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THE INFLUENCE OF VIRTUAL AND UBIQUITOUS ENTERPRISES, AND META-INSTITUTIONS IN ENVIRONMENTAL IMPACT BY ACCELERATING NEW SUSTAINABLE PRODUCTS DEVELOPMENT

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Virtual and Ubiquitous Enterprises, Meta-Institutions, GHG Emissions, Sustainable Products, ImPACT Identity.

ABSTRACT

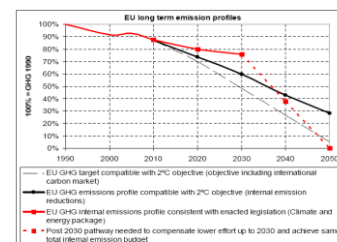
The aim of this paper is to prove the influence in the environmental impact through the acceleration of the development of new sustainable products supported by advanced organizational models and organizations, namely, Virtual and Ubiquitous Enterprises, and Meta-Institutions.

The Kyoto Protocol, in 1997, was the starting document for the implementation of environmental policies at international level in order to target the reduction on global warming. Since then, a set of documents were formulated, some on global level and others at regional level, to pursue the environmental target objectives. At global level, the most relevant documents are Kyoto Protocol (United Nations, 1998), and Copenhagen Accord (United Nations, 2009). EU plays an important role at global level and is one of the most important economic and greenhouse gas emission reduction agents. EU also published important documents, at regional level, such as (European Commission, 2010).

EU made a commitment to achieve at least a 20% reduction of greenhouse gas emission (GHG) by 2020 compared to 1990. But to achieve the Copenhagen Agreement, which mentions that the increase in global temperature should be below 2 degrees Celsius (United Nations, 2009), the global GHG must be reduced to less than 50% of 1990 levels by 2050.

In order to accomplish the submitted commitments, the implementation of new mechanisms is mandatory. Policies

and technological options, such as, product eco-design, new product standards, low- and non-carbon emission products are required.



Source: POLES, PRIMES, GAINS

Figure 1: Short term EU profile compared to 2°C compatible long term target (p. 40) (European Commission, 2010).

The proposal of this work is to present the quantitative benefits of new organizational models, in particular, Virtual Enterprises (VE) and Ubiquitous Enterprises (UE), supported by external organizations called Meta-Institutions (MI) and the impact of these organizational models and organizations in the GHG emissions due to the acceleration of new sustainable products development.

VE and UE are two advanced organizational models that are based on networked structures, i.e., these two models represent specific characteristics and properties of networked enterprises (inter-enterprises). Although, different they are complementary. MI are external organizations / entities that provide environment and platform for enabling and support VE and UE integration and dynamic reconfiguration. The presented organizational models and organizations are based in the work developed by (Cunha et al. 2000).

Founded in the presented organizational models and organizations, a case study to prove the acceleration of



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sustainable products was created. The case study was simulated in a developed web-based demonstrator that measures impact of the product Time-To-Market (TTM) using the proposed organizational models and organizations.

For the formulated case study, providing real case parameters, the demonstrator output has a range of product TTM reduction between 26% and 74%.

ImPACT identity model (Waggoner and Ausubel, 2002) was used order to evaluate the influence of VE and UE, and MI environmental impact by accelerating sustainable products development. In the ImPACT identity, the total environmental impact (I) results from the product of four state variables: population (P), affluence (A), consumers' intensity of use (C) and technologists' intensity of emission (T). The formula of the total environmental impact is the following:

$$I = P \times A \times C \times T \quad (1)$$

Using annual percentage changes of the four state variables, i is the percentage of environmental impact change per year. Therefore, p is population change (% of capita per year), a is affluence change (% of GDP/capita per year), c is dematerialization in terms of products (% of products/GDP per year) and t is decarbonization (% of tons of carbon/products per year).

Applying since 2020, the conservative value of 26% product TTM reduction in development of new sustainable products, i.e., products with free carbon – decarbonization (t) –, simulated by the developed demonstrator and considering that the state variables (p , a , c , t) are constant (κ), i.e., it is considered that the variation of the change variables is the same along the years.

Taking as reference the graphical representation of the short term EU profile compared to 2°C compatible long term target (Figure 1), and using the linear annual impact reduction obtained due to the development of new sustainable products using VE and UE, and Meta-Institutions, the graphical representation achieved is the following.



Figure 2: Graphical representation of impact reduction of 26%.

This reduction indicates that the target result of zero percent of GHG emission is achieved in year 2042 (point D' in figure 2), instead of 2050 (point D in figure 2). This reduction of 8 years is a significant achievement towards a faster environment protection.

As conclusion, this paper validates the influence that Virtual Enterprises, Ubiquitous Enterprises and Meta-Institutions have in the environment protection by accelerating the development of sustainable products.

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