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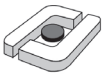

Hochschule Osnabrück
University of Applied Sciences

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Sustainable Logistics

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Preface

This book mainly presents articles, which were prepared for the research project entitled "Sustainable Production Logistics" (Nachhaltige Produktionslogistik). The aim of our studies was to find a basic and simple way to assist the idea of the United Nations to install a worldwide process of sustainability. Our approach logically starts with an analysis of the production processes of enterprises. So the team consisting of researchers of both, the University of Applied Sciences of Osnabrück, Campus Lingen, and the University of Szczecin, first tried to develop an adequate production function to depict the production processes. Second it was necessary to set up special conditions for this function to ensure sustainability.

The project was supported by the German Academic Exchange Service (Deutscher Akademischer Austauschdienst, DAAD) and the Polish Ministery of Science and Higher Education (MNiSW). For the publication of the results of the mentioned research project the two party cooperation was enlarged to a third partner, the National University of the South (Universidad Nacional del Sur), Bahía Blanca, Argentina. Just before publication the third partner joined the team and made his contribution to the articles presented. Further he organized the last necessary steps before printing.

We hope that our findings will help to support the worldwide process of sustainability. Before concluding let us mention another important point. Working on the project we learnt, that economics do not need a complex approach. A simple approach is a predicative attempt. This finding led to the foundation of what we would like to call the "Szczecin School of simple Economics".

We are grateful to the National University of the South (Universidad Nacional del Sur), Bahía Blanca, for publishing our research results.

Hermann Witte
Mariusz Jedlinski
Raúl O. Dichiara

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Chapter 1
The Monetary Production Function as a Basis of Sustainability

Hermann Witte[1]

1. Introduction

To install a worldwide process of sustainability it is necessary to analyse the production processes of enterprises. This implies to develop an adequate production function and to determine special conditions for its validity to ensure sustainability. We intend to establish a simple monetary production function and to demonstrate its adequacy.

Production functions are used to illustrate production processes. They are a mathematical relation between input and output or between the production factors and the final product. The development of production functions started with the illustration of agricultural production processes (Turgot 1727 - 1781, v. Thünen 1783 – 1859)[2]. Later on production functions were designed to describe industrial production processes[3] and the production of services[4].

The most famous and widely discussed production function is surely the one set up by Cobb and Douglas[5]. The discussion of the Cobb-Douglas production function led to a great number of further production functions. These functions are classified by various criteria. Some authors distinguish between classical and non-classical production functions.[6] Others subdivide production functions into types graded from A to F[7] or into "limitative" and "substitutive" production functions according to the use of criteria or characteristics of the production factors.[8] In contrast Linde defines three classes of production functions.[9] Class a (a1 – a5) is made up by using the relation between result (output) and input of single production factors as a criterion of demarcation. Class b (b1 – b3) is constituted by considering the relationship between result and amount of input of all production factors. Class c (c1 – c3) is based on the correlation between the amount of input and the marginal productivity of the production factors.

With reference to the levels of analysing facts in, and the classification of basic variables of, business administration it is possible to allot the production functions to three groups: quantitative[10], quantitative time-based[11] and monetary production functions. As the monetary production function can be regarded as an innovation, only this type of production function will be discussed in our article.

2. Deduction of a Monetary Production Function

Gutenberg[12] defines the industrial production process as an act of producing goods under the constraint of productivity which depends on the quantitative relationship between output and

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[2] see Krelle, W.: Produktionstheorie, Tübingen 1969, p. 16

[3] see Gutenberg, E.: Grundlagen der Betriebswirtschaftslehre, 1. Bd.: Die Produktion, 10th ed., Berlin et al 1965, pp. 314 ff.

[4] see Corsten, H.: Betriebswirtschaftslehre der Dienstleistungsunternehmungen, 2nd ed., München, Wien 1990, pp. 118 – 170; Fandel, G.; Blaga, S.: Aktivitätsanalytische Überlegungen zu einer Theorie der Dienstleistungsproduktion, in: Zeitschrift für Betriebswirtschaft, Ergänzungsheft 1/2004, pp. 1 - 21

[5] see Cobb, C.W.; Douglas, P.H.: A Theory of Production, in: American Economic Review, Vol. XVIII (1928), Supplement, pp. 139 – 165

[6] see Krelle, W.: Produktionstheorie, pp. 22 f.

[7] see Wöhe, G.: Einführung in die Allgemeine Betriebswirtschaftslehre, 19th ed., München 1996, pp. 512 – 532; Jung, H.: Allgemeine Betriebswirtschaftslehre, 2nd ed., München, Wien 1996, pp. 424 - 431, 438 – 439

[8] see Fandel, G.: Produktion I – Produktions- und Kostentheorie, 6th ed., Berlin et al 2005, p. 56; Förstner, K.: Betriebs- und volkswirtschaftliche Produktionsfunktionen, in: Zeitschrift für Betriebswirtschaft, Jg. 32 (1962), pp. 264 – 282, here p. 266

[9] see Linde, R.: Produktion II: Produktionsfunktionen, in: HdWW, 6. Bd., Stuttgart et al 1981, pp. 276 – 295, here p. 278

[10] see Krelle, W.: Produktionstheorie, pp. 33 f.

[11] see Böhm-Bawerk, E.v.: Kapital und Kapitalzins, 2. Abt.: Positive Theorie des Kapitales, Innsbruck 1889 (Faksimile-Ausgabe 1991), pp. 81 – 97; Gutenberg, E.: Grundlagen der Betriebswirtschaftslehre, 1. Bd. pp. 314 ff.

[12] see Gutenberg, E.: Grundlagen der Betriebswirtschaftslehre, 1. Bd., p. 290

input. He calls this connection a "relationship of productivity" which can be described by a production function. Gutenberg´s findings demonstrate that a quantitative production function can be deduced on the basis of productivity given by the ratio of output to input. Therefore it is possible to deduce a monetary production function by using the following formulas for efficiency:

(1) $$w = \frac{E}{K} \text{ or } w = \frac{N}{K}$$

Key:

E = proceeds

N = benefit

K = cost

w = efficiency/value added factor

If we write equation (1) in terms of E (proceeds), include equation (2) for the cost and replace the proceeds E by the general value of the output Y, we get equation (3):

(2) $$K = AK + KK$$

Key:

K = cost

AK = cost of labour used in the production process

KK = cost of capital used in the production process

The simple monetary production function as presented in equation (3) can be used as a production function for an enterprise or an economy:[13]

(3) $$E = Y = w\,(AK + KK) \qquad 0 \le w \le \infty$$

(Witte production function)

Key:

Y = value of output/proceeds/gross national product ($Y = E$)

AK = cost of labour used in the production process

KK = cost of capital used in the production process

w = efficiency of the production process/value added factor

This simple monetary production function has some advantages: (1) It is compatible with business accounting and with national accounting,[14] (2) it shows the value added factor of a production process, (3) it is not necessary to find a cost function for the production function by using an inverse function, because the cost are a term of the production function itself, (4) it is possible to aggregate several production functions for single enterprises to form a national production function of the same type.[15]

The graph of the production function represented in equation (3) is illustrated in Figure Nº 1. To find the curve we have to assume that one production factor is constant. The graph falls into three stages. In the first the value added factor is less than one ($w < 1$). The value of the output rises less than the increasing value of the labour or capital used in the production process. In the second stage the value added factor is equal to one ($w = 1$), this means that the value of the

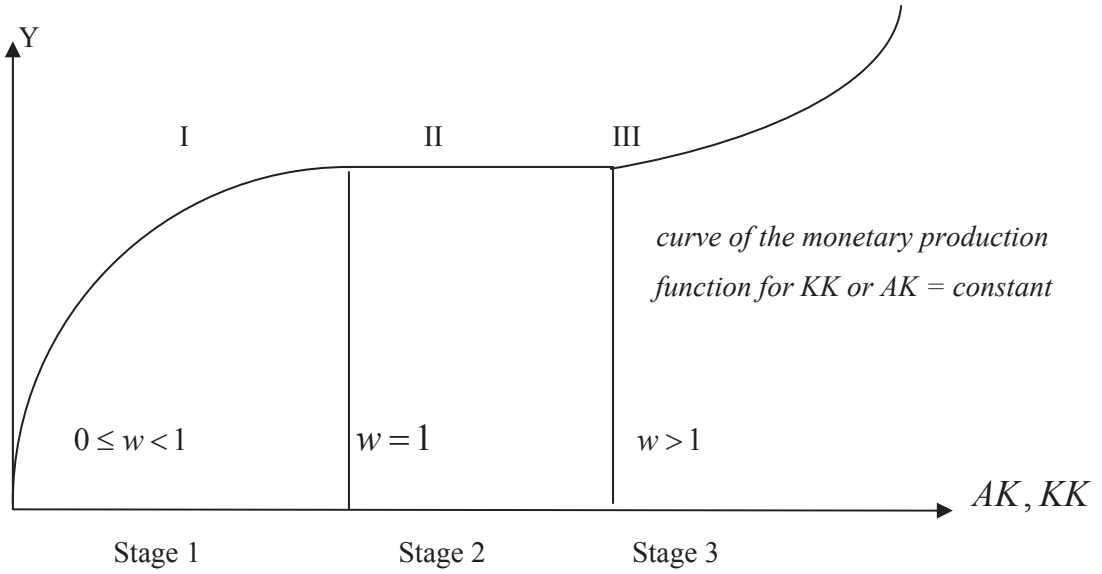
[13] see Witte, H.: Eine Produktionsfunktion für die Abbildung nachhaltiger regionaler Entwicklungen, in: Scientific Journal (of the University of Szczecin), Nr. 479, Regional Development, Vol. 1 (2007), pp. 57 - 69; Witte, H.: La Función de Producción en la Simulación Económica, in: Documentos seleccionados del Instituto de Economía 2008, Bahia Blanca 2009, pp. 61 - 76

[14] see Annex 1, Table 1

[15] see Annex 1, Table 2

output is on the same level with the value of the cost of labour or the cost of capital. In the third stage the value added factor is higher than one ($w > 1$). In this case the value of the output increases more than the value of labour or capital.

