CIRCULAR ECONOMY AND INTEGRATION WITH GREEN TRAINING AND INDUSTRY 4.0:
research agenda and framework for future studies

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Abstract: Circular Economy is a concept with increasing visibility in sustainability. Large companies in the world started to adopt and pay attention to circularity ideas instead of the linear model. The linear model can only reduce environmental impacts and traditional sustainability models are no match for the challenges that the world will face with the environment. This article seeks to show the innovations that can help in the sense of human behavior with industry 4.0 and the new knowledge that interdisciplinarity with neuroscience can bring. Especially for sustainability training for the public health sector. The conclusions are that the main challenge is the way that the human being acts and the difficulties of ingrained habits change, which can sabotage possible important changes for the well-being and the future quality of life.

Key words: Circular Economy, Sustainability, Green Human Resource Management

Introduction

Circular Economy (CE) is a concept that is in the radar of researchers and business strategists with much more frequency than ever before. As (Jabbour et al., 2019) Jabbour et al. (2019) describe, it's rare to link Green Human Resources Management (GHRM) with CE. Economic and environmental issues are even more in evidence after the pandemic Coronavirus in 2020. One of the main problems that involve the broad adoption of CE is human behavior (HB) and the change in the mindset from a linear to a circular model (Lam et al., 2017). Consumer's habits and social moments seem to play a significant role in a consciousness behavior consumer and employees (Marie et al., 2019; Lie et at., 2019).

The change in consumer behavior is one of the main drivers toward a transition from linear to CE economy. One driver is the attitude of the HB toward greener behavior. People got used to a linear approach, and the way they see and act lead us to believe that this theme can be one of the most significant barriers to CE (Zsóka, 2013; Li et. all, 2019). For example, households are responsible for 72% of global greenhouse gas emissions. Dubois et al. 2019 advocates that education for a conscious consumption should begin at home. The problem is that it doesn't happen in most countries, and the linear approach it's encrusted in the consumption behavior of most people.

CEO's, managers, scholars, and policymakers represent other barriers to CE implementation (Kirchherr, 2017). These finds lead us to believe that human behavior is at the heart of the issue, and HB can be the key to accelerate the transition to a sustainable economy and a CE. The pillars of the CE business model take into account the notion of sharing and reuse that in several parts of the world are not used to, mainly in developing regions (Ferronato et al., 2019).

Habits are compelling for people's decisions and behaviors and can influence their pro-environmental actions. Capturing the habit's impact and understand they decision-making process, can be an indispensable part and driver for CE (Li et al., 2020). Taking this into account, new applied neuroscience tools can bring benefits to understand behavior (Fortunato et al., 2014; Oliveira et al., 2014).

The motivation of the research is: which neuroscience tools could help to understand behavior better and be integrated with CE and HB, considering the difficulty of changing behaviors? This article can contribute to a better understanding of the challenges of changing habits that will be needed to accelerate the CE implementation

2. Theoretical background

2.1 Circular economy

CE can be framed as how Ellen MacArthur explained being an industrial economy that is restorative and regenerative by intention and design. Geissdoerfer et al. (2017) define CE "as a regenerative system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops. This change can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling".

The main idea behind CE is to change the way we make and consume stuffs and to avoid the loss of energy that traditional methodologies of efforts to be sustainably have failed because they do not think in the hole system or when considering the whole system, the cant makes progress in the idea that the economy will receive more and more consumers and people want to buy more, not less. Prieto-sandoval (2018) reflects that are three different levels of CE: (1) micro-level, which are the companies that are the enterprises with the main objectives; at this level, the main concern is related with prestige towards they consumers and cost reductions (2) meso level that is composed by companies and other economic agents that will impact the local economy, for example, local policymakers, the integrated supply chain; and the last on (3) macro level, that sees the whole picture, taking into consideration government policies that are concerned with eco-cities and the impact for the country image and the impact to the nature conservation.

2.2 - Green Human Resources Management

Green Human Resources Management (GHRM) refers to the alignment of traditional Human Resources Management with concerns about the impact of environmental development (Teixeira et al., 2015). For Tariq et al. (2016) GHRM is part of an effort of firms to get green as a result of society's pressure to make green footprint diminishes.

