibilities for transformation?**

It is found the company by observing other industries for lessons, e.g. Inspiration from Toyota (automobile sector) to implement lean system. The management have developed the capability and skills to see waste in the organisation and take action. By engaging with academia is able to develop and better understand new skills and capability required. It is found the company by working with industry affiliations, through multi-stakeholder engagement are able to lead the industry

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toward a shared vision of sustainability, build a common understanding and priorities action and opportunities collectively.

### 3.3 Analysing existing frameworks strengths and weakness in relation to case study

In this section Table 2 presents the strengths & weaknesses of the frameworks observed through the lens of the case study company.

Each framework in turn was presented to the company and discussed, what matched and what didn't match and what might be missing to plan for transformation towards industrial sustainability. The analysis of strengths and weakness of the frameworks in terms of their ability to explain and encourage transformation toward industrial sustainability is presented.

**Table 2. Case study: Strengths & weakness of the frameworks**

**a) The Natural Step Framework**

**Strengths:**

- The framework helps understand whether the system designed is moving towards sustainability or not.
- Assists in understanding, describing and analysing the dynamic relationships between the ecological and social systems
- Aids planning actions needed using back-casting technique for strategic planning.
- Creating shared understanding

**Weaknesses:**

- The framework is not strong in dealing with collaboration, i.e. how to collaborate with other people. (Role of collaboration was clearly important to the case company in achieving its sustainability goals)
- Requires expert facilitation when starting the journey (training programs, systems thinking)

**b) Cradle to Cradle model**

**Strengths:**

- Offers the mechanical rules for designing the new system
- Help understand the need to separate and identify the biological and technical nutrient flow
- The concept 'waste equals food', aids the ability to see waste as a nutrient

**Weaknesses:**

- Does not provide sufficient details on how to manage new relationships
- High levels of knowledge of the toxicological and eco-toxicological characteristics of the substance are needed but not available within the case company
- Require expert knowledge for business executive to design and implement such a system

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**c) Sustainability by Design**

**Strengths:**

- Provides the understanding sustainability by design as a set of root causes of unsustainability
- Aids in understanding the consumption culture and a poor understanding of the complex interactions between people, products and planet
- Helps understand new strategies are need to attain sustainability, to continue to deliver all the qualities of life we hold important
- Provides an understanding of the way that humans and the natural world work

**Weaknesses:**

- Does not provide a methodical set of steps to apply to transform consumer culture, both individually and collectively
- Case company found it did not provide enough details and tools on how to design for care though it triggered the need to shift.
- The case company found it needed a better understanding of the relationship between the industrial and ecosystems. Expert knowledge required.
- Not strong in understanding customer value.

**d) The Natural Capitalism model**

**Strengths:**

- Integrates insights from eco-efficiency, nature's services, and biomimicry.
- Defines four major shifts in business practices required, which helps with strategy formation

**Weaknesses:**

- Does not provide enough details on how to value natural capital

**e) Industrial Ecology model**

**Strengths:**

- Give a lot of thought on pairing up with other actors/organisation and match material flows
- Provide sets of design rules

**Weaknesses:**

- Little thought on how do you manage the relationship
- Who's the suppliers, who's the receivers (does that matter)
- Who gives the contract to whom (who is the lead contractor)

**f) Product service systems (PSS)**

**Strengths:**

- Aids in understanding mechanism to reducing material consumption by increasing the information-density of products

**Weaknesses:**

- Does not provide understanding of skills and capabilities required for decision making to effectively shift manufacturing businesses from product selling to PSS offering.

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- Lacks methodology to identify the new value proposition to change business model
- Lack understanding of which tools and methods enable transformation to PSS? For instance, which tools support innovation (e.g. design thinking) and strategy implementation, and how can performance and societal impacts be managed or measured (e.g. sustainability scorecard)

#### **g) Core Learning Capabilities for systemic change**

##### **Strengths:**

- Provides the understanding that the core learning capabilities is essential and must be developed together and people do not learn how to develop the collective systems intelligence to tackle complex problems if not.