Figure Nº 1: Curve of the monetary production function



Source: Author´s own presentation

3. Conclusion

The classification of production functions differs in literature. In this article we use a classification based on the traditional point of view in, and the classification of basic variables of, business administration. In doing so, we have distinguished between quantitative, quantitative time-based and monetary production functions. The quantitative production function has been deduced from the equation for productivity, the quantitative time-based production function from the equation of time-based productivity (velocity of production) and finally the monetary production function from the equation of efficiency.

Our classification has led to a monetary production function, which is an improved version of a simple, cursorily deduced production function developed by Samuelson.[16] Samuelson, however, did not propagate his production function, judging the function be too simple. The monetary production function developed by the author represents the value added of the production process, which is given by the transformation of input to output. If the value added factor (w) is higher than one, the production process creates value. If the value added factor is equal to one ($w = 1$), the enterprise is operating at the "break-even point" or the market for the output can be a market with perfect competition. In this case the competition on the market is so intense that the enterprise selling the output has no chance to create a value added. The cost of production is equal to the proceeds ($K = E$). As a result the enterprise makes no profit or loss.

The simple monetary production function is adequate for supporting a worldwide process of sustainability, because it is possible to aggregate the functions of several enterprises to a macroeconomic production function. This is a necessary condition, because the worldwide process of sustainability starts in enterprises and the results produced in all enterprises establish the global result. So our function has an advantage over the Cobb-Douglas production function which leads to complications when aggregating several functions. Furthermore the Cobb-Douglas function is more complicated and its user needs more time as well as expenditure to calculate the same final result than using the simple monetary production function. This advantage will be

[16] see Samuelson, P. A.: Paul Douglas´s Measurement of Production Functions and Marginal Productivities, in: Journal of Political Economy, Vol. 87 (1979), pp. 923 – 939, here p. 927

demonstrated in annex 2. If you compare the results calculated in annex 1 immediately after Table Nº 1 and its continuation with the results in annex 2, the conclusions will be evident. In annex 3 it will be proved that the simple monetary production function leads in the case of increase of the value (cost) of the input of x percent to a rise of x percent of the value of the output. This is the same as with the linear homogeneous Cobb-Douglas production function.

To set up the simple monetary production function it is necessary to enclose conditions that ensure worldwide sustainability. This is attempted in the following article entitled “Models of Sustainability”.

Annex 1

Table Nº 1: Test of applicability of the monetary production function

Expenses	profit-and-loss	account (year 01)	Revenues
material expenses	300.000	proceeds	1.000.000
wages and salary	454.000	e.o. returns	60.000
contributions and tolls	2.000		
assurances	6.000		
depreciation	145.000		
interest paid	40.000		
external services	12.000		
e.o. expenditure	6.000		
profit	95.000		
	1.060.000		1.060.000

Source: Wöhe, G./Kaiser, H./Döring, U.: Übungsbuch zur Einführung in die Allgemeine Betriebswirtschaftslehre, 8th ed., München 1996, p. 530

(3) $Y = E = w\ (AK + KK)$

Key:

$Y = E$ = proceeds

AK = cost of labor

KK = cost of capital plus all other costs which are not cost of labor

w = value added factor (efficiency)

The enlargement of cost of capital is necessary, because there are more positions of cost in the profit-and-loss account than in the original form of the simple monetary production function.

(3.1) $1.060.000 = w\ (454.000 + 300.000 + 2.000 + 6.000 + 145.000 + 40.000 + 12.000 + 6.000)$

(3.2) $w = 1.060.000 / 965.000 = 1{,}0984455$

(4) $G = E - K \quad \rightarrow \quad G = w\ (K) - K$

Key:

G = profit

E = proceeds

K = cost

(4.1) $G = 1{,}0984455 \bullet (965.000) - 965.000$

(4.2) $G = 105.999{,}99 - 965.000$

(4.3) $G = 94.999{,}999 \approx 95.000$ Q.E.D. (see Table Nº 1)

Table Nº 1 (continuation)

Expenditures	profit-and-loss-account		(total expenditure format)	Revenues
Enterprise expenditures per period			**Enterprise attainments**	
1. wages and salary	30.000		1. sales proceeds	200.000
2. material expenses	70.000		2. final amount of semi-finished and finished products	20.000 220.000
3. depreciation	10.000		3. starting amount of semi-finished and finished products	- 40.000 180.000
4. interest paid	5.000			
5. further expenditures	25.000	140.000		
profit		40.000		
		180.000		180.000

Source: Wöhe, G.: Einführung in die Allgemeine Betriebswirtschaftslehre, p. 1141

(3) $Y = E = w\,(AK + KK)$

(3.3) $180.000 = w\,(30.000 + 70.000 + 10.000 + 5.000 + 25.000)$

(3.4) $w = 180.000 / 140.000 = 1{,}2857142$

(4.4) $G = E - K \quad \rightarrow \quad G = w\,(K) - K$

(4.5) $G = 1{,}2857142 \bullet (140.000) - 140.000 \qquad G = 179.999{,}98 - 140.000$

(4.5) $G = 39.999{,}98 \approx 40.000$ Q.E.D. (see Table Nº 1, continuation)

Table Nº 2: Deduction of a national production function from the production functions of several enterprises by addition (w = 1)

Enterprise	Production function in form of (3.4)
1	$w = (10 \bullet 2) / (10 \bullet 2) = 1$
2	$w = (12 \bullet 2) / (12 \bullet 2) = 1$
3	$w = (14 \bullet 2) / (14 \bullet 2) = 1$
4	$w = (16 \bullet 2) / (16 \bullet 2) = 1$
$\sum$ ew PF = gw PF	$w = (52 \bullet 2) / (52 \bullet 2) = 1$

Source: Author´s own calculations

ew PF = production function of an enterprise

gw PF = national production function

Annex 2

The Cobb-Douglas production function is formulated in equation (5). Douglas[17] explained that his production function is homogeneous of the first degree or linear-homogeneous. Cobb and Douglas held the opinion that for empirical operations this production function had to be used with index-linked values.[18]

(5) $x = f(A^{\alpha} \bullet K^{\beta})$ $\alpha + \beta = 1$

Key:

x = physical production in production units

A = amount of labor in numbers of workers or working hours

K = amount of capital in monetary units

f = parameter independent of A und K

α = production elasticity of labor

β = production elasticity of capital

$\alpha + \beta$ = elasticity of scale

To test the Cobb-Douglas production function or to compare the results with the outcome of the profit-and-loss account we have to put the data of tab.1 in equation (5) and to calculate the profit (G), the physical production (x), the production elasticity of labor (α), the production elasticity of capital (β) and the value of the parameter (f). But it is not possible to use indexes, because there is only one profit-and-loss account. To fulfil the condition of Cobb and Douglas we use values without measurement units.

For calculation it is necessary to give some more information about two values of the profit-and-loss account. The value for "wages and salary" of 454.000 monetary units is given by 45.400 working hours and a wage of 10 monetary units per hour. The "proceeds" of 1.060.000 monetary units is calculated by 106.000 product units (x) and a price of 10 monetary units per product unit.

Now we can write equation (5) as follows:

(5.1) $106.000 = f(45.400^{\alpha} \bullet 511.000^{\beta})$ $\alpha + \beta = 1$

(5.2) $f = 106.000 / (45.400^{\alpha} \bullet 511.000^{\beta})$ $\alpha + \beta = 1$

As we have only one profit-and-loss account it is impossible to calculate values for the production elasticity of labor (α) and the production elasticity of capital (β). So we have chosen some special combinations of these values which fulfil the condition that their sum is one:

Table Nº 3: Calculation of f and G based on alternative values for α and β

α	β	f	profit (G)
0	1	0,207436	- 764.824,26
0,4	0,6	0,546299727	- 437.820,7634
0,5	0,5	0,695933093	- 293.424,5653
0,6	0,4	0,88655155	- 109.477,7543
1	0	2,334801762	1.288.083,7

Source: Author´s own calculations

[17] see Douglas, P.H.: The Cobb-Douglas Production Function Once Again: Its History, Its Testing, and Some New Empirical Values, in: Journal of Political Economy, Vol. 84, (1976), pp. 903 – 915, here p. 904

[18] see Cobb, C.W.; Douglas, P.H.: A Theory of Production, p. 149

(5.2.1) $f = 106.000 / (45.400^{0} \bullet 511.000^{1}) = 106.000 / 511.000 = 0{,}207436$

(5.2.2) $f = 106.000 / (45.400^{0{,}4} \bullet 511.000^{0{,}6}) = 106.000 / 72{,}91591687 \bullet 2.661{,}046968$
$f = 106.000 / 194.032{,}6795 = 0{,}546299727$

(5.2.3) $f = 106.000 / (45.400^{0{,}5} \bullet 511.000^{0{,}5}) = 106.000 / 213{,}0727575 \bullet 714{,}84264$
$f = 106.000 / 152.313{,}4925 = 0{,}695933093$

(5.2.4) $f = 106.000 / (45.400^{0{,}6} \bullet 511.000^{0{,}4}) = 106.000 / 622{,}6349739 \bullet 192{,}0296808$
$f = 106.000 / 119.564{,}3953 = 0{,}8865515$

(5.2.5) $f = 106.000 / (45.400^{1} \bullet 511.000^{0}) = 106.000 / 45.400 = 2{,}334801762$

With these values we calculate the profit (G) in order to test if the profit calculated by the Cobb-Douglas production function has the same value as the profit of the profit-and-loss account:

(6) $G = E - K$

Key:

G = profit

E = proceeds $E = p \bullet x$ or $E = f(K)$

key: p = price; x = physical production

K = cost

To calculate the profit (G), we use the values of the parameter (f) calculated above:

(6.1) $G = f \bullet 965.000 - 965.000$

(6.1.1) $G = 0{,}207436 \bullet 965.000 - 965.000 = 20.0175{,}74 - 965.000 = -764.824{,}26$

(6.1.2) $G = 0{,}546299727 \bullet 965.000 - 965.000 = 527.179{,}2366 - 965.000 =$
$-437.820{,}7634$

(6.1.3) $G = 0{,}695933093 \bullet 965.000 - 965.000 = 671.575{,}4347 - 965.000 =$
$-293.424{,}5653$

(6.1.4) $G = 0{,}88655155 \bullet 965.000 - 965.000 = 855.522{,}2458 - 965.000 =$
$-109.477{,}7543$

(6.1.5) $G = 2{,}334801762 \bullet 965.000 - 965.000 = 2.253.083{,}7 - 965.000 = 1.288.083{,}7$

(6.1.6) For G = 95.000 we have $95.000 = f \bullet 965.000 - 965.000$

(6.1.6.1) $f = (95.000 + 965.000) / 965.000 = 1.060.000 / 965.000 = 1{,}102702703$
for $f = 1{,}102702703$ is G = 95.000.

