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TOTAL ENVIRONMENTAL ASSESSMENT FRAMEWORK IN AN ORGANIZATION

Pavol Molnár, Martin Dolinský

Abstract

Purpose of the article is to present the way of application of methodology of environmental metrics within the total environmental assessment framework. An inevitable part of sustainable development initiatives is sustainable measurement metrics. This kind of metrics is being represented by three sets of indicators: Environmental, Social and Economic. Sustainability measurement metrics tends to measure environmental safety (e.g.: Ecological footprint), social responsibility (e.g.: Global Reporting Initiative) and economic efficiency (e.g.: Net Present Value test). Studying behaviour of companies in sustainability measurement metrics application, using another scientific method is well welcomed. **Methods** used in article are synthesis, analysis, deduction and comparative analysis. We are synthesizing those methods in a presented model which examines quality of environmental improvements across departments of selected organization. In other words, the model is able to quantify an extent how individual managerial decision contributed towards overall improvement in environmental performance of whole organization. Model works with and additive elements. In order to derive results using multiplicative elements, we are using logarithmic method in a model. **Scientific aim** of the article is to synthesize scientific methods aimed at environmental performance measurement into unified and universal model usable by managements of small and medium-sized enterprises. The background of this mission is to ensure that environmental performance will be correctly reported, data delivered by various companies (organisations) will be benchmarkable and consequently, Corporate Social Responsibility concepts worked out by individual organizations will be trustable. In the article, we are discovering that use of proposed universal model has marketable outcomes. Thanks to an existence of thriving markets valuating triple bottom line of sustainability, results delivered by the model helped to a company PintInox, S. p. A. to succeed at such kind of market. **Conclusions** the article delivers are pointing out an importance of interdisciplinary cooperation within field of sustainable development.

Keywords: Sustainable development, sustainability measurement metrics, three tier model

JEL Classification: M14, M16

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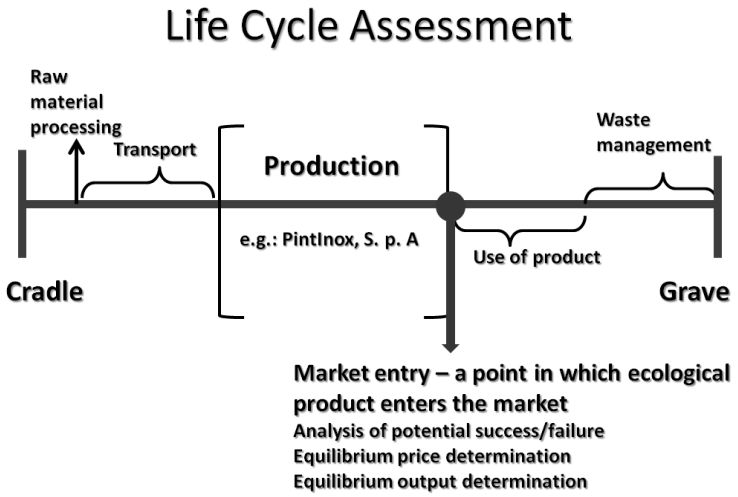
Introduction

We have started the research in the matter concerned in 2011 and goes on already for three years. The main goal of this research was to assist small and medium-sized enterprises in a preparation for the new entrepreneurial reality where the classical way of doing business is changed. It means, that economic criterion is not dominant anymore, but reduces its importance since there are other two emerging fields of company's performance measurements – environmental safety and social responsibility. Three sets of indicators are usually called triple bottom line of sustainability. Indicators with an ambition to measure sustainability are labelled as sustainable measurement metrics (enterprise sustainability metrics). Traditional management systems were not designed for a balanced view of financial, environmental and social metrics (Lipsky, Russell, Wirtenberg 2009). Small and medium-sized enterprises (SMEs) are in our opinion a decisive field of a success or failure of sustainable development. Scientists are warning now that we move toward a "point of no return" in climate change, polluting the natural compartments with too many emissions (Narodoslawsky, Sandholzer 2007). Therefore, the aim of our initiative was highlighted by cooperating with SMEs – biggest polluters and biggest employers in European Union. To be aimed at SMEs seems to us as a crucial concentration onto a field where "things will be decided". Sustainability measurement metrics must be understood within dimensions of time. We have to distinguish whether to track environmental performance in a phase of supply, production or use of a product (i.e.: within all the life cycle stages). Distinguishing time dimension, it is necessary to speak about "life cycle" of a product, in other words, assessment of an impact from "cradle to the grave". This paper suggests "Total environmental assessment framework" within the sustainability measurement metrics. Mentioned Total environmental assessment framework is represented by a model able to quantify contribution of every responsible managerial decision towards overall improvement of environmental performance. Model has variations depending on which environmental aspect is examining. If assessed managerial decisions concerns use of electricity, the model bears label **(e)IMPACT**. On the other hand, if we deal with pollution or consumption of water, the model uses abbreviation **(w)IMPACT**. Examples are available in the table 1.