To Jabbour et al. (2017) GHRM must be aligned with the whole strategy of the enterprise and have several factors to be succeeded like green recruitment and selection, green training, green performance, and rewards. Coaching is a critical factor for the success of GHRM. For CE GHRM is essential, although many firms see this as a "cost", not investment. One of the challenges that CE has to accelerate is making the leaders and CEO's of organizations to understand that CE is a value creator for the company, not a cost.

For a greener staff to get engaged, there are several barriers that must be transposed. For Paillé et al. (2014) attracting high-level staff is one of the most important obstacles and multinational companies are incorporating GHRM as a way to improve they selection attractiveness, especially in millennials, that are more concerned with environmental issues and take in consideration not only money but the impact the environmental that these potential employers can do to harm the sustainability of the planet.

To link operation management and sustainability, there are several barriers and practices that need to be put in practical agenda in organizations like, internal environmental management, green purchasing, cooperation with customers, ecodesign besides others (Jabbour and Jabbour, 2016). The problem that can be anticipated is that for all these changes to happen, there is necessary support by high levels in the hierarchy, that without this support, it is not possible to activate the required to greener companies.

Shanafelt and Noseworthy (2017) show that physical burnout and turnover of executives constitute a significant problem in big companies. That said, as CE implementation requires high levels of commitment from the top managers, there is one barrier that turns difficult to transpose: how long a company that opted for the "avenue" of CE will maintain the course the leader of today can leave the company? Training and conscientization of the middle staff seems to be crucial, enabling then when hes/her boss leaves the company.

2.3 - Applied Neuroscience

There are several concerns about the applications and ethics of applied neuroscience into companies (Oliveira et al., 2015). The invasion of privacy, for example, is one of the most common concerns. The innovations that are appearing can be associated with suboptimal decisions "and actions during cycles of inflated expectations, disappointment, and unintended negative consequences" (Fox, 2018). On the other hand, we see an opportunity to implement CE as a necessary action towards the future of organizations.

Like every innovation, Artificial Intelligence (AI) and Applied Neuroscience (AN) can be applied for benefits the society or to harm and invade the privacy of the employees. The ethical concerns about the link of multidisciplinary aren't new, mainly when applied to business. Notably, in sales and marketing, these concerns already have practical use (Oliveira et al. 2015). They describe some of the innovations that were rare in the past, but today as the cost gets lower, they are more accessible, and the application of electroencephalography (EEG), galvanic skin response (GSR), and functional magnetic resonance imaging (fMRI), among others . All these tools allow accessing the brain and behavior better than ever before, with more accuracy and insights. Figure 1 shows some that are being used to achieve this.
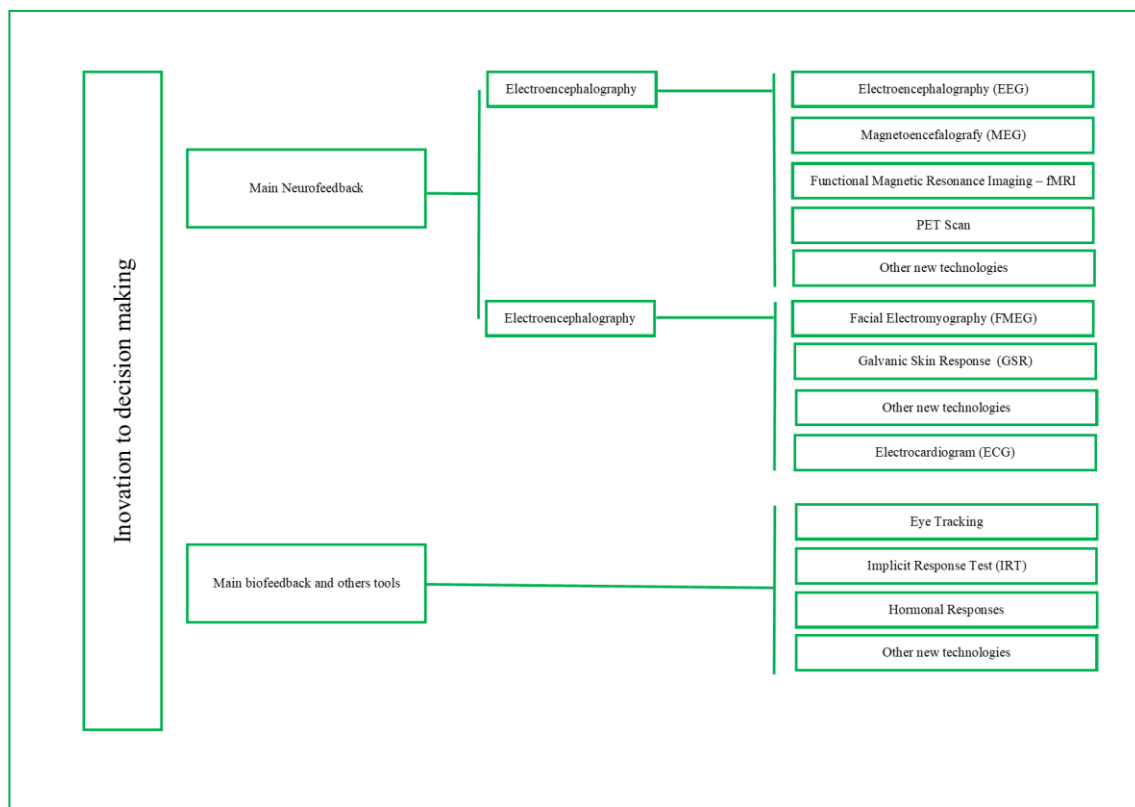
Inovation to decision making

Main Neurofeedback

Electroencephalography
- Electroencephalography (EEG)
- Magnetoencefalografy (MEG)
- Functional Magnetic Resonance Imaging – fMRI
- PET Scan
- Other new technologies

Electroencephalography
- Facial Electromyography (FMEG)
- Galvanic Skin Response (GSR)
- Other new technologies
- Electrocardiogram (ECG)

Main biofeedback and others tools
- Eye Tracking
- Implicit Response Test (IRT)
- Hormonal Responses
- Other new technologies

Figure 1: source, the authors

In figure 1, one can have the idea of some of the devices been used to better understand the decision-making process. Industry 4.0 has using these devices to make money. Still, there is an excellent opportunity to use these devices to diminishes the resistance in an essential part of CE, which is human behavior towards ownership and green training.

These devices were too expensive a few years ago. The costs of applying to research have been lowing down day by day. fMRI, EEG, GSR, and other types of equipment that were traditionally employed in the diagnosis and health sector began to be used to understand and sell better. Known as consumer neuroscience, it's a sub-category of applied neuroscience that companies started to get attention to design and make better appealing products and services (Gurgu et al., 2020). Some of these types of equipment are too much invasive, but there are others that can allow the researcher to comprehend consumer behavior without or with a minimum invasion. This advance in technologies allow us to imagine the potential for more noble applications of just sell more products and services, but to apply into research to accelerate CE through the understanding the prejudgments and resistances that's the final consumer can have with one or more concepts of CE, like the idea of use instead of own a product.

3 - Proposal of a research framework integrating GHRM, CE Business Models and Applied Neuroscience

In the direction of the issues discussed in section 2, we now propose an integrative framework (see fig. 2). This framework allows us to have a big picture of how applied neuroscience can contribute to accelerating systems works today in a linear model to a CE,