This figure indicates that the profit has not always the value of 95.000 as calculated in the profit-and-loss account. Only if f equals 1,102702703 the profit has the value of 95.000. This implies that the production function is for most values of α and β not an acceptable approximation of the production process, because the differences to the result of the profit-and-loss account are too huge. The production function is an adequate solution just in one special case.

Now we have to calculate the values of α and β using the above calculated value of (f) (f = 1,102702703, see (6.1.6.1)):

(5.1) $1.06.000 = f(45.400^{\alpha} \bullet 511.000^{\beta})$ $\alpha + \beta = 1$

(5.1.3) $106.000 = 1{,}102702703 \ (45.400^{\alpha} \bullet 511.000^{\beta})$

(5.1.3.1) $(45.400^{\alpha} \bullet 511.000^{\beta}) = 106.000 / 1{,}102702703$

If α and β are independent, this equation has no solution, because it is impossible to solve an equation with two unknown quantities. So it is obligatory that α and β should be dependant. This means that the condition of equation (5) is important and necessary:

(5.1.3.2) $(45.400^{\alpha} \bullet 511.000^{1-\alpha}) = 106.000 / 1{,}102702703$

(5.1.3.3) $(45.400^{\alpha} \bullet 511.000^{1-\alpha}) = 96.127{,}45095$

(5.1.3.4) $\ln (45.400^{\alpha} \bullet 511.000^{1-\alpha}) = \ln 96.127{,}45095$

(5.1.3.5) $\alpha \ln 45.400 + (1 - \alpha) \ln 511.000 = \ln 96.127{,}45095$

(5.1.3.6) $10{,}723267384\ \alpha + 13{,}144124869\ (1 - \alpha) = 11{,}473430204$

(5.1.3.7) $10{,}723267384\ \alpha + 13{,}144124869 - 13{,}144124869\ \alpha = 11{,}473430204$

(5.1.3.8) $-2{,}42085748\ \alpha = -1{,}67069466$

(5.1.3.9) $\alpha = -1{,}67069466 / -2{,}42085748 = 0{,}690125161 \quad (\approx 0{,}69)$

(5.1.3.10) $\beta = 1 - \alpha = 1 - 0{,}690125161 = 0{,}309874839 \quad (\approx 0{,}31)$

(5.1.3.11) $\alpha + \beta = 1$

(5.1.3.12) $0{,}690125161 + 0{,}309874839 = 1$

We have to prove it again by using equation (5.1):

(5.1) $106.000 = f(45.400^{\alpha} \bullet 511.000^{\beta})$

(5.1.4) $106.000 = 1{,}102702703\ (45.400^{0{,}690125161} \bullet 511.000^{0{,}309874839})$

(5.1.5) $106.000 = 1{,}102702703\ (1.636{,}633439 \bullet 58{,}73486939)$

(5.1.6) $106.000 = 1{,}102702703 \bullet 96.127{,}45129$

(5.1.7) $106.000 = 106.000{,}004$ (a very good approximation)

This means that the Cobb-Douglas production function is more than a valuable approximation. It is so good, that we can say, the Cobb-Douglas production function is an exact approach. But we have to remind that the result is only valid in one special case.

Annex 3

Last but no least it is necessary to test the simple monetary production function. The Cobb-Douglas production function is linear homogeneous, this means that an increase of x percent of the input, of the factors labor and capital, leads to an increase of the output of x percent.

The following example demonstrates that the simple monetary production function also leads to an increase of x percent of the value of the output, if the value of the input (the cost of labor and capital) increases by x percent. The example starts with equation (3):

(3) $Y = E = w\ (AK + KK)$

(3.3) $180.000 = w\ (30.000 + 70.000 + 10.000 + 5.000 + 25.000)$

(3.3.1) $Y = 1{,}2857142 \bullet 140.000$

(3.3.2) $Y = 1{,}2857142 \bullet 154.000$

(3.3.3) $Y = 197.999{,}9868$

(3.3.4) $Y \approx 198.000$

Equation (3.3.3 or 3.3.4) shows an increase of the value of the output of 10 percent induced by an increase of 10 percent by the value (costs) of the input.

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Chapter 2

Models of Sustainability

Hermann Witte

1. Introduction

To realise a sustainable development a postulation is advocated by the United Nations. The concept of sustainability was compiled in the Brundtland report[19]. An ancient concept of sustainability concerning forestry is based on the ideas of von Carlowitz (1713).[20]

There is a sustainable development as defined by the United Nations can be realised if the following three requirements are implemented:[21]

(1) A balance between generations,

(2) A balance between economy and ecology and

(3) A balance between "poor" and "rich".

So far it has been impossible to realise such a development. Especially the third requirement, a balance between "poor" and "rich", has not been met in any existing economy. The question to be answered is what theoretical basis is needed to fulfil the three requirements of sustainability as claimed by the United Nations.

To this purpose models of sustainability are to be designed. The basis is a "one-product-model". To find conditions which guarantee a sustainable development as defined by the United Nations, the production process has to be analyzed. The model should be based on an adequate production function. The production process of a single product ("one-product-model") is the elementary unit to realise sustainability. As lots of products are manufactured in an economy, the "one-product-model" must be transformed into a "multi-product-model" later on.

The expansion will be carried out step by step. First a "multi-product-model" for pro-ducts with cost of production on the same level will be devised. Later on a "multi-product-model" for products with different costs of production will be set up.

2. The "One-Product-Model" of Sustainability

The basis for developing a "one-product-model" is a monetary production function that is suitable for this task. A quantitative production function is inappropriate because especially for the third requirement of sustainability a monetary point of view is needed. The "one-product-model" is appropriate for a small economy consisting of a single enterprise that only produces one product. It only contains two economic entities.

The respective monetary production function is shown in equation (1):[22]

(1) $PL_n = Y = E = w\ (AK + KK)$

Key:

$PL_n = Y = E$ = sustainable output/gross national product/proceeds

AK = cost of labour used in the production process

[19] see Hauff, V. (Ed.): Unsere gemeinsame Zukunft. Der Brundtland-Bericht, Greven 1987

[20] see Carlowitz, H.K.v.: Sylvicultura oeconomica oder haußwirtschaftliche Nachricht und Naturmäßige Anweisung zur Wilden Baum-Zucht, Leipzig 1713 (reprint Freiberg 2000), p. 105

[21] see Hauff, V. (Ed.): Unsere gemeinsame Zukunft. Der Brundtland-Bericht, esp. pp. XI, XV s., XXII, XXIV, 1 f., 9 f., 41 - 45, 46 - 69

[22] see Witte, H.: Eine Produktionsfunktion für die Abbildung nachhaltiger regionaler Entwicklungen, in: Scientific Journal (of the University of Szczecin), Nº 479, Regional Development, Vol. 1 (2007), pp. 57 – 69; Witte, H.: Das Logistikkonzept „nachhaltiges Supply Chain Management", in: Scientific Journal (of the University of Szczecin), Nº 506, Ökonomische Probleme, Nº 23, Nachhaltiges Supply Chain Management – Ideen, praktische Lösungen und Finanzierung, (2008), pp. 11 - 42

KK = cost of capital used in the production process

w = efficiency/value added factor

The monetary production function has some advantages compared to other well-known production functions: it is compatible with both business and national accounting; values from profit-and-loss accounting can directly be used for the production function;[23] there is no need to operate with index values; it is not necessary to find a cost function by using an inverse function; it is not a problem to use the production function either for an enterprise or a national economy; it is possible to aggregate the production functions of several enterprises to a national production function[24] and the production function indicates the value added factor obtained by selling a product[25].

There are some restrictive conditions regarding the monetary production function which secure sustainability. The first aspect of sustainability, the balance between generations, is ensured by the constraint in equation (2):

(2) $z \bullet tgl = PGS = N = RR$ (constraint 1)

Key:

z = working days per year (for example 260 or 365)

tgl = daily amount of output

PGS = annual velocity of production

N = annual demand

RR = ratio of regeneration of the production factors

If in an economy the annual national output is equal to the annual velocity of production, the annual demand and the annual regeneration of the production factors, the first requirement of sustainability is met.

The second aspect of sustainability is ensured by equation (3). The environmental damages or better the environmental costs (known as "external costs") have to be compensated by an ecological tax or the external costs (K_E) must be reduced to zero respectively:

(3) $K_E = 0$ (constraint 2)

This constraint involves the use of an ecological balance sheet to measure the environmental effects both of the output and of the factors of production. It could be helpful to incorporate a further constraint which brings the external benefits (N_E) down to zero:

(4) $N_E = 0$ (constraint 3)

The levy of an ecological tax is the task of the state/the government.

The third aim, the balance between "poor" und "rich", is achieved by two further constraints: Firstly, the value added factor in a national production process has to be equal to one (w = 1):

(5) $w = 1$, if $p \bullet x = K_G \rightarrow A = N$ (constraint 4)

Key: p = price

x = product quantity

K_G = total cost

N = demand

A = supply

[23] see Witte, H.: The Monetary Production Function, in: this volume
[24] see Witte, H.: The Monetary Production Function …, in: this volume
[25] see Witte, H.: The Monetary Production Function, in: this volume

Secondly, equal payment has to be realized, i.e. all economic entities must earn the same. This constraint is accounted for a modified form of equation (1):

(1) $Y = p \bullet x = AK + KK$

(6) $10 \bullet 2 = 10 \bullet 2 = (5 + 5) \bullet 2 = 5 \bullet 2 + 5 \bullet 2 \qquad 20 = 10 + 10 = 20$

(7) $L_{M1} = L_{M2} = , ..., = L_{Mn}$ (constraint 5)

Key:

L_{M1}, …, L_{Mn} = payment to employees (economic entities) 1 to n, here n = 2

L_{M1} = payment to jobholder 1, $L_{M1} = AK$

L_{M2} = payment to capital owner 1, $L_{M2} = KK$

The values for the "one-product-model" are shown in Table Nº 4.

