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**Industry and environment –  
The need for a new industrial revolution**

**Vienna, Austria**



**Round Table 2**  
**Industry and environment –**  
**The need for a new industrial revolution**

Tuesday, 2 December 2003, 9:00 -11:00 a.m.

**I. Introduction**

Ever since the publication of “Our Common Future” in 1987 (commonly known as the Brundtland Report), there have been calls to radically rethink the relationship between our societies and the environment in general, and industry and the environment in particular. Many proposals have been put forward: the Factor Ten or Factor Four proposals (where countries would commit to 90 percent and 75 percent reductions, respectively, in energy and materials intensity); adoption of the concepts of industrial ecology (where groups of enterprises use each other’s wastes as raw materials); dematerialization (the replacement of physical products with non-physical products or services, thereby reducing a company’s production, demand and use of physical products, and the end-user’s dependence on physical products); Zero Waste initiatives (the recycling of all materials back into nature or the marketplace in a manner that protects human health and the environment), the Natural Step (a framework of four principles promoting reduction, reuse, recycling, and composting), to name but a few. The need for such a radical realignment was underscored when the Member States of the United Nations declared in their Millennium Declaration of 2000 that “the current unsustainable patterns of production and consumption must be changed in the interest of our future welfare and that of our descendants” and adopted as one of the Millennium Development Goals that of ensuring environmental sustainability.

In the last years of the last century and the early years of this, two books were published that took up many of these proposals and wove them together into radically new programmes for reaching environmentally and socially sustainable development: “Natural Capitalism, The Next Industrial Revolution” by Paul Hawken, Amory B. Lovins and L. Hunter Lovins, published in 1999, and “Cradle to Cradle, Remaking the Way We Make Things” by William McDonough and Michael Braungart, published in 2002. This paper reviews the principal ideas proposed in these two books and explores their practicability and applicability to the situation in the developing countries.

## **II. “Natural Capitalism, the Next Industrial Revolution”**

The authors start with the contention that the central failure of current economic policies is to considerably undervalue natural capital used in our economic systems - the natural resources that are the inputs to our economies, but also the ecosystems that absorb, break down, detoxify and recycle our economies' waste materials. As a result, the world's stocks of natural capital are currently being consumed at unsustainable levels. The authors go on to propose that four central strategies need to be adopted if we wish to avert scarcity, perpetuate abundance, and provide a solid basis for social development. They see these strategies as the basis of responsible stewardship and prosperity for this century and beyond.

The first is to radically increase resource productivity, which the authors see as offering three significant benefits:

- It lowers resource depletion at one end of the value chain;
- It lowers pollution and waste at the other end of the value chain;
- In the specific case of energy efficiency, it reduces the much of the threat to climate due to CO<sub>2</sub> emissions from fossil fuels;
- It provides a basis to increase worldwide employment with meaningful jobs.

The result of this can be to lower costs for business and society, which no longer has to pay for the chief causes of ecosystem and social disruption.

The second central strategy that the authors propose is the strategy of biomimicry, in which industrial systems are redesigned along biological lines. Rather than having materials primarily used in a linear fashion by our economies (raw materials extracted from the natural environment, and the products which are made from them dumped into the environment when no longer needed or functioning), as is the case today, products and industrial processes should be changed to mimic the biological world, where materials are constantly cycled through the environment and reused. This includes the use of no-fossil-carbon fuels like biomass and renewables.

The third central strategy put forward by the authors is to bring about a fundamental change in the relationship between producers and consumers, shifting from an economy based on goods and purchase to a service and flow economy. Essentially, this requires manufacturers to cease thinking of themselves as sellers of products (e.g. washing machines) and become instead deliverers of services (e.g., the washing of clothes at home) provided by long-lasting, upgradeable durable goods. In the authors' words, “[t]his concept offers incentives to put into practice the first two innovations of natural capitalism by restructuring the economy to focus on relationships that better meet customers' changing value needs and to reward automatically both resource productivity and closed-loop cycles of materials use.”

The final central strategy presented by the authors is to invest in natural capital. As the authors see it, “[t]his works towards reversing world-wide planetary destruction through reinvestments in sustaining, restoring, and expanding stocks of natural

capital, so that the biosphere can produce more abundant ecosystem services and natural resources.”