It is advised to use sustainability measurement metrics through complete life cycle of a product (Life Cycle Assessment - LCA). An important phase is depicted in the Figure 1 when a product is entering market.



Source: Authors' design based on PintInox departmental research materials

Figure 1 ***Life Cycle Assessment of a product***

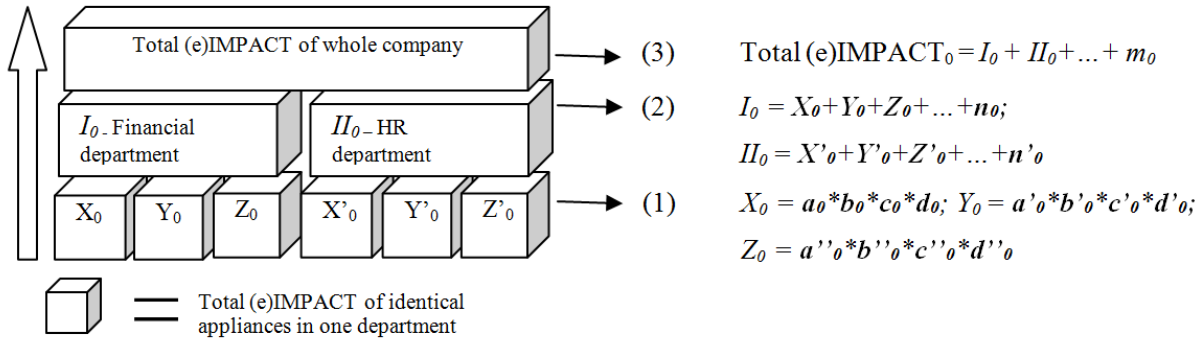
Advanced entrepreneurial subjects are dedicating more and more activities towards accepting the "triple bottom approach", which is mostly oriented towards environmentally friendly approaches within entire company philosophy. The reason is that customers, mostly in developed countries, are welcoming products (services, etc.) with the "environmentally friendly" labeling!

As it was mentioned before, during our research period lasting few years, methodology of evaluating and measuring environmentally friendly actions and activities (innovations) have been developed.

1 Universal Assessment Model

In order to present practically applied model, electricity consumption impact measuring is the best example how we can design the way of application. Every organisation (company), department, office, etc., is consuming electricity. Electricity consumption (**(e)IMPACT**) is one of the best indicators for expressions of changes in behaviour, managerial decisions (e.g.: organizational and process innovations resulting into lower electricity consumption).

In the Figure 2, projection of entire (e)IMPACT assessment of electricity consumption is presented. First, calculation of (e)IMPACT of identical electric appliances (consumptions) (1) = **First Tier**, then calculation of (e)IMPACT of all electric appliances within one department (organisation subjects) (2) = **Second Tier**, and finally, calculation of (e)IMPACT of entire organisation (complete activities of an organisation) (3) = **Third tier**.