Table Nº 4: Payment to and disbursements of the employees of an enterprise

	Payments in Monetary Units	**Disbursement for product 1 Monetary Units**	**∑ Disbursements Monetary Units**
Jobholder 1	5 ● 2 = 10	10 ● 1 = 10	10
Capital owner 1	5 ● 2 = 10	10 ● 1 = 10	10
∑	20	20	20

Source: Author´s own presentation

Table Nº 5: Deduced constraints (NB) for the "one-product-model" to guarantee sustainability as defined by the United Nations

Aspect of sustainability	**Constraint**
1. balance between generations	1. NB: z ● tgl = PGS = N = RR
2. balance between ecology and economy	2. NB: $K_E = 0$ 3. NB: $N_E = 0$
3. balance between „poor" and „rich"	4. NB: w = 1 5. NB: p ● x = AK + KK or $L_{M1} = L_{M2} = , ..., = L_{Mn}$

Source: Author´s own presentation

3. The "Multi-Product-Model" of Sustainability

Now we are to expand the "one-product-model". We have to consider more than one product. In principle the model should work with any number of products. The "multi-product-model" has two variants: Version 1 relates to products with the same costs of production and version 2 pertains to products with different costs of production.

3.1. The "Multi-Product-Model" for Cost of Production on the same Level

The extension of the "one-product-model" first leads to a "two or more product-model" for products with cost of production on the same level. We choose to start with two products. There

are two enterprises each producing one product. Either enterprise has two employees and manufactures four units of its product. For this model the following relationships apply:

(8) $w_1 = p_1 \bullet x_1 / (AK_1 + KK_1)\, x_1$

(9) $w_1 = 10 \bullet 4 / (5 + 5)\, 4$

(10) $w_2 = p_2 \bullet x_2 / (AK_2 + KK_2)\, x_2$

(11) $w_2 = 10 \bullet 4 / (5 + 5)\, 4$

The aggregated production function and the aggregated values respectively are reflected in equations (12) and (13):

(12) $w_3 = p_3 \bullet x_3 / (AK_3 + KK_3)\, x_3$

(13) $w_3 = 10 \bullet 8 / (5 + 5)\, 8$

A summary of all values for the "two-product-model" with cost of production on the same level are presented in Table Nº 6.

Table Nº 6: Payments to and disbursements of the employees of the two Enterprises with the same cost of production

	Payments in (Monetary Units)	**Disbursements for product 1 (Monetary Units)**	**Disbursements for product 2 (Monetary Units)**	**∑ Disbursements (Monetary Units)**
Jobholder 1	5 ● 4 = 20	10 ● 1 = 10	10 ● 1 = 10	20
Jobholder 2	5 ● 4 = 20	10 ● 1 = 10	10 ● 1 = 10	20
Capital owner 1	5 ● 4 = 20	10 ● 1 = 10	10 ● 1 = 10	20
Capital owner 2	5 ● 4 = 20	10 ● 1 = 10	10 ● 1 = 10	20
∑	80	40	40	80

Source: Author´s own presentation

Constraints 1, 2 and 3 are valid for the "two-product-model". It remains for us to prove the validity of constraints 4 and 5 for the "two- respectively multi-product-model". We have demonstrated that both constraints, w = 1 and the same payment to all employees, are also valid for the "two- respectively multi-product-model" (see Table Nº 6). With reference to this model, constraints 4 and 5 guarantee the third United Nations requirement of sustainability.

In contrast, as for the "two- respectively multi-product-model" with the same cost of production there are two further constraints which have to be validated. The first one implies that the enterprises have to produce so many units of the products that all employees can accommodate their demands:

(14) $ME_i = NE$ (constraint 6) $i = 1, \ldots, n$

Key:

ME = quantity units of the product i

NE = number of employees

i = index of the products, i = 1, …, n

The additional constraint demands that the quantity of each product has to be equal to the number of employees of all enterprises:

$$(15)\quad ME_i = \sum_{j=1}^{m} NE_j \qquad \text{(constraint 7)} \qquad i = 1, \ldots, n;\ j = 1, \ldots, m$$

Key:

ME = quantity units of product i

U_j = enterprise j

NE_j = number of employees of enterprise j

i = index of products, i = 1, …, n

j = index of enterprises, j = 1, …, m

Under these conditions the "two-product-model" can be expanded to comprise an optimal number of products/production processes. So sustainability as determined by the United Nations is always guaranteed. But we must admit that the "two- respectively multi-product-model" with the same cost of production is not very realistic. Even enterprises which produce the same product normally operate with different production costs.[26] For this reason we will have to design a "two- respectively multi-product-model" allowing different costs of production in the subsequent chapter.

Table Nº 7: Deduced constraints to guarantee sustainability as defined by the United Nations for the "multi-product-model" with the same cost of production

Aspect of Sustainability	Constraints
1. Balance between the generations	1. NB: z ● tgl = PGS = N = RR
2. Balance between economy and ecology	2. NB: $K_E = 0$ 3. NB: $N_E = 0$
3. Balance between „poor" and „rich"	4. NB: w = 1 5. NB: $L_{M1} = L_{M2} = , ..., = L_{Mn}$ 6. NB: $ME_i = NE$ (m) 7. NB: $ME_i = \sum_{j=1}^{m} NE_j$

Source: Author´s own presentation

3.2. The "Multi-Product-Model" for different Costs of Production: The stage Model

The solution presented regarding the multi-product-case with different costs of production is a "layer" or "stage model". We assume that an economy consists of three component circuits. In the first (at the first stage) the essential (inferior) products are made which all people need and buy. In the second (at the second stage) products of a higher value (superior products) are manufactured which are also bought by all people. In the third circuit (at the third stage) luxury products are fabricated that are only purchased by people who work in the second and third circuit.

For the above mentioned economy the values of chosen variables are presented in Table Nº 8. These are the monetary production functions, the payments to the employees (jobholder (AK) and capital owners (KK); EI) of the enterprises and the disbursements of the employees (AU) for the products bought. The amount of payments to the employees is equal to the cost of pro-

[26] see Witte, H.; Voigt, F., Laschet, W.: Die Preisbildung im Luftverkehr, Berlin 1982, pp. 206 - 220

duction. Multiplying the production cost (or the payments) and the value added factor (w) we get the proceeds (Y) of the enterprises.

Table Nº 8: Production functions, payments and disbursements of the employees of the enterprises of the "three-stage-model" with different cost of production

1st Stage	2nd Stage	3rd Stage
$Y_1 = w_1 (AK_1 + KK_1)$	$Y_2 = w_2 (AK_2 + KK_2)$	$Y_3 = w_3 (AK_3 + KK_3)$
6 ● 10 = 1 (6 ● 5 + 6 ● 5)	6 ● 20 = 1 (6 ● 10 + 6 ● 10)	4 ● 30 = 1 (4 ● 15 + 4 ● 15)
60 = 30 + 30 = 60	120 = 60 + 60 = 120	120 = 60 + 60 = 120
$AU_1 = 2 ● 10 = 20$	$AU_1 = 2 ● 20 = 40$	-
$AU_2 = 2 ● 10 = 20$	$AU_2 = 2 ● 20 = 40$	$AU_2 = 2 ● 30 = 60$
$AU_3 = 2 ● 10 = 20$	$AU_3 = 2 ● 20 = 40$	$AU_3 = 2 ● 30 = 60$
$EI_1 = 30 + 30 = 60$	-	-
-	$EI_2 = 60 + 60 = 120$	-
-	-	$EI_3 = 60 + 60 = 120$
$EI_1 – AU_{1,1} = 60 – 20 = 40$	$EI_1 – AU_{1,1+2} = 60 – 20 – 40 = 0$	-
$EI_2 – AU_{2,1} = 120 – 20 = 100$	$EI_2 – AU_{2,1+2} = 120 – 20 – 40 = 60$	$EI_2 – AU_{2,1+2+3} = 120 – 20 – 40 – 60 = 0$
$EI_3 – AU_{3,1} = 120 – 20 = 100$	$EI_3 – AU_{3,1+2} = 120 – 20 – 40 = 60$	$EI_3 – AU_{3,1+2+3} = 120 – 20 – 40 – 60 = 0$

Source: Author´s own presentation

The values of the variables given in Table Nº 8 are chosen with regard to the findings of the models developed and presented above. In one circuit/for one product the payment to the employees is the same and the value added factor of all production processes is equal to one (w = 1). The output, however, is only the same in the first two circuits (for the first two products); in the third (for the third product) the output is less than in each of the former circuits.

The values in Table Nº 8 show that on the assumptions made the value added factor in all three circuits (in all three production processes) equals one (w = 1). That means the payments to the employees (EI) and the disbursements (AU) of the employees respectively are equal. For the enterprises the cost of production are equal to the proceeds. Consequently the third condition of sustainability as set by the United Nations, the balance between "poor" and "rich", is fulfilled.

4. Conclusion

The generated models of sustainability satisfy the three requirements for a sustainable development as specified by the United Nations. It is possible to guarantee these aspects for a single production process i. e. on the level of business administration. This has been clearly verified in our analysis of the "one-product-model". More over, it is also possible to secure these aspects on the level of economics. The examination of the "multi-product-model" designed for products with different costs of production has proven the validity of that thesis.

The demonstration of the theoretical possibility to guarantee the three aspects of a sustainable development is only a first step on the way to its realization. The second step is implementing the theoretical findings in an economic concept which then has to be put into reality through practical economic policy to start a worldwide process of sustainability. We assume that the willingness to make good use of the theoretical findings is shared by all United Nation member

states that have accepted the agenda 21.[27] It is hard to tell if they will find a consensus to change the current concepts of economic policy. To realise the theoretical findings some rethinking will have to take place, especially concerning some core factors like growth, distribution and population policies.

Unfortunately in this article, it is impossible to discuss those terms and concepts mentioned and maybe other aspects and policies. Further research work must be done in the future. At the moment we have to be patient and need to spend some time on putting the theoretical findings into practice step by step.

[27] see Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Ed.): Umweltpolitik. Konferenz der Vereinten Nationen für Umwelt und Entwicklung im Juni 1992 in Rio de Janeiro - Dokumente -, Agenda 21, Bonn o.J.