##### **Weaknesses:**

- Does not provide the tools and knowledge for collectively seeing systems, collaborating across boundaries and creating desired futures

### **4. Discussion**

Today, leaders, managers and entrepreneurs are challenged to contribute to sustainable development on the individual, organisational and societal level. It is found that common approaches of technological, process, and product innovation are insufficient to create the required transformation of organisations, industries and societies towards Industrial sustainability. Organisation need to learn how to use significantly less material and energy to create the same or better customer value, while creating little or no waste in today's volatile world. Practitioners are exploring and experimenting, how new business models can help maintain or even increase economic value of the businesses by either radically reducing negative or creating positive external effects for the natural environment and society. It was found the case company had addressed production related waste by implementing lean principles, 5S, waste management and prevention best practice, which the company learnt and implemented by observing the automobile industry. Through collaboration with new actors the company was able to access technical knowledge to launch an innovative product design that is recyclable. Through strategic partnerships and innovative business models to provide in house print solution, the company was able to create long-term value and eliminate unwanted buffer stock in production resulting in significant waste minimisation. It was found, one of the mechanisms to collaborate and co-ordinate industry actors in a non-competitive manner was through Industry affiliation channels, where a shared

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vision and strategy for end-to-end supply chain partners and best practices can be shared and implemented jointly.

It was observed that frameworks were used by manufacturers to navigate their way through the complexities of designing sustainable industrial systems, strategy formation and aid long term planning. Frameworks help reflect the need for 'closed loop' cycles for components and materials (where materials are not lost to the system), and trigger thoughts on networked-distributed production, system resilience and learning from biological examples. It was found from the case study analysis that frameworks such as industrial ecology and cradle-to-cradle provide sets of design rules that contributes towards learning from the characteristics of natural systems [16]. From an industrial design perspective this means developing materials, products, supply chains, and manufacturing processes that replace industry's cradle-to-grave manufacturing model [5]. It was found through use that the cradle to cradle framework is strong on establishing the mechanical rules necessary to design a industrial system, It required high level of knowledge of the toxicological and eco-toxicological characteristics of the substance which was not available within the case company.

The core learning capabilities proposed by Senge [19], are confirmed in the case, where it was found that without the capacity to see systems and their place in them, people and organisations will naturally focus on optimising their piece of the puzzle rather than building shared understanding and a larger vision. It was observed that one of the shortcoming of this model is that it does not provide understanding of application of the models to current business practice. For example; how to see in systems, how to co-ordinate with new actors and collaborate across boundaries.

It was observed that frameworks such as the TNS and back-casting technique facilitated the development of a shared understanding, and helped to align the actions of different actors needed, while still allowing them to work independently. It aided with structuring a process for working together to identify, organize, and prioritize actions and have a discussion with different actors in the system.

## **5. Conclusion**

The evidence observed from the case study demonstrates that dramatic improvements can be made at the level of sub-systems, such as factories or businesses. It also shows that the understanding and capabilities necessary to enable changes in the whole industrial system can be developed collectively using techniques such as back-casting. It was found that working with industry affiliations is one mechanism to work together in a pre-competitive space and drive systemic change. It was found that through multi-stakeholder engagement, the affiliations are able to lead the industry toward a shared vision of sustainability and build a common understanding and priorities action and opportunities collectively.

It is found from the case study implementation of innovating business models was possible by overcoming the behaviour of being reluctant to experiment with new or

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unknown technologies, partnering with new actors and initiating voluntary partnership programs that create a win-win.

The Frameworks help understand what sustainability is, how it impacts upon the current industrial system and how the industrial system may have to change. Frameworks are used by manufacturers to navigate their way through the complexities of designing sustainable industrial systems, strategy formation and long term planning. It is observed that the framework's basic principles for sustainability are essential to guide problem solving and launch system-level planning programs. It was found the framework aided the case company with planning what information is relevant to problems and solutions, and discovering which information is missing. It offers a way to organize thinking and have dialog around the complexity of sustainability. Frameworks were observed to give the actors in the system a common language and a way to unify their efforts in the same direction from their various areas of expertise.

Frameworks help managers and decision makers to shift their attention from eco-efficiency (less bad) to eco-effectiveness (more good). It is observed organisations need to develop their skills and capabilities to see materials as nutrients that can be maintained in two safe metabolisms: biological and technical as proposed by McDonough & Braungart [5]. Cradle-to-Cradle design defines a broad framework for creating eco-effective industrial systems. It is found for businesses to put this framework into practice they need both the right technologies and the right strategies, which implies a need to collaborate with different actors & stakeholders across the system. It is observed the framework can help inspire new thinking and improve shared understanding through structured discussions with other actors in the system.

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