utilizing applied neuroscience to better understand consumer behavior and other stakeholders in the process of changing the mindset towards circular instead of linear models.
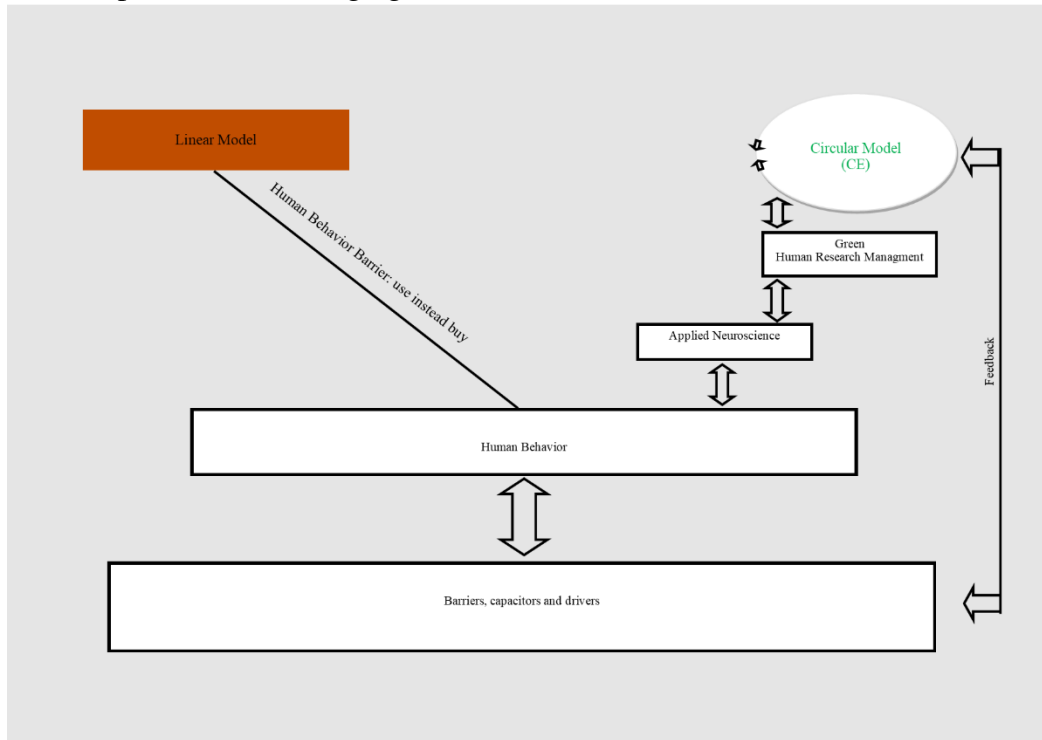

Figure 2: Proposed Framework. Source: the authors

It is crucial to change the mindset, and allows consumers to see an economy in a different way they see today. Human behavior impacts not only the attitudes toward CE but affects the way relations between the role system works, allowing better chances to accelerate the CE.

In the framework, the same principles that apply to consumers apply to the green supply chain. The understanding and the necessity of better and more motivating actors in the supply chain plays an essential role in the development of CE.

The feedback is also critical because they can play a piece of vital information about the effectiveness that is put in place if these actions are working or note. In figure 2, the schematics show the barriers, capacitators, and drivers. In the base of the barriers, De Jesus and Mendonça (2018) identifies the hardest (technical and economic) and the soft factors the better implement CE. The proposed framework focus on one of the main important softer barriers: the consumer. The author's cities the importance of rigidity in changing individuals' habitats and business routines.

In this point, applied neuroscience can help understand consumers and all actor in the chain, allowing us to understand how people think without the filters that are applied when they have to use a tool that allows one to think about the answers and to respond according to the researcher are trying to extract.

Fox (2018) alert us of an irresponsible approach in the innovations around neuroscience, especially for the youngers that have not yet full maturity to understand manipulation. On another side, that represents a big opportunity to change the way this new generation gets

involved with problems of the society and the impacts that the current method will take us to the precipice of lack of natural resources and climatic issues arising from the linear model. Criticism and skepticism about the innovations to understand better the behaviors are certain until a certain point (El-kassar and Kumar, 2017). These new technologies appear to give more than they can deliver in terms of practical results.

Despite this kind of critic, applied neuroscience has been used as a tool to unlock the consumer's mind and a lot of companies joined with consulters that works with medical equipments to take advantage in for seller more and without losing money (Ford, 2019). The equipments have a big potential for better use when we think that one of the most significant barriers for a CE be implemented at a higher speed.

As we see in figure 1, these tools allow us to have insights from neuro and biofeedback. These insights can help researchers in CE in several ways. Neurofeedback, mainly the non-invasive like EEG can enable to get the level of engagement of decision-makers and stakeholders to understand what are the main concerns they have in without passing throughout forms.