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Chapter 3

The Concept of Sustainable Production Logistics

Hermann Witte

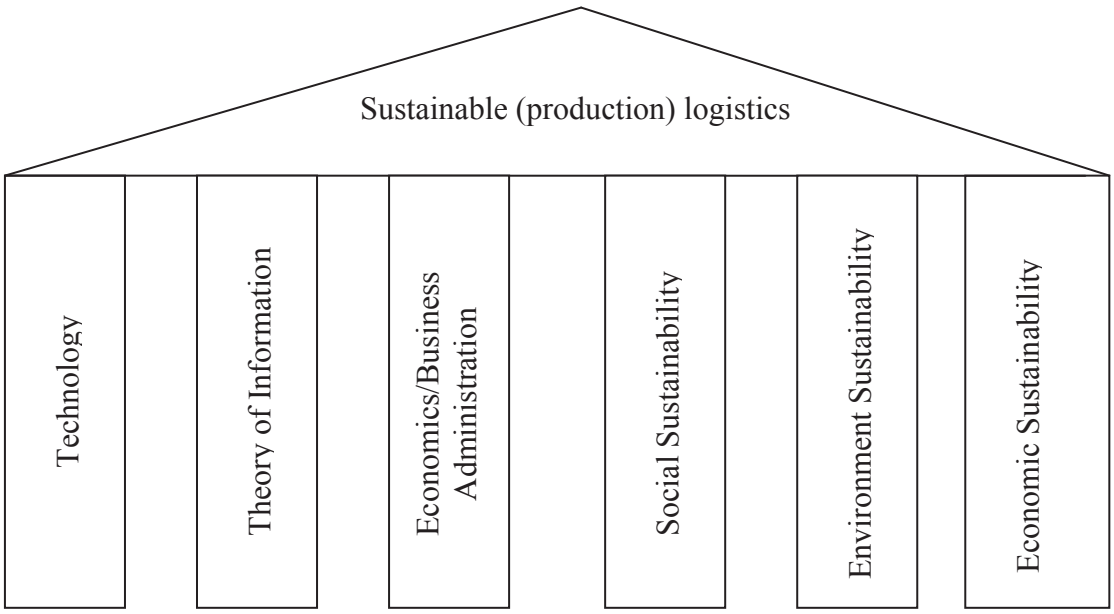
1. Introduction

A basis for designing models of sustainability has been found: the simple monetary production function, which is more practicable than the Cobb-Douglas production function.[28] The production function devised by us is necessary to define the conditions to fulfil the third requirement of sustainability, the integration of the poor and the rich, demanded by the United Nations. Three models of sustainability were presented in the article "Models of Sustainability"[29]. The first model describes sustainability in a very simple economy, involving only one enterprise. The second and the third model illustrate sustainability in an economy with more than one enterprise. While in the second model the enterprises operate with production cost on the same level, the third deals with enterprises which have production cost on different levels. The latter model is more realistic. But the former models are important to demonstrate the preconditions for sustainability.

The last step is to work out a concept of sustainable production logistics. In order to do so we must refer to a concept of sustainable logistics. Thus we have to enlarge the concept of logistics by three constituent parts: the component of social sustainability, the one of environmental sustainability and the one of economic sustainability. The traditional components of logistics are technology, theory of information and economics and business administration. This enlargement is illustrated in Figure Nº 2.

To formulate a concept of sustainable production logistics means to combine logistics with sustainability. The integration is based on the simple monetary production function and the deduced preconditions to fulfil the United Nations qualifications of sustainability. The combination of logistics and sustainability is not only based on the qualifications of sustainability, but it is also necessary to take into account the main principles of logistics, which are introduced in the following part.

Figure Nº 2: The components of Sustainable logistics



Source: Author´s own presentation

[28] see Witte, H.: The Monetary Production Function as Basis of Sustainability, in: this volume
[29] see Witte, H.: Models of Sustainability, in: this volume

After integrating logistics and sustainability to create a concept of sustainable production logistics, it is sensible to point out some critical remarks on the new-developed approach.

2. Formulation of a Concept of Sustainable Production Logistics

In the following section the concept of logistics has to be combined with the concept of sustainability in order to formulate a sustainable concept of logistics. For this task it is necessary to name and to describe the important characteristics of logistics and sustainability.

2.1. The concept

The basic concept of logistics is characterised by the three essential components, which are: the realisation of (1) the order principle, (2) the flow principle and (3) self adjusting (canban) cycles.[30] These three basic characteristics are the starting points for deducing more principles, which however are not important in this context.

The advanced concept of logistics called the "ideal model of logistics"[31] is significant. This ideal model shows that the costs of production are at the minimum when a constant flow of material has been realized with the assistance of the flow principle. The constancy of the flow of material does not have to be effected by growth or contraction.

The concept of sustainability contains three aspects: the integration of (1) the generations, (2) ecology and economy and (3) the "poor" and the "rich". It is possible to fulfil these three conditions of sustainability. The analysis of the models of sustainability developed by our research project has proved it.[32] The models illustrate that the United Nations demands of sustainability are non utopian ideas. This means that the combination of the concept of logistics and the concept of sustainability should be possible.

The combination of logistics and sustainability leads to a sustainable approach of (production) logistics, which should fulfil the following six conditions: the realisation of (1) the order principle, (2) the flow principle and (3) self adjusting (canban) cycles, and the integration of (4) the generations, (5) ecology and economics and (6) the "poor" and the "rich".

It is possible to fulfil these six requirements. The practical approach of (production) logistics has shown that the performance of conditions (1) to (3) is possible. The three models of sustainability above mentioned prove that conditions (4) to (6) can be accomplished.

So the combination of the approach of (production) logistics and sustainability can be carried out. The conditions do not contradict each other, they are compatible. To fulfil the three conditions of sustainability too, means that the approach of (production) logistics has to operate under new conditions which are more rigid than the three traditional ones. The order principle prevents inefficiency in the use of the production factors. Following this rule only goods are produced and shipped that have already been sold. The successful application of the order principle partly helps to fulfil two conditions of sustainability: the integration of the generations and the integration of ecology and economics. As the approach of (production) logistics aims at a market balance by using the order principle, it contributes to fulfil the third condition of sustainability, the integration of the "poor" and the "rich". If the order principle is assisted to find a market balance by the conditions of sustainability, it is possible to realise a sustainable approach of (production) logistics. This means that a market balance is realised by using a special method of price setting, which leads to an integration of the "poor" and the "rich" as well as to an integration of the generations and an integration of ecology and economics respectively. The strategy of price setting has been explained in the article dealing with the models of sustainability.[33]

[30] see Witte, H.: Logistik, München, Wien 2001, pp. 31 ss.; Witte, H.: Allgemeine Betriebswirtschaftslehre, 2nd ed., München, Wien 2007, pp. 8 ff.
[31] see Witte, H.: Das Idealmodell der Logistik und die Anti-Wachstumsthese, pp. 121 - 133
[32] see Witte, H.: Models of Sustainability, in: this volume
[33] see Witte, H.: Models of Sustainability, in: this volume

2.2. Critical Remarks on the Sustainable Approach of Production Logistics

The ideas conceived by the United Nations and by the Brundtland commission to bring about a worldwide process of sustainability are not utopian. From the theoretical point of view it is possible to realise the process based on the three models of sustainability and the approach of sustainable production logistics as demonstrated by our research. From the practical point of view there are some problems, because it is necessary to start a process of rethinking in economics. Traditional positions/theories have to be given up. It will be necessary to pull down a wall in people´s heads.

To reach the break-even point means to give up the idea of maximisation of the profits and minimisation of cost. The distinction between profits acquired by exercising social responsibility and those obtained without accounting for social responsibility, as proposed by the research approach called "Corporate Social Responsibility",[34] seems compared with the break-even point solution to be a half-hearted attempt.

To attain sustainability it is important to find a way to convince all enterprises to accept the break-even point solution. Furthermore we need to search for means of financing investigations and research work, necessary to limit the "wear and tear" of production potential. Funding by way of (not distributed) profits is impossible under the conditions of sustainability as such investigations can only be interpreted as cost relating to the category of cost of capital.

Besides, it is also necessary to discuss the initiation of new products, the foundation of new enterprises, the consequences of technical progress, the effects of changes in population growth, the basic model of competition and the effects of division of labor. Reorientation will be inevitable which is to bear upon the theory and policy of distribution, of growth, and the interpretation of the market economy as a planned economy. The models of sustainability proposed do not conform with "mainstream economics".

The painful procedure of reorientation will be a long term process in the (world) economy devoid of crises induced by the economic system. The second effort targets the realization of (worldwide) sustainability.

3. Conclusion

To give power and evidence to the papers of the United Nations, which deal with sustainability, all enterprises in their member countries and all their governments have to modify their policies. This is a long term process entailing a great number of problems of adjustment. Nevertheless, it seems possible to solve the problems by means of the simple monetary production function and the preconditions of sustainability found. It will be more difficult to put away the common traditionally accepted ideas of mainstream economics which is a general problem of logistics. Wildemann learned from experience that for the realisation of a logistics concept it is vital to convince the employees of enterprises of the advantages of the new approach and the new way of thinking and operating.[35] Japanese economists have asserted that walls in the heads of people must be torn down before new and successful concepts can be generated and put into practice.[36]

The results of our attempt to find conditions of sustainability and sustainable (production) logistics are gratifying, because preconditions of distribution theory and policy have been established and widely been discussed in science as well as in practical policy.

If we cannot get rid of ancient outdated ideas, concepts and prejudices which do not adjust to the requirements of new challenges we will not obtain sustainability, but damage and destroy our own bases of life.

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[34] see e.g. Kommission der Europäischen Gemeinschaften: Grünbuch – Europäische Rahmenbedingungen für die soziale Verantwortung der Unternehmen, KOM(2001) 366 endgültig vom 18.7.2001

[35] see Wildemann, H.: Das Just-in-Time-Konzept, 3rd ed., St. Gallen 1992, pp. 187 ff., 225, 290

[36] see Yamada, H./Kataoka, T.: Joshiki Yaburi no Monozukuri, (Produktion gegen die Mauer im Kopf oder Die Herstellung von Waren ohne traditionelle Arbeitsteilung), 2nd ed., Tokio 2002

Furthermore it is obvious that the realisation of a worldwide process of sustainability does not need a distribution or social policy of its own. The conditions of distribution mentioned above to achieve and maintain sustainability include the social aspect.