Source: Authors' design and calculation

Figure 2 ***Universal three-tier model***

Categorization of the suggested model has been designated as a Sustainability Decision Tool (Molnar, Dolinsky 2012). It is based on comparing two time periods and recording a change occurred. Model is able to identify extend into which organizational, process or product innovation is responsible for improved (e)IMPACT. The model is able to quantify influence a concrete managerial decision is having on an overall (e)IMPACT improvement. Under the term (e)IMPACT improvement, we do understand size (particular value in m^2) of earth surface consumed. Expression in m^2 of earth surface consumed was reached thanks to an application of Ecological footprint indicator. The use of this sophisticated indicator automatically brings life cycle element into our evaluation. In the calculations, there are two sets of elements used: Multiplicative elements of equation (1) and additive elements of equation (2, 3). Information delivered by the model is devoted to company management, to those having decision making power to implement Corporate Social Responsibility concept into company's business strategy. When CEO spots improvement in (e)IMPACT, he/she is logically interested in knowing the reason of this improvement in order to identify inventors, i.e. author of the innovation with the following premium. CEO wants to know, which factor, in our case – environmental innovation, caused the improvement. This information will be delivered via this model. The model is able to state, which department had the biggest % contribution into overall improvement (4).

Change (%) in total impact caused by, e.g.: Financial department:

$$\Delta(e)IMPACT_I = \frac{\Delta I}{\Delta(e)IMPACT} \times 100 \quad (4)$$

Change in m^2 of consumed earth's surface occurred in whole financial department: $\Delta I = I_0 - I_1$

Change in m^2 of consumed earth's surface occurred in whole company: Δ(e)IMPACT = (e)IMPACT$_0$ - (e)IMPACT$_1$

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(e)IMPACT$_0$ means: "impact caused by electrical energy consumption" before an innovation, whilst (e)IMPACT$_1$ means "impact caused by electrical energy consumption" after innovation.

The third tier assessment has identified, which department is responsible for the biggest contribution towards (e)IMPACT improvement. A company management should be then interested in the reason behind, what enabled this department to become the "best performer" (i.e.: best performing among the others). Processing with second tier assessment, model will define which appliance made the biggest contribution towards overall result of entire department (5).

Change (%) in total impact caused by one type of electric appliances: $\boldsymbol{\Delta I_Y = \frac{\Delta Y}{\Delta I} \times 100}$ *(5)*

Whilst change in m^2 of consumed earth's surface occurred within group of identical electric appliances (e.g.: computers) is expressed as: $\Delta Y = Y_0 - Y_1$. And change in m^2 of consumed earth's surface occurred in the whole financial department is expressed as: $\Delta I = I_0 - I_1$.

Going deeper into our model – into the first tier, model is able to measure success of a concrete environmental innovation (product, process or organizational). As an explanatory example, we selected an idea coming from the manager of "financial department" – organizational innovation which lowered operating time of computers in a department. Let's imagine that a company management, examining results delivered by the model, identified "financial department" as the most significant contributor into overall (e)IMPACT improvement.

Having the best company's environmental innovation identified, the model was identifying, what was the extent of this innovation (running time of computers) among the other elements (consumption rate, number of computers, etc.). Our calculation is based on *Ceteris paribus* condition, meaning that all other things being equal (e.g.: Source of electricity consumed in department) during the assessment period. In first tier, the model has multiplicative elements (mathematical operation = multiplication) – which predefine calculation method used. Calculation contains consumption rate (a), running time (b) and number of identical appliances (c). We derive final result (a contribution of individual appliance to an overall environmental improvement caused by a single department) using logarithmic method (6).

$$\Delta X_a = \Delta X \frac{log\frac{a_1}{a_0}}{log\frac{a_1}{a_0} + log\frac{b_1}{b_0} + log\frac{c_1}{c_0}} = \Delta X \frac{log\frac{a_1}{a_0}}{log\frac{a_1}{a_0} \times \frac{b_1}{b_0} \times \frac{c_1}{c_0}} = \Delta X \frac{log\frac{a_1}{a_0}}{log\frac{X_1}{X_0}} \quad (6)$$

In calculation (6), principles (7), (8), (9), (10), (11), (12) were applied.

$$X_0 = a_0 \times b_0 \times c_0 \quad (7)$$

$$X_1 = a_1 \times b_1 \times c_1 \quad (8)$$

$$\Delta X = X_1 - X_0 \quad (9)$$

$$X_1 - X_0 = X_0 \frac{X_1}{X_0} - X_0 \quad (10)$$

$$X_1 - X_0 = X_0 \left[\frac{a_1}{a_0}\frac{b_1}{b_0}\frac{c_1}{c_0} - 1\right] \quad (11)$$

$$\frac{a_1}{a_0} = 10^{log\frac{a_1}{a_0}} \quad (12)$$

The abovementioned applications can be understood as an algorithm how to identify best practices in terms of environmentally friendly decisions. We selected departments typical for almost every type of business and aimed our example at electricity consumption, which is an impact being present in every kind of business, regardless an industry. Described algorithm or i.e. model is universal and can be used for tracking environmental impact and identification of environmentally friendly decisions in a greater variety of company's processes, as documented by the table 1.