Attention is an important part of an engagement. Eye-tracking measures where people are looking. A great piece of what we get is by visual attention, and a great part of our brain works to process what the eyes bring (Santos et al., 2015). Having this information may lead to better development of websites, white papers, conferences, and other forms of the learning process to CE.

1. Proposition 1: the adoption of applied neuroscience in green human supply chain

Applied neuroscience is a field of opportunities to understand better the resistance that each sector has to the extensive implementation of CE in different cultures, with different linear consumption habits. Understanding signals different from those that are verbalized enables researchers and companies to approach these different audiences differently.

2. Proposition 2: allows new technologies to get involved in CE

New technologies are at the heart of the concepts that include CE, but not in an organized way, and many efforts are made in a timely manner. In addition, there are, to date, no applications of technologies to reduce resistance to CE. Improve the learning Hub by knowing the different types of resistances in different sectors allows you to have a body of knowledge specific to plastics, clean energy, reuse of materials, textile industry and so many other sectors that can benefit from the transition from the linear economy to the circular economy.

3. Proposition 3: improve the learning hub about CE and its benefits

Ellen MacArthur Foundation today stands for Circular Economy and serves as the main learning hub to accelerate CE. However, it is essential that each segment, given the specificities of each one, sees the importance and the generation of value for the supply chain in its own sectors. EMF has made this effort through strategic partnerships with key players in each segment, but the wide adoption of CE will ultimately depend on an active movement of entrepreneurs, who already have associations and make disconnected efforts for sustainable

actions. Small and medium-sized companies are not yet able to see the benefits they can have, and these associations need to visualize in numbers and indicators the positive impacts of CE for them.

4. Proposition 4: turn GRHM the main driver to CE

GHRM needs to be the central focus of circularity. The human being is the one who impacts and is the one impacted by the linear model. Without a change in people's mindset, the time it will take for the transition from linear economy to circular economy will be longer. At this point, understanding the fears and feelings of individuals becomes critical to circularity

5. Proposition 5: makes a more effective and scientific way to measure, creating an indicator of engagement in the process

Some important tools are being developed to measure impacts and track CE. The proposal of Resolve Model, from Ellen MacArthur Foundation integrating with big data (Jabbour et al., 2017) is one of the most prominent tools that can help. Circulytis, for example, it is another new tool that the Ellen MaCarthur Foundation launched in 2020. The tool comprises a series of indicators that are answered by organizations, aiming to measure and compare the level of circularity that each company is engaged in (The Ellen MaCarthur Foundation, 2020).

The advantage of neuroscience tools is to allow complementary techniques to understand and measure levels of resistance to the adoption of Circular Economy. These techniques, as they do not depend on the written answer or on concrete indicators, are appropriate to understand human behavior from a point of view that is not obtained otherwise.

6 - Final remarks

The work contributes to the integration of green training with innovations of industry 4.0, particularly in HS. The main output of this research is the proposal of an original framework relating key-aspects of the applied neuroscience and innovations in the health sector that can be applied to reduce the behavioral resistance of stakeholders in the area to accelerate the implementation of the CE.

The integration between CE, HS and Industry 4.0 innovations for HS and the relationships explored in the proposed framework are unique. These aspects allow to open a door for new concepts and variables that no studies were developed, with a clear lack of integration. Multidisciplinary are increasingly important in academic studies and CE is inherently a multidisciplinary and systematic area in nature.

The impacts of a Circular economy in health sector, instead of a linear economy, currently in effect, will allow gains for all stakeholders involved. Hospitals with cost savings. The public and private health system, with a drastic reduction in redundancies. and most importantly, patients, who will be able to access a more effective care system, with less information asymmetry and with lower chance of medical mistakes or tacking incorrect medication.

This work has several limitations that can be overcome through future studies. The theorical framework can be applied in a pilot project to better understand other resistances and difficulties. Other frameworks with more details of relations can be created to simplified framework that was proposed. Clearly, the full potential that a framework proposal has must take into account the meaning of theory and what underlies a theoretical contribution (Sutton and Staw, 1995).

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