Last but not least it will have become evident that business administration and economics are very closely related, because only a view on both business administration and economics leads to a suitable approach to ensure sustainability as promoted by the United Nations. This means that a further wall in the people´s mind has to be pulled down which consists of rigorous separation of business administration and economics in theory and practice.

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Chapter 4

Traveling Salesman Problems in Bilayered Networks[37]

Blanca I. Niel[38], Agustín Claverie[39] and Raúl O. Dichiara[40]

1. Introduction

Today's marketplace makes imperative to speed up everywhere efficient strategies. Therefore, the works on the Traveling Salesman Problem (TSP) are motivated by direct applications among others to the scheduling of the truck loading diagrams; the planning of crop surveys; the movement of equipments and vehicles around freight tours -i.e. logistics, salesmen or tourists structured addressing, parce deliveries, etc. Each struggle aims the performing of different processes in least time and/or minimum costs.

We formulate and solve here both TSP versions, min. TSP and max. TSP, in a specific bilayered network architecture. We focus on the computational experiences ranging from a Brute Force exploration to the coding and handling of an adequate Concorde heuristic interface, through the Nearest Neighbor and Farthest Neighbor algorithms. This framework paves the way to overcome these optimal transportation problems by theoretical reasonings. The bilayered architecture of the network $N := \left\{K_{N=2n}(e^{i\pi}\sqrt[n]{1},\ r\,e^{i\pi}\sqrt[n]{1}),\ D\right\}$ is built by the complete graph K_N and the $N \times N$ matrix $D = (d_{ij})$ of the euclidean distances between nodes. At the outer layer the vertex's locus are the points of a regular n-polygon, $e^{i\pi}\sqrt[n]{1}$. Meanwhile, the remainders n vertices $e^{i(\pi+\alpha)}\sqrt[n]{1}$ are located in the inner circular layer of radius $r \in (0,1)$.

Section 2 deploys the complete analysis of Min and Max TSP in the simplest $N := \left\{K_6(e^{i\pi}\sqrt[3]{1},\ r\,e^{i\pi}\sqrt[3]{1}),\ D\right\}$ network. Section 3 devotes to Max TSP and reflective cycles in $N := \left\{K_{N=2n}(e^{i\pi}\sqrt[n]{1},\ r\,e^{i\pi}\sqrt[n]{1}),\ D\right\}$ networks. Section 4 displays simplistic results of the computational experiences sired by the algorithms and designed graphics interfase for a free version of the Concorde routine[41]. Finally, Section 5, sets forth our insight to capture the Min and Max TSPs in the bilayer $N := \left\{K_{N=2n}(e^{i\pi}\sqrt[n]{1},\ r\,e^{i(\pi+\alpha)}\sqrt[n]{1}),\ D\right\}$ networks.

2. TSPs in $N := \left\{K_{N=2n}(e^{i\pi}\sqrt[n]{1},\ r\,e^{i(\pi+\alpha)}\sqrt[n]{1}),\ d_{NxN}\right\}$ networks

2.1 The simplest networks $N := \left\{K_6(e^{i\pi}\sqrt[3]{1},\ r.e^{i\alpha}\sqrt[3]{1}),\ d^{E}_{NxN}\right\}$

We choose the cyclic pathways that start and end up at $C = (-1,0)$ of the unitary circumference, they touch five times the outer and / or the inner circle vertices. Each feasible tour must undergo a single contact to every node at the bilayer structure $N := \left\{K_{N=2n=6}(e^{i\pi}\sqrt[3]{1},\ r.e^{i\alpha}\sqrt[3]{1}),\ d^{E}_{NxN}\right\}$, with $\alpha \in \left[0,\ \pi/3\right]$.

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[37] This paper is a simplified version of "Min. and Max. Traveling Salesmann Problems in Bilayered Networks", Niel, B,: Claverie, A. ; Dichiara, R., SIGEF XV Congress, 2009

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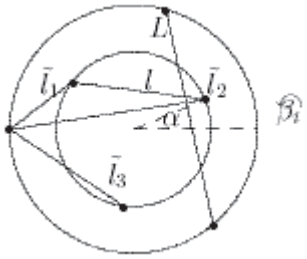
Figure Nº 3: Relevant links in $N := \left\{K_{N=2n=6}(e^{i\pi}\sqrt[3]{1},\ r\ e^{i\alpha}\sqrt[3]{1}),\ d^{E}_{NxN}\right\}$ uncoupled networks

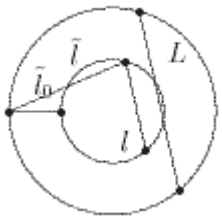


These bilayer networks have three links between the inner and the outer layers, i. e. l_1, l_2 and l_3 in addition to each intrinsic layer lengths L and l.

2.2 The simplest coupled networks

In $N := \left\{K_{N=2n=6}(e^{i(\pi+\pi/3)}\sqrt[3]{1},\ r.e^{i\alpha}\sqrt[3]{1}),d^{E}_{NxN}\right\}$, for bravity's sake, we accord mutatis mutandis that $\bar{l}_1 \rightarrow \bar{l}_0$; $\bar{l}_2 = \bar{l}_3 \rightarrow \bar{l}$ and $\bar{l}_3 = \bar{l}_2 \rightarrow \bar{l}$.

Figure Nº 4: Relevant links in $N := \left\{K_{N=2n=6}(e^{i\pi}\sqrt[3]{1},\ r\sqrt[3]{1}),\ d^{E}_{NxN}\right\}$ coupled networks



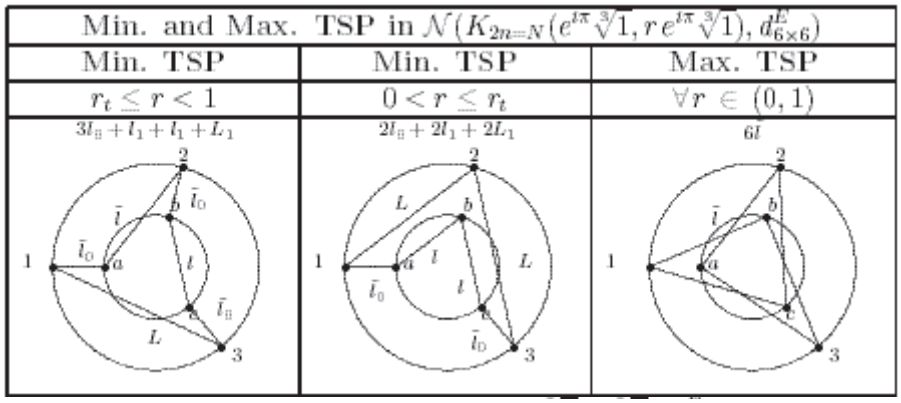
The overall traveled length of tours is built by the assignment of four specific integer positive numbers z_1, z_2, z_3 and z_4 of each one of the four directed links $l^{\pm}$, $\bar{l}^{\pm}$, $\bar{l}_0^{\pm}$ and $L^{\pm}$. Therefore the whole traveled length - $L(z_1, z_2, z_3, z_4)$ - is conformed by:

$$L(z_1, z_2, z_3, z_4) = z_1\sqrt{1+r+r^2} + z_2\, r\, L + z_3\, L + z_4\,(1-r),$$

that is equivalent to:

$$L(z_1, z_2, z_3, z_4) = z_1\,\bar{l} + z_2\, l + z_3\, L + z_4\, l_0$$

Figure Nº 5: Min and Max TSP in $N := \left\{K_{2n=6}(e^{i\pi}\sqrt[3]{1},\ r\sqrt[3]{1}),\ d^{E}_{6x6}\right\}$ networks



It is easy to confirm that z_2 and z_3 can not be greater and equal than 3 in order to conform a Hamiltonian cycle in these networks. In addition, z_1 = 5 does not build any Hamiltonian cycle. The obvious restrictions in order to achieve the goals are $z_1 \neq 5 \cup 0 \leq z_1 \leq 6$, $0 \leq z_2 \leq 2$, $0 \leq z_3 \leq 2$, as well as $0 \leq z_4 \leq 3$. Moreover, $z_1 + z_2 + z_3 + z_4 = 6$. Therefore, the whole feasible euclidean hamiltonian cycles must be build up with the assignments of the right table for $\bar{l} = \sqrt{1 + r + r^2}$, $l = r.L$, L and $l_o = 1 - r$

Table Nº 9: Spectra of the overall lengths $L(z_1, z_2, z_3, z_4)$ of the traveled Hamiltonian cycles in

$N := \left\{K_{N=2n=6}(e^{i\pi}\sqrt[3]{1},\ r\,e^{i(\pi+\pi/3)}\sqrt[3]{1}),\ d^{E}_{NxN}\right\}$ coupled networks

$L(z_1, z_2, z_3, z_4)$			
$\bar{l}$	l	L	l_0
z_1	z_2	z_3	z_4
6	0	0	0
4	1	1	0
4	0	0	2
3	1	1	1
3	0	0	3
2	1	1	2
2	2	2	0
1	2	2	1
1	1	1	3
0	2	2	2

2.2.1 Transition radii in Min TSP $N := \left\{K_{N=2n=6}(e^{i\pi}\sqrt[3]{1},\ r\,e^{i(\pi+\pi/3)}\sqrt[3]{1}),\ d^{E}_{NxN}\right\}$

At first glance, the brute force computations make clear evidence that there exists a transition radius where at least two shapes and two assignments of sides get the min TSP in these coupled bilayer nets. That is he overall traveled length $3\bar{l}_o + \bar{l} + l + L = 2\bar{l}_0 + 2L$ at

$r = 0{,}5(\frac{1 - 2c_1.c_2}{c_1^2 - 1}) + 0{,}5\sqrt{(\frac{2c_1c_2 - 1}{c_1 - 1})^2 - 4(\frac{c_2^2}{c_1^2} - 1)} \cong 0{,}12241$ with $c_1 = \sqrt{3} + 1$ and $c_2 = \sqrt{3} - 1$.

On the contrary, a cursory look to the tail data in Table Nº 2 promotes a single shape for the max TSP, $6\bar{l}$ wichever be the radius of the inner layer. Since the length of any euclidean hamiltonian cycle corresponds to $L(z_1, z_2, z_3, z_4)$ for $z_i \in \{1,2,3,4\}$ assign by the rows of Table Nº 2. It is not to hard to demonstrate that $L(6,0,0,0) > L(4,1,1,0) > L(4,0,0,2)\ \forall r \in (0,1)$ .In addition that $L(6,0,0,0) > L(3,0,0,3), L(6,0,0,0) > L(1,1,1,3), L(6,0,0,0) > L(6,0,0,0)$ $L(2,1,1,2), L(6,0,0,0)\ L(2,2,2,0), L(6,0,0,0) > L(1,2,2,1)$ and $L(0,2,2,2)$ $\forall r \in (0,1)$. Hence, these calculations confirm that the max TSP is unique except for orienteering (Refer to Figure Nº 4, right hand side sketch).

Unfortunately, the sequences and shapes that resolve the min. TSP problem depend on radius of the inner layer. To cast a glance to the third row of Table Nº 2 foresees this reality. A painstaking work releases that $L(1,1,1,3) < L(6,0,0,0)$, $L(1,1,1,3) < L(4,1,1,0)$, $L(1,1,1,3) < L(4,0,0,2)$, $L(1,1,1,3) < L(3,1,1,1)$, $L(1,1,1,3) < L(3,0,0,3)$, $L(1,1,1,3) < L(2,1,1,2)$ each one of the previous inequalities are true $\forall r \in (0,1)$. However $L(1,1,1,3) < L(2,2,2,0)$ if and only if $r \in (\frac{13 - 3\sqrt{13}}{2(11 + 6\sqrt{3}}, 1)$ and otherwise it is false. In addition $L(1,1,1,3) < L(1,2,2,1)$ if and only if $r \in (\frac{2 - L}{2 + L}, 1)$ and otherwise it is false. Finally $L(1,1,1,3) < L(0,2,2,2)$ if and only if $r \in (r_t = \frac{\sqrt{21} - 3}{2(3 + 2\sqrt{3})}, 1)$ and otherwise it is false.

Table Nº 10: Ranking of the overall length of the traveled hamiltonin tours in $N := \left\{K_{N=2n=6}(e^{i\pi}\sqrt[3]{1}, re^{i(\pi+\pi/3)}\sqrt[3]{1}), d^E_{NxN}\right\}$ coupled networks for peculiar radius r of the inner layer.

$r = 0.95$	$r = 0.5$	$r_* = \frac{1}{1+L}$	$r_t \approx 0.1224$	$r = 0.05$
$r = 0.95$	$r = 0.5$	$l_0 = l$	$l_0 + l_1 = l + L$	$r = 0.05$
$3\bar{l}_0 + \bar{l} + l + L$	$3\bar{l}_0 + \bar{l} + l + L$	$3\bar{l}_0 + \bar{l} + l + L$	$3l_0 + l + l + L$ $2\bar{l}_0 + 2l + 2L$	$2\bar{l}_0 + 2l + 2L$
$3\bar{l}_0 + 3\bar{l}$	$3\bar{l}_0 + 3\bar{l}$	$3\bar{l}_0 + 3\bar{l}$	$l_0 + l + 2l + 2L$ $3\bar{l}_0 + 3\bar{l}$ $2\bar{l}_0 + 2\bar{l} + l + L$	$\bar{l}_0 + \bar{l} + 2l + 2L$
$2\bar{l}_0 + 2l + 2L$	$2\bar{l}_0 + 2l + 2L$	$2\bar{l}_0 + 2l + 2L$	$2\bar{l} + 2l + 2L$ $2\bar{l}_0 + 4\bar{l}$ $\bar{l}_0 + 3\bar{l} + l + L$	$2\bar{l} + 2l + 2L$
$2l_0 + 2l + l + L$	$2l_0 + 2l + l + L$	$2l_0 + 2l + l + L$	$4l + l + L$	$3l_0 + l + l + L$
$2\bar{l}_0 + 4\bar{l}$	$2\bar{l}_0 + 4\bar{l}$	$2\bar{l}_0 + 4\bar{l}$	$6\bar{l}$	$2\bar{l}_0 + 2\bar{l} + l + L$
$\bar{l}_0 + \bar{l} + 2l + 2L$	$\bar{l}_0 + \bar{l} + 2l + 2L$	$\bar{l}_0 + \bar{l} + 2l + 2L$		$\bar{l}_0 + 3\bar{l} + l + L$
$l_0 + 3l + l + L$	$l_0 + 3l + l + L$	$l_0 + 3l + l + L$		$4l + l + L$
$4l + l + L$	$2l + 2l + 2L$	$2l + 2l + 2L$		$3l_0 + 3l$
$2l + 2l + 2L$	$4l + l + L$	$4l + l + L$		$2l_0 + 4l$
$6l$	$6l$	$6l$		$6l$

A meticulous study between $L(2,2,2,0)$, $L(1,2,2,1)$, $L(0,2,2,2)$ and $L(1,1,1,3)$ renders that the min TSP shapes depend on the inner layer radius. Precisely, min TSP = $L(0,2,2,2)$ = $2\bar{l}_o + 2l + 2L$ for $r \in (0, r_t = \frac{\sqrt{21} - 3}{2(3 + 2\sqrt{3})})$ and min TSP = $L(1,1,1,3)$ = $3\bar{l}_o + \bar{l} + l + L$ for $r \in (r_t = \frac{\sqrt{21} - 3}{2(3 + 2\sqrt{3})}, 1)$.

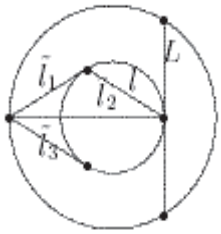
2.3. The simplest opposite uncoupled bilayer networks

In $N := \left\{K_{N=2n=6}(e^{i\pi}\sqrt[3]{1},\ r\sqrt[3]{1}),\ d^{E}_{NxN}\right\}$, herein $l_2 = 1 + r$ and $\bar{l}_1 = \bar{l}_3 = \sqrt{1 - r + r^2}$.

The overall traveled length of tours is built by the assignment of four specific integer positive numbers $\overline{z_1}$, $\overline{z_2}$, $\overline{z_3}$ and $\overline{z_4}$ of each one of the four directed links. Hence the whole traveled length - $L(\overline{z_1}, \overline{z_2}, \overline{z_3}, \overline{z_4})$ - is conformed by:

$$L(\overline{z_1}, \overline{z_2}, \overline{z_3}, \overline{z_4}) = \overline{z_1}\ \sqrt{1 - r + r^2} + \overline{z_2}\ \ r\ L + \overline{z_3}\ \ L + \overline{z_4}\ \ (1 + r)$$

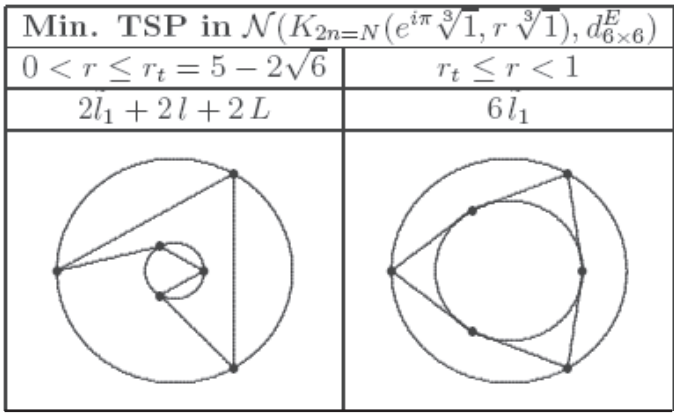
Figure Nº 6: Links $\bar{l}_1 = \bar{l}_3, l_2, l$ *and* L $N := \left\{K_6(e^{i\pi}\sqrt[3]{1},\ r\sqrt[3]{1}),\ d^{E}_{6x6}\right\}$ networks



2.3.1 Transition radii in Min and Max TSP in $N := \left\{K_6(e^{i\pi}\sqrt[3]{1},\ r\sqrt[3]{1}),\ d^{E}_{6x6}\right\}$

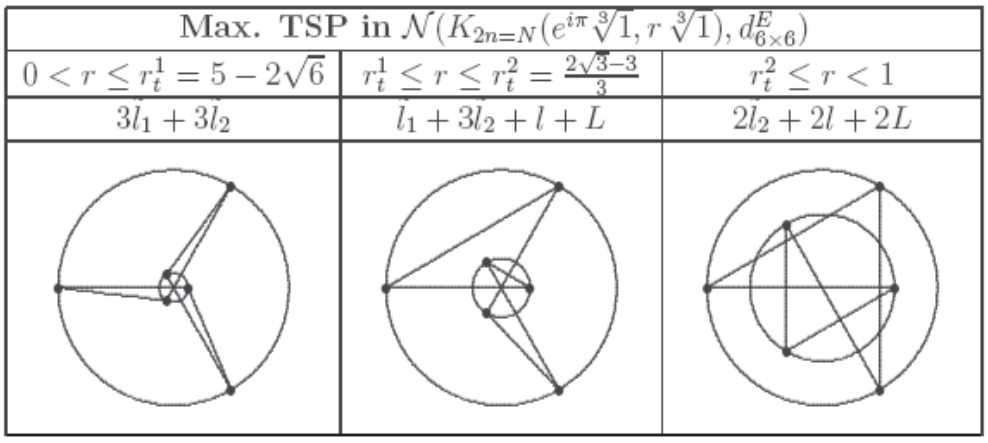
Similar tasks to those done in 2.2.1 allow us to resolve the max. TSP and min. TSP in $N := \left\{K_6(e^{i\pi}\sqrt[3]{1},\ r\sqrt[3]{1}),\ d^{E}_{6x6}\right\}$ networks, the simplest opposite uncoupled nets. The min. TSP dominant tours sire the overall shortest lengths $2\tilde{l}_1 + 2l + 2L$ and $6\tilde{l}_1$. First one implanted in $0 \prec r \le rt = 5 - 2\sqrt{6}$ and the second one in $rt \le r \prec 1$. Refer to the left-hand and right-hand drawings in Figure 7, respectively.