2 Assessment Results in an Organization (company)

The selected geographical field of our research was Northern Italy. Region Lombardia has its own specific features. Behaviour of managers in Lombardia is influenced by the long-lasting entrepreneurial traditions. The characteristics of a typical Italian business are: small in size, family governed, specialized in sectors not requiring large and challenging investments, with an extreme capacity of adaptation (Signorini, Visco 1997). Luigi Federico Signorini and IgnazioVisco are reconfirming what we are observing in PintInox, S. p. A, an organization we are cooperating with: Italian SMEs are highly innovative with the ability to adapt quickly to changing market conditions, and are being endangered by the countries typical for low-cost labour.

Table 1 ***Total Environmental Aspects Framework and its Environmental Impact***

Processes	Activities – second tier (2)	Environmental aspect – first tier (1)	Environmental impact
I. Management	1.Administration (e.g. Financial dept.)	A. Electrical energy consumption	a. Natural sources exhausting; indirect environmental pollutions
	(e)IMPACT	B. Office material consumption	(e.g. Financial dept.)
		C. Sewage water discharge	b. Natural sources exhausting;
		D. Drinking water consumption	c. Water pollution
	(w)IMPACT	E. Office rooms heating	d. Natural sources exhausting
		F. Waste generation	e. Air pollution
			f. Waste pollution of environment
II. Main processes	1. Production	A. Electrical energy consumption	a. Natural sources exhausting; indirect environmental pollutions
	(e)IMPACT	B. Raw material consumption	b. Natural sources exhausting;
		C. Emissions (e.g. CO, NO, organic pollutants)	c. Air pollution
	(w)IMPACT	D. Water consumption	d. Natural sources exhausting
		E. Hazardous waste generation	e. Waste pollution of environment
		F. Sewage water discharge	f. Water pollution
		G. Smell, noise, vibrations	g. Environment degradation
III. Supporting processes	1. Air conditions	A. Electrical energy consumption	a. Natural sources exhausting; indirect environmental pollutions
	2. Storage of raw material and chemicals	B. Emissions of F-gases	b. Air pollution
	3. Storage hazardous waste	C. Risk of accident – discharge dangerous substances into the water	c. Water pollution
	(e)IMPACT	D. Hazardous waste generation	d. Waste pollution of environment
		E. Packaging waste generation	e. Waste pollution of environment
	(w)IMPACT	F. Risk of accident – discharge dangerous	f. Waste pollution of environment
IV. Miscellaneous	1. Canteen	A. Electrical energy consumption	a. Natural sources exhausting; indirect environmental pollutions
	(e)IMPACT	B. Drinking water consumption	b. Natural sources exhausting
		C. Sewage water discharge	c. Water pollution
	(w)IMPACT	D. Foodstuff consumption	d. Natural sources exhausting
		E. Detergents consumption	e. Water pollution
		F. Municipal waste generation	f. Waste pollution of environment

Source: Authors', based on structuring of EN ISO 14001

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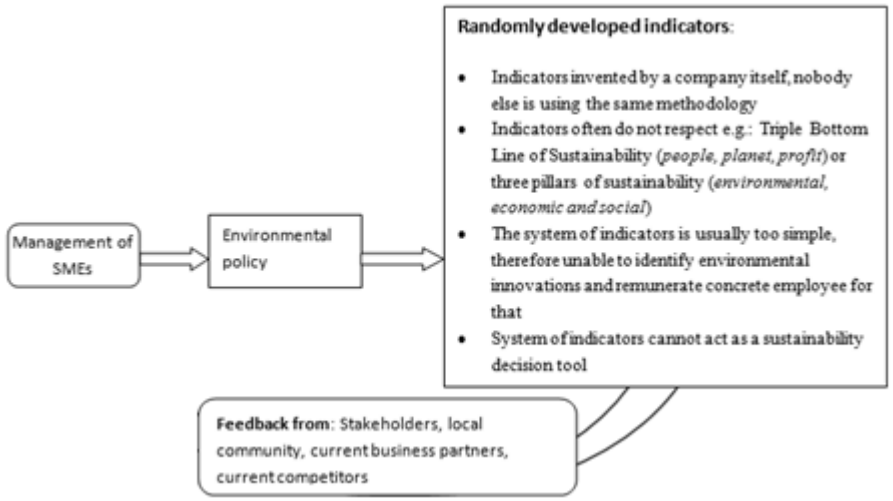
At the beginning of our stay with the management in the company in Lombardy, it was evident that Italian small and medium-sized enterprise, PintInox, S. p. A., didn't possess human capacities to successfully apply sustainability measurement metrics (ecological, social and economic indicators) on its own. However, thanks to a long entrepreneurial tradition typical for region Lombardia, thanks to high innovation potential of local businesses and thanks to readiness and preparedness of management to quickly accept new business philosophy, SME from Lombardy has offered a platform for application and testing our research outcomes – sustainability measurement metrics application. In "new competition", it is creativity (or invention) that stimulates and supports the achievement of innovative outputs; organizations may thus become configured to value creativity and innovation as sources of competitive advantage rather than as additional costs (Jeffcutt, Pratt 2009). PintInox, S. p. A. values sustainable development as a new source of creativity. This posture of management enabled us to help to PintInox, S. p. A. to build up their Corporate Social Responsibility Policy based on standardized sustainability measurement metrics. To work out this policy, variations of IMPACT model were used (e.g.: (e)IMPACT, (w)IMPACT, etc.) as a major part of Total environmental assessment framework. From December 2012, PintInox, S. p. A. uses our research outcomes during negotiations with B2B customers in order to present them their new business strategy based on philosophy of Corporate Social Responsibility.

3 Reasons for Sustainability Measurement Metrics Application

The term "sustainability" was firstly introduced 25 years ago by the World Commission on Environment and Development, sustainability is therefore not a brand new issue. Today's reality is growth based economic system often generating debt. Economic system was designed as a perpetual motion machine, i.o.: Can go forever without any relation to ecosystem. But if it is not to be a perpetual motion machine (a perfect recycler of matter and energy), then wastes must go somewhere and new resources must come from somewhere outside the system (Daly, Farly 2004). Professor David C. Korten noted 10 years ago that economic system is a subsystem of an ecological system (Korten, 2001). In other words, ecology as a factor limiting economic growth represents a ceiling we will someday reach. Growth has in our opinion environmental limitations and the "belle époque", characterized by orientations solely onto a performance, without a link to eco-system, belongs definitely to a history, instead of economics. A climatologist Giampiero Maracchi warns that natural catastrophes are logical consequence of anthropogenic activities like urbanization and excessive emissions of CO_2 that cannot be absorbed by natural compartments[1]. We need to shift from carbon economy into utilization of direct and indirect energy from the sun. Research initiatives should be composed of concrete steps done in order to make the use of *efficient* climate benign technologies more frequent.
These steps were systemized into our model applicable in small and medium-sized enterprises. When developing it, one of our main ambitions was to make it multifunctional. In a sense that model should possess following abilities:

- To identify fake environmental improvements,
- to deliver exact, fair and benchmarkable results (in order to accomplish this, we were using Ecological footprint indicator),
- to be based on already existing, "freeware", "shareware" principles developed by other environmental scientists (technicians, economists, architects, psychologists, etc.), which means - to be recognizable by proper authorities and therefore acceptable,
- to export data into cluster, regional or national level in order to create regional picture of environmental impact caused by local entities (the precondition to this ability is already mentioned ability to deliver benchmarkable results),
- to be easily understandable and to deliver results in an eye-catching mode,
- to address results to those having decision making power,
- to discover company's environmental strengths and weaknesses, to answer a question: "*Quo vadis in environmental performance*?",
- to act as a pre-assessment prior to EMAS, ISO 14 001 or ISO 14 040 certification.

According to annual report on SMEs prepared for European Commission, SMEs represent 99.8% enterprises operating in European Union (EU) and employ 66.9% of European labor force and form 58.4% of the total Gross-Value Added produced by private businesses in the EU in 2010 (Wymenga, Derbyshire 2011). Therefore, we consider small and medium-sized enterprises to be the backbone of the European economy. Applying indicators developed by Global Reporting Initiative within structures of SMEs, thanks to the local character of their business activities, SMEs are having great potential to occupy leading positions in social performance evaluations, e.g.: They traditionally employ local labor force, which automatically supports local community (salaries and wages provided by local SMEs automatically supports also family members of employees of SMEs). However, the fact that SMEs are operating under different circumstances and are using different principles creates in the other hand a barrier towards application of proper sustainability measurement metrics. Therefore, paradoxically, those having a good potential to succeed in sustainability measurement metrics utilization, have no idea about the existence of this kind of metrics. The reason behind is that environmental metrics is not standardized like e.g.: accounting standards IAS/IFRS. Considering EMAS (Environmental Management and Audit Scheme), there is a toolkit available for SMEs: EMAS "easy" for Small and Medium Enterprises. The EMAS toolkit offers a description of what can be done by the management of a company, e.g.: Eco-mapping, using simple indicators – "Eco-controlling" (water, energy consumption or waste production), environmental policy creation, file management and external communication. Indicators suggested by EMAS toolkit for SMEs represent a simple observation of basic material used, energy consumption, etc[2]. However, according to our opinion, this category of indicators either disables to mutually compare companies from different industries (different setup of production) or indicators, can be too simple to uncover all three dimensions of sustainability (Environmental, economic and social) and do not enable Life Cycle Assessment. There are some SMEs conducting independent initiatives resulting into own, specific environmental indicators as a part of their Corporate Social Responsibility policy. Imperfections coming from these initiatives are: Incomparability of delivered results and in some cases – indicators might be based on own opinions of managers which is not a projection of a reality.



Source: Authors' design[3]

Figure 3 ***Scheme of feedback coming from the realization of environmental policy based on privately developed indicators***

The situation, when randomly, independently or privately developed indicators are drivers of company's environmental policy is depicted in the Figure 3. We remark that in such case, SME is facing limitations in variety of entities potentially able to provide management of SME with feedback. Due to the fact that privately developed indicators were not accepted by academic community, no one else within the industry (and also across the industries) is using them and no one has verified whether

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they deliver exact results. As a consequence, environmental policy in this case cannot significantly boost environmental innovativeness, cannot reconnect small and medium-sized enterprise with external entities like research teams or potential B2B (business to business) customers who are seeking for a supplier with *verifiably reported environmental performance* conforming to standards prescribed by environmental scientists.

Responsible entities with proper know-how are tracking environmental impact of their products from "cradle to grave" (Life Cycle Assessment) or at least, they strive to deliver complete information about impact generated during the phases prior to the point when the product is sold to a customer (e.g.: m^2 of earth consumed during design, production or transportation). Since many phases are being outsourced, the importance of unified environmental metrics has risen, because otherwise it would be impossible to calculate environmental impact occurred during more phases of production chain. In our research, we stress the importance of unification in environmental metrics. We have applied our assessment model in an Italian region called Lombardy. For many decades, province of Brescia is famous for its long-lasting relationships among companies offering mutual assistance during each other's production process. However, not every European region "worships" same entrepreneurial values like province of Brescia, and if the cooperation between companies faces complications, the information exchange is consequently not rigorous. In order to prevent missing data in the Life cycle assessment, Ecological footprint indicator uses databases of standardized processes (e.g.: Impact of a production of Tetrachloroethylene).

The main driver for a Corporate Social Responsibility policy creation as a part of company's business philosophy is not in many cases altruism, but a desire to succeed at the market that values Corporate Social Responsibility (CSR). These new types of market are being created (according to our experience) by large companies. Large companies are setting up additional environmental and social requirements for their suppliers as a part of their CSR policy. The commitment made by large companies to the nature and local community is often being expressed in their mission statements: "Briggs & Stratton: We will create superior value by developing mutually beneficial relationships with our customers, suppliers, employees and communities".[4] What this mission statement recognizes is that the only way to ensure the maximization of long-term shareholder value is to pay attention to the needs and interests of all of the firm's stakeholders (Martin, Petty, Wallace 2009). In other words, some large companies understood that it is in the interest of shareholders to be focused on the needs of all groups of stakeholders. In November 2013, PintInox, S.p. A. went successfully through Bureau Veritas certification.

Pintinox, S.p.A., besides IMPACT model, works with three standardized concepts we label as sustainability measurement metrics – Global Reporting Initiative, Ecological footprint and a Game theory. In our research, we are using Cournot game as a Managerial decision support tool, and as a matter of fact, it helps companies to get a picture about their competitiveness and abilities to place certain amount of environmentally friendly production to the market valuating sustainability principles (Dolinsky, Dolinska 2013).

One of the tasks PintInox, S. p. A. had to fulfil was to present their commitment towards sustainable development. The summary of results PintInox, S. p. A. presented is available in the table 2.

Table 2 ***Sustainability Measurement Metrics Application***

	Global reporting initiative	Ecological footprint	Game theory
Environmental dimension	GRI indicators were not used within this dimension	Analysis of a Metal degreasing process, transportation and raw material consumption	Mode of use not developed yet
Social dimension	Distribution of wealth within the region, salaries and wages in a comparison with regional average	Not applicable	Analysis of an interaction between managers applying their own CSR concepts
Economic dimension	EVD (Economic Value Distributed indicator)	Not applicable	Equilibrium price and output determination at markets valuating triple bottom line of sustainability

Source: Authors

Successfully accomplished certification process means that PintInox, S. p. A. receives a permission to distribute their products within facilities of COOP Italia. For the details about COOP Italia, see the table 3. COOP Italia is an example of a typical creator of a market valuating triple bottom line of sustainability. COOP Italia has created their program "*10 principles of COOP environmental policy*", the most targeted principle in terms of new market creation is a commitment towards its members and clients: "*To pay attention to the environmental impact of goods and services offered to members and consumers*".[5]

Table 2 ***COOP Italia - Description***

Company name	Legal form	Year of establishment	No. of employees	No. of selling points	Environmental progamme
COOP Italia	Cooperative	1967	55 000	1 394	COOP for environment – 10 Principles of COOP environmental policy

Source: www.e-coop.it

Corporate Social Responsibility philosophy is a vital concept, with infinite time horizon considering its application. Applying this concept responsibly means that companies will be constantly reviewing their decisions, doing self-evaluation, stating their weaknesses in own CSR concept and implementing improvements as sets of cumulative changes. The progress in CSR policy improvements should be very similar to Japanese Kaizen concept, which is defined as "process of continual improvement in which many small steps and improvements produce over time continual advancement and adaptive evolution of the organization"(Moss, 2011).

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Conclusion

Sustainable development is an interdisciplinary topic. It links people with technical background together with people from social sciences. This paper demonstrates how such a unified effort looks like. With knowledge from various fields, it is possible to prepare companies for entering promising markets valuating principles of sustainable development. In such markets, economic efficiency is not the only decisive factor. There are two other goals entrepreneurs must accomplish – environmental safety of their products and social responsibility of their activities. Henkel innovation challenge contest in 2013, as one of pioneering events in Slovakia in the matter concerned, was already tracking this new entrepreneurial reality and prescribed to all competing students to prepare suggestions which will conform into all three requirements (environmental safety, social responsibility and economic efficiency) of new emerging markets.

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Author (s) contact (s)
Pavol Molnár (assoc. prof., Ing., PhD.), head of department, Department of Company Economy and Management**,** Faculty of Economics and Business, Pan European University, Tematinska 10, 851 05 Bratislava, Slovakia, pavol.molnar@paneurouni.com

Martin Dolinsky (Ing., PhD.), assistant, Department of Company Economy and Management**,** Faculty of Economics and Business, Pan European University, Tematinska 10, 851 05 Bratislava, Slovakia, martin.dolinsky@sustainability.sk

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