### **III. “Cradle to Cradle, Remaking the Way We Make Things”**

The authors start by taking aim at eco-efficiency, a term coined by the World Business Council for Sustainable Development in 1992 (it can be considered equivalent to Hawken’s and the Lovins’ strategy of increasing resource productivity). They contend that eco-efficiency is not the path to sustainability that it is so often claimed to be by various groups. As they put it, eco-efficiency essentially advocates doing more with less, allowing industry to grow and prosper while at the same time using fewer resources, producing less waste, and generating less pollution. In their view, increasing resource productivity (alone) does not avoid the inevitable catastrophic scarcity of natural resources that will occur; it merely makes the inevitable take longer to happen. It also is a strategy that is fundamentally incompatible with human nature; human beings find it difficult to accept a strategy that perpetually asks them to do with less.

The authors argue instead that economies should primarily follow strategies of eco-effectiveness. Fundamentally, this is equivalent to Hawken’s and the Lovins’ strategy of biomimicry, where the flows of materials through our economies are circular, with materials being reused over and over again. The authors of “Cradle to Cradle” refine the concept to argue that two major and distinct flows of materials must be created, one made up of biodegradable materials, which they call “biological nutrients”, and one made of non-biodegradable materials (such as metals and plastics), which they call “technical nutrients”. The Earth’s natural cycles will ensure that the biological nutrients are recycled, while our economies will need to put in place the necessary systems to recycle the technical nutrients. For this recycling of materials to occur properly the authors argue that product design becomes vitally important. It is only by designing products that can easily be consigned to one or the other of the two nutrient flows that the material loops of technical or biological nutrients can be properly closed. The authors also introduce the concept of maximizing the use of current solar income through the use of renewable energy sources. This too requires radical redesigns of the products we use.

To this the authors add the concept of a product as a service, at least for products made of technical nutrients. In the words of the authors, “[i]nstead of assuming that all products are to be bought, owned, and disposed of by “consumers”, products containing valuable technical nutrients … would be reconceived as *services* people want to enjoy. In such a scenario, customers (a more apt term for the users of these products) would effectively purchase the service of such a product for a *defined user period* … When they finish with the product, or are simply ready to upgrade to a newer version, the manufacturer replaces it, taking the old model back, breaking it down, and using its complex materials as food for new products” [all italics are the authors’].

#### **IV. Comparison of the Two Approaches**

The approaches advocated by Hawken and the Lovins', on the one hand, and McDonough and Braungart, on the other, are in many ways very similar. Both stress the vital importance of creating economies where the flow of materials through them is circular rather than linear. Both stress the centrality of product design to make this happen. Both see a change from manufacturers selling products to offering services as a necessary outcome of this approach. Both argue that there are actually large cost-savings to be made if circularity rather than linearity is adopted, since companies can design out of the product many of the current, and generally hidden costs, associated with the handling, transportation and disposal of materials. Both suggest the use of renewable energy sources. Both emphasize that social equity can be significantly enhanced by this approach.

Where they appear to differ sharply is the importance they give to the strategy of improving resource productivity. In their book, McDonough and Braungart strongly reject this as a valid strategy, whereas Hawken and the Lovins' have it as one of their four central strategies. However, in discussions Mr. Braungart has held in UNIDO, he has made it clear that what he and McDonough are actually against is adopting improvement in resource productivity, or eco-efficiency, as the only strategy towards environmental sustainability. If it is used together with eco-effectiveness (as an add-on to eco-effectiveness) eco-efficiency has its merits.

The vision, then, that both sets of authors promote is one where:

- Our societies move towards circular flows of materials through our economies on an (almost) infinite basis;
- The size of these flows can be reduced through greater efficiency in the use of the materials (Hawken and the Lovins stressing this more than McDonough and Braungart);
- Circular flows encourage, and are supported by, changes in the relation between manufacturer and user, where manufacturers change from selling products to supplying services;
- There is a move towards the use of non-fossil-carbon energy sources.

In both books, the role of industrial design in bringing this about is extremely important, if not paramount in the case of "Cradle-to-Cradle". Both sets of authors stress that the quasi-infinite circulation of materials in our economies is only possible if products are designed to allow this to happen.

#### **V. UNIDO's Activities in the Field of Cleaner Production**

The strategy promoted by both sets of authors fits well with the concept of cleaner production as defined by UNEP and adopted by UNIDO. Therefore, it is valuable to briefly review UNIDO's activities in this field, in which it has been working since at least the early 1990s. One of UNIDO's major cleaner production activities is the work it is undertaking under the Montreal Protocol. It also has a strong programme to establish National Cleaner Production Centres (NCPCs) in the developing countries

and countries with economies in transition. In addition, UNIDO undertakes cleaner production work through its leather and textile units, as well as through such focused programmes as that on mercury reduction in artisanal gold mining. Finally, UNIDO is working in the field of renewable energy and industrial energy efficiency.

UNEP has defined what cleaner production means for production processes, for products, and for services. For production processes, cleaner production means reducing the amount of raw material and energy inputs into processes; eliminating the use of toxic and dangerous raw materials in processes; and reducing the quantity and toxicity of all emissions and wastes released from processes, at their source in the process. This is equivalent to the radical increase in resource productivity promoted by Hawken and the Lovins, and to the eco-efficiency discussed by McDonough and Braungart. To date, this is where UNIDO has focused most of its cleaner production work.

For products, cleaner production means reducing their environmental, health and safety impacts over their entire life cycles, from their manufacturing (which is equivalent to cleaner production in production processes), through their transport and use (where cleaner production reduces the consumption of natural resources by the product during use and during its transportation), to their ultimate disposal (where cleaner production ensures that the materials of the product are re-used to the maximum extent possible). Thus, there is an element here of resource productivity increase/eco-efficiency but the definition also covers the concepts of biomimicry/eco-effectiveness. UNIDO has been involved in product design, particularly in the leather and textile units, but not necessarily from an environmental point of view. This is changing now, with the NCPCs in particular getting more involved in environmentally driven product (re)design.

For services, UNEP simply states that cleaner production implies incorporating environmental concerns into designing and delivering services. This is much weaker than the two books' concept of moving from manufacturing goods to offering services. UNIDO has not worked at all in this area.

## **VI. The Applicability of the Concepts to the Situation in the Developing Countries**

By far the largest consumer markets are in the developed countries. Therefore, it is only if these countries act that there will be a significant move towards the sustainable patterns of production and consumption<sup>1</sup> that both sets of authors proclaim are necessary. Furthermore, it is in these countries that the overwhelming majority of consumer product design takes place. A measure of the latter contention can be had from data on the resources spent by the private sector on research and development -

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<sup>1</sup>A working definition of sustainable consumption has been given as "the use of goods and services that respond to basic needs and bring a better quality of life while minimizing the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardize the needs of future generations." Sustainable production is one that supports such patterns of consumption.

product innovation necessarily requires R&D – that is shown in figure 1 (produced by UNIDO's Strategic Research and Economics Branch). This is a Lorenz Curve of private sector R&D spending in 87 countries, and it shows that 95% or more of such spending worldwide takes place in the developed countries.

Therefore, significant worldwide progress in the implementation of the concepts advocated by both sets of authors will only come about if the industries based in the developed countries and their designers adopt them (either voluntarily, because they appreciate the important cost savings and/or increased market share they can obtain, or because public policies are passed to make it happen).

One could argue that the revolution has already started. For quite a number of years now, there have been regulatory and non-regulatory pressures in the developed countries to make companies design consumer products so that they are more efficient during use or use less toxic/hazardous compounds. For instance, fuel efficiency in cars has been a subject of concern for many years. A number of energy labeling regulations exist, and these have encouraged companies to make their consumer products more energy efficient. Various eco-labeling schemes, while still quite weak, have encouraged some companies to redesign their consumer products to make them more efficient during use in the consumption of water, detergents or other materials. This would fall into the category of eco-efficiency or increased resource productivity. Small steps are now being taken in the direction of eco-effectiveness or biomimicry. The European Union and Japan are moving forward on directives or laws that promote so-called product take-back or extended producer responsibilities for certain categories of consumer products. These policies require the manufacturers of certain product categories to take back their products once consumers no longer want them. Generally, the driving force behind such policies are to resolve waste management and disposal problems, but the fact of forcing companies to take back their products is already leading to a growing movement in redesign of consumer products to extend their useful lives and/or to make them more easily recyclable once they are taken back. Even the concept of consumer products becoming services has already been exploited by a limited number of companies.

So where does this leave the developing countries? Would this new industrial revolution pass them by? Would they be affected by it in any way? Would they have a role to play in it? In today's globalized world, a revolution of this magnitude would assuredly not leave the developing countries unaffected. They would definitely be impacted by a series of knock-on effects; whether overall these impacts would be for better or for worse is difficult to say at this stage. In general, their role in this revolution would be modest but there would be one area where they could play an active and positive role. These points are dealt with below.

## **A. The Knock-on Effects and their Impacts**

### **1. The Effect on Globalized Material Flows**

One of the primary outcomes of globalization is that many of the products consumed in the developed countries are manufactured in the developing countries, often also using raw materials extracted in these countries. This has enormously increased the global flow of finished or semi-finished products. Given this, there appear to be three possible consequences for the developing countries from a strong trend towards circularity of material flows have in the developed countries. One could be positive for the developing countries, the other two not.

- Developed countries could adapt their economies to send the used materials back to the developing countries for reprocessing into new products. This would tend to further develop the manufacturing economies of developing countries.
- If the costs of sending the used materials back were too high, developed countries might begin to shift manufacturing back, in which case developing countries would begin to lose their export-oriented manufacturing base.
- In either case, many of the resource-based industries in the developing countries will come under pressure; in theory, economies with circular flow of materials no longer require the extraction of non-renewable resources such as metals (or only require it if there are overall increases in the circular flows due to population increase, or there are losses, or for some other reason).

*To date, there appears to have been no studies on this topic. As part of its Global Forum activities, UNIDO could explore the possible outcomes of material flow circularity on global flows of products and manufacturing in the developing countries.*

### **2. The Effect on Global Supply Chains**

In cases where global supply chains continue after the adoption of policies for circular material flows (see above), the patterns of manufacturing in the developing countries could nevertheless be quite significantly altered, for a variety of reasons:

- Substantial modifications to manufacturing processes would be required to deal with recycled rather than virgin materials, or to substitute biodegradable materials for non- and vice versa.
- It is quite possible that it would be cheaper to disassemble products in the developing countries, and this would require developing new processes and new skills in the developing countries.
- Specifications on materials used in products and in processes will certainly become much more demanding since one of the primary design concerns will be to ensure that the main materials making up products are not contaminated with low levels of other materials that make it difficult to reuse them.

All these elements will put sub-contractors in the developing countries under yet more pressure to innovate and to assure high levels of quality. One can expect sub-contractors to lose existing contracts if they are not flexible enough or gain new

contracts if they can quickly respond to the new requirements. Shifts within countries and between countries can be expected.

*UNIDO already works with enterprises in developing countries that are in supply chains, assisting them to meet technical requirements of the international market place. Its scope of activities could be expanded to cover these new challenges facing developing-country entrepreneurs. In countries where they exist, NCPCs or SPXs could be the mechanism to deliver this support. In addition, UNIDO could use its Public-Private Partnership programme to team up with multinational companies that have decided to redesign their products and work with them to bring the companies' supply chains in line with the new designs.*

### 3. The Effect of Collection Systems

A vital component of any economy based on circular flows of materials is collection systems that ensure that waste products are separated and sent back to the correct place for disassembly and recycling/reuse. Where enterprises in developing countries are tied very strongly to the final manufacturer and/or retailer in their supply chains, it can be expected that the latter will do the necessary to ensure collection. However, enterprises with much looser ties with the final manufacturers or retailers could well be expected to work out their own collection mechanisms, which could become a significant Technical Barrier to Trade for these enterprises.

Something along these lines has already been seen in connection with the take-back policies in place in the European Union for packaging material. Enterprises in developing countries have been faced with the risk of losing their access to the EU's markets because they were made responsible for finding solutions to the collection requirements. Some concern is already surfacing in enterprises in developing countries about similar impacts on their export markets due to further take-back policies coming on line in the EU. It is possible that this kind of pressure would drive enterprises in the developing countries into much tighter contractual relationships with companies they supply than they currently have, leaving them even less room for maneuver than they have now.

*Two sets of activities by UNIDO are possible here. Should UNIDO go forward with plans to establish an Early Warning Mechanism for TBTs in general, it could make sure that information on collection requirements are covered by the scope of the Mechanism. In addition, as part of the scope of the Early Warning Mechanism, UNIDO could support clusters of enterprises affected by the new requirements to find and implement solutions. Secondly, as part of the Global Forum activity suggested above, UNIDO could evaluate the likely outcomes on enterprises in the developing countries of different possible collection requirements.*

Depending on how moves towards circularity of material flows develop, there could be a trend towards the export of used products and equipment from the developed countries to the developing countries, for sale there at greatly reduced prices. Strictly speaking, this would not set up circularity in the flow of materials unless the products

were finally dismantled and the materials recycled in the developing countries that received them. However, it might be argued by industries in the developed countries that this would be the first step towards a circular economy. If such global markets in a wide array of second-hand products were truly to take off, it could ruin the chances of enterprises in the developing countries to create local markets for these products, placing a significant barrier on their ability to expand their productive capacity. This type of phenomenon has already been in existence for some time now in the garments sector (although for different reasons), where exports of used garments from developed to developing countries has ruined the latter's local garment markets. The rapid buildup of electronic waste products in the developed countries is leading to the same phenomenon. Similar phenomena have even occurred between developed countries, where the dumping of waste paper, for instance, by one country in another country has ruined the latter's paper recycling markets.

*The dumping of used products in developing countries seems to be outside of UNIDO's mission, this being more an issue of international trade in waste and therefore falling under the jurisdiction of the Basel Convention and UNEP. Nevertheless, as part of its Global Forum function, UNIDO could call attention of the world community to this kind of development and the effects it is having on the economies of the developing countries.*

### ***B. A Role in the Revolution for the Developing Countries***

As was stated above, the role of the developing countries in this revolution would be modest, but there is one important area where they could play an active role. Until now, we have been focusing on the final product purchased by the consumer, and primarily the consumer in the developed countries at that, since as we have said this is where the biggest markets are. Yet every product requires the consumption of many other natural resources to manufacture it, as the primary raw materials that make it up are mined or otherwise harvested, as these materials are processed to make them fit for use, as they are brought together for assembly, as they are assembled, and as they are transported to the final retail space where they will be purchased by the consumer. And in turn all of the materials that were consumed during this process had to be themselves mined or harvested, processed and transported. Thus, behind every final product stands a substantial pile of materials that the consumer never sees but that were consumed to bring him the product. It has been estimated that the mass ratio between the product and these other materials can be as high as 1:9, i.e. for every kilogram of product some 9 kilograms were consumed to make it.<sup>2</sup> Sustainable patterns of consumption and production require that these materials also be subjected to the concepts of circular material flows.

Because of the globalized nature of trade, much of this "ancillary consumption" takes place in the developing countries, where much of the mining/harvesting of raw materials and manufacturing of semi-finished or finished goods takes place. In theory, therefore, there is the possibility that developing countries could make significant

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<sup>2</sup> See "Factor 4: Doubling Wealth - Halving Resource Use" by E. von Weizsäcker, A.B. Lovins, L.H. Lovins.

contributions to circular material flows through industrial design (product and/or process design), as well as through cleaner production/eco-efficiency. However, with respect to product design in particular, the actual freedom of action that enterprises in the developing countries will have to do this may be not be as great as one could suppose. Some clients will give enterprises strict specifications on what processes to use and what ancillary materials to use, leaving the enterprise with little room for independent design decision-making. Others will be much more flexible. In addition, often the ancillary materials (and technology) that enterprises in the developing countries use have been designed by designers from the developed world and therefore the enterprises have little opportunity to pressure the designers to change the designs.

This last point, the lack of influence of enterprises in developing countries over designs decided upon in the developed country, points to what is perhaps the most far-reaching effect of moves towards circularity of material flows. Such moves will widen the already yawning gap between the developed and the developing countries with respect to design capacity. Even though some design and innovation takes place in the developing countries, as was noted above the vast majority of it is to be found in the developed countries. If there is now another quantum jump in design capabilities in the developed countries to meet the requirements of material flow circularity, then the developing countries will get left even further behind in the design “race”. This will increase the barriers to their further development since beyond a certain level of wealth developing countries need to have their own design capacity, or more broadly their own innovation capacity, if they are to continue to develop.

In effect, if these concepts become the standard in the developed countries there is a real danger of creating a “two-tier” world, with the developed economies having the monopoly on product (and technology) design and being served by global supply chains where enterprises in the developing countries are trapped into being responsible only for manufacture. Since MVA levels are lower in the manufacturing stage, this means the bulk of the value added during a product’s cycle from design to marketing would remain in the developed countries, thus increasing the wealth divide between the developed and the developing countries. In addition, the local markets in the developing countries will be untouched, thus raising the possibility of “sustainable” products being available only in the developed countries and the local markets in developing countries being served only by unsustainable and marginalized industries.

*It will take time for the revolution described in this paper to take place so the developing countries do still have a “window of opportunity” in which to begin to catch up with the developed countries in the field of design, and more generally innovation. It is therefore of paramount importance that UNIDO starts now to assist developing countries to build up their design and innovation capabilities. They can be built up through existing UNIDO programmes such as the NCPC programme or the SPX programme, or through a specific design capacity-building programme such as is proposed in UNIDO’s Thematic Initiative on product innovation. The capacities*

*can initially be built up around the ancillary materials consumed in the manufacture of products destined for the markets in the developed countries, as well as around products that serve local markets (and therefore where the design decision rests with enterprises in the developing country) or the few products that are designed locally for the markets of the developed world. The design capacities UNIDO builds up can already contain the elements of the coming revolution, so that they will be ready to affront it when it comes.*

## VII. Summary

Ever since the publication of the Brundtland Report in 1987, there have been calls to radically rethink the relationship between industry and the environment. Many proposals have been put forward; two books in particular, "Natural Capitalism" and "Cradle to Cradle", took up many of these and wove them together into radically new programmes for reaching environmentally and socially sustainable development. The vision that both books promote, with variations, is one where:

- Our societies move towards circular flows of materials;
- The size of these flows are reduced through greater efficiency in the use of materials;
- Circular flows encourage changes in the relation between manufacturer and user, where manufacturers change from selling products to supplying services;
- There is a move towards the use of non-fossil-carbon energy sources.

One could argue that this revolutionary programme has already started in the developed countries. For a number of years now, companies in the developed countries have been persuaded or forced to design consumer products that are more efficient or less toxic/hazardous during use. The European Union and Japan are now preparing policies that will make companies take back certain consumer products when their owners no longer want them, and this is already leading to product redesign to extend the useful lives of consumer products and/or make them more easily recyclable once they are taken back. Even the concept of consumer products becoming services has already been exploited by a limited number of companies.

Where will this new industrial revolution leave the developing countries? Will it pass them by? Will they be affected by it in any way? Will they have a role to play in it?

By far the largest consumer markets are in the developed countries, so only if these countries act will there be a significant move towards sustainable patterns of production and consumption. Furthermore, it is in these countries that the overwhelming majority of product design takes place. This suggests that the role of the developing countries in this revolution will be modest. However, in today's globalized world, with developed and developing countries locking into supply chains for the manufacture of consumer products, a revolution of this magnitude will assuredly not leave the developing countries unaffected. They will definitely be impacted by a series of knock-on effects; whether on balance these impacts will be for better or for worse is difficult to say at this stage. And even if overall their role will be modest, there is one area – the ancillary materials used in production and process

technology – where they could play an active and positive role in product/process redesign and innovation.

UNIDO believes that four primary issues can be distilled out from this, and which the panel can discuss:

1. There needs to be a more exact understanding of the knock-on effects that this revolution might have on developing countries, especially in relation to the potential for the revolution (or misdirected elements of it) to create barriers to the access by developing countries to international markets;
2. There needs to be an evaluation of the programmes that multilateral and bilateral organizations in general, and UNIDO in particular, can modify, extend, or create *de novo*, to assist enterprises in the developing countries that are part of global supply chains to surmount and adapt to the new demands that this revolution could put on them;
3. There needs to be a more exact understanding of the contribution, even if modest, that the developing countries can make to this new industrial revolution;
4. There needs to be an evaluation of the programmes that multilateral and bilateral organizations in general, and UNIDO in particular, can modify, extend, or create *de novo*, to assist enterprises in the developing countries play their role in the new industrial revolution, in the areas of product design and more generally innovation.

Figure 1