Figure Nº 7: Min. TSP in $N \coloneqq \left\{K_6(e^{i\pi}\sqrt[3]{1},\, r\sqrt[3]{1}),\, d^{E}_{6x6}\right\}$networks



However the structures that attain the max. TSP begets two transition stages. The resident structure in $0 \prec r \leq r^1 t = 5-2\sqrt{6}$ with $3\tilde{l}_1 + 3\tilde{l}_2$ whole traveled length (Refer to the left-hand drawing in Figure 8). The longest length cycle $\tilde{l}_1 + 3\tilde{l}_2 + \tilde{l} + \tilde{L}$ lodges in the intermedium stage $r_t^1 \prec r \leq r_t^2 = \dfrac{2\sqrt{3}-3}{3}$ (Refer to the center sketch in Figure 8). Finally, the maximum overall length $2\tilde{l}_2 + 2\tilde{l} + 2\tilde{L}$ locates in $r^2 t \leq r \prec 1$. (Refer to the right-hand drawing in Figure 8). Naturally, the last shape is baited by the max. TSP in the $N \coloneqq \left\{K_6(e^{i\pi}\sqrt[3]{1},\, r\sqrt[3]{1}),\, d^{E}_{6x6}\right\}$ network.

Figure Nº 8: Max. TSP in $N \coloneqq \left\{K_6(e^{i\pi}\sqrt[3]{1},\, r\sqrt[3]{1}),\, d^{E}_{6x6}\right\}$networks

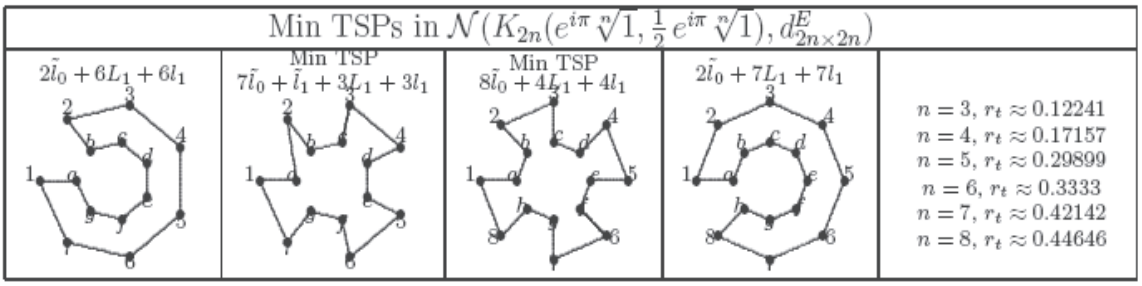


2.3.2 Computational experiences

We have performed simulations with a Pentium 4, C.P.U. speed 2.4 GHz, 256 MB of R.A.M., Windows XP and DevC++ ver. 4.9.9.2 software. The processing time was in the networks with 14 nodes less than one second in a brute force checking, meanwhile with some clever programming behind the exploration ran two seconds over 16 nodes and 6 days and four hours on 26 nodes. Last data forecast for 42 nodes the laughable requirement of 13 millions of years [11, 2, 7]. In addition, we instrument an algorithm that uploads the nodes of any bilayer networks in a graphics interface of the free version of the Concorde which generates a screen dump of the routings [3]. Sketches or draftings of those simulations appear all along this contribution as

illustrative simplistic examples of TSPs in $N := \left\{K_{N=2n}(e^{i\pi\sqrt[n]{1}},\, r\sqrt[n]{1}),\, d^{E}_{2nx2n}\right\}$ networks. Min TSPs in $N := \left\{K_{N=2n}(e^{i\pi\sqrt[3]{1}},\, r\sqrt[3]{1}),\, d^{E}_{2nx2n}\right\}$ are in general sensitives to the structural parameter r. For the sake of clarity, we sketch the shapes of those shortest Hamiltonian cycles in Figure 9 for n = 7 and n = 8. Our computational experiences, exhaustive exploration and Concorde heuristics coincide with this theoretical result of the transition radius, rt, in Min TSPs.

Figure Nº 9: Transition radii of Min TSPs in $N := \left\{K_{N=2n}(e^{i\pi\sqrt[n]{1}},\, r\sqrt[n]{1}),\, d^{E}_{2nx2n}\right\}$networks



Since, the boundary cases of TSPs at r = 1 and r = 0 lure the responses of Min and Max TSPs with r nearby cero and one. Min TSP shapes in $N := \left\{K_{N=2n}(e^{i\pi\sqrt[n]{1}},\, r\sqrt[n]{1}),\, d^{E}_{2nx2n}\right\}$ networks are baited by Min TSP in $N := \left\{K_{N=2n}(e^{i\pi\sqrt[2n]{1}}),\, d^{E}_{2nx2n}\right\}$ networks, that is the 2n polygon shape and Min TSP in the hub architecture $N := \left\{K_{N=2n}(e^{i\pi\sqrt[2n]{1}}),\, \{(0,0)\},\, d^{E}_{2nx2n}\right\}$ respectively. However, there are certain radii in $N := \left\{K_{N=2n}(e^{i\pi\sqrt[n]{1}},\, re^{i\pi\sqrt[n]{1}}),\, d^{E}_{2nx2n}\right\}$ networks where the shortest tours have diverse shapes apart from the mentioned regular and quasi regular shapes [16, 15, 6].

The goal is to determine the shortest and longest overall traveled lengths in euclidean Hamiltonian tours. Even though not necessarily there is uniqueness in the optimum shapes however the optimum shapes in monolayer architectures entice the responses in $N := \left\{K_{N=2n}(e^{i\pi\sqrt[n]{1}},\, re^{i\pi\sqrt[n]{1}}),\, d^{E}_{2nx2n}\right\}$networks.

Max TSPs in $N := \left\{K_{2(2p+1)}(e^{i\pi\sqrt[2p+1]{1}},\, re^{i\pi\sqrt[2p+1]{1}}),\, d^{E}_{2nx2n}\right\}$ networks is the strongest example of this aspect.

3. Conclusion

Herein, we itemize the essential pursuits that we deal with in the present disclosure. In reference to the question: *Are Min. and Max. TSP in the bilayered* $N := \left\{K_{N=2n}(e^{i\pi\sqrt[n]{1}},\, r\,e^{i(\pi+\alpha)\sqrt[n]{1}}),\, D\right\}$ *networks baited for the respective shapes of the Min. and Max. TSP in the single layer* $N := \left\{K_{N=2n}(e^{i\pi\sqrt[n]{1}}),\, D\right\}$ *networks ?* We expose evidences that the optimum Hamiltonian cycles and paths in the bilayer networks mimick the optima in the monolayer architecture. Then certain Min. and Max. TSP in the bilayered $N := \left\{K_{N=2n}(e^{i\pi\sqrt[n]{1}},\, r\,e^{i(\pi+\alpha)\sqrt[n]{1}}),\, D\right\}$ networks are lured for the regular shapes of N-gons and (N/z)-stargons, $z \in \{1, 2, \cdots, n\}$.

Some routings are independent of the structural parameter r, specially the reflective Hamiltonian cycles. Because, in a vis-`a-vis correlate from Euler function in their presence in the bilayer architecture they updated shapes of those dwellers in the monolayer architecture. The reflective Hamiltonian paths in $N := \left\{K_{N=2n}(e^{i\pi\sqrt[n]{1}},\, r\,e^{i(\pi+\alpha)\sqrt[n]{1}}),\, D\right\}$ networks are feasible of enumeration. The simplest strategy called *Nearest Neighbor* algorithm resolves the Min. TSP in

$N \coloneqq \left\{K_{N=2n}(e^{i\pi}\sqrt[n]{1},\ r\,e^{i(\pi+\alpha)}\sqrt[n]{1}),\ D\right\}$ networks. On the contrary, the strategy known as *Farthest Neighbor* algorithm does not resolve the Max. TSP in the $N \coloneqq \left\{K_{N=2n}(e^{i\pi}\sqrt[n]{1},\ r\,e^{i(\pi+\alpha)}\sqrt[n]{1}),\ D\right\}$ networks. We implement algorithms that bring forth the response for any practical case of Max. TSP in $N \coloneqq \left\{K_{N=2n}(e^{i\pi}\sqrt[n]{1},\ r\,e^{i(\pi+\alpha)}\sqrt[n]{1}),\ D\right\}$ networks. From theoretical reasonings we deploy mathematical tools that confirm the solutions of Max. TSP in the $N \coloneqq \left\{K_{2(2p+1)}(e^{i\pi}\sqrt[n]{1},\ re^{i\pi}\sqrt[n]{1}),\ D\right\}$ networks. Hence, Min. and Max. TSP in $N \coloneqq \left\{K_{N=2n}(e^{i\pi}\sqrt[n]{1},\ r\,e^{i(\pi+\alpha)}\sqrt[n]{1}),\ D\right\}$ networks are predictables.

We show the absence of a one to one relationship between overall traveled lengths and shapes in $N \coloneqq \left\{K_{N=2n}(e^{i\pi}\sqrt[n]{1},\ r\,e^{i\pi}\sqrt[n]{1}),\ D\right\}$ networks. That is many shapes leave under the same overall traveled length. Furthemore, there are structural parameters in which all the traveled Hamiltonian cyclic length are reduced to a handful of feasible values, e.g. in $N \coloneqq \left\{K_{8}(e^{i\pi}\sqrt[4]{1},\ r\,e^{i\pi}\sqrt[n]{1}),\ D\right\}$ network. We engage at the beginning of an application of these horizontal network architectures with the sociocultural attributes in sub-nets built from a survey of regional SMEs [9, 5, 4]. The aim is to assist the enterprises in order to fostering connectivity and cooperation amongst those small firms struggling to survive in similar economic activities in regional's marketplace.

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Section Two
Methodological Principles

Chapter 5
Understanding the Essence and Principles of One sustainable Development

Izabela Dembińska[42]

1. Introduction

Sustainable development has become the benchmark of a new approach of economic transformations contrary to the one that is focused only on unconditional growth. The structure of the welfare system involved creating an economical landscape based on ignorance of the laws that determine proper functioning of environmental system or even invasive towards the environment. In result of such interpretation of obligation of the environment to economy was its progressive destruction, which was taking a toll on economic and social systems constantly with greater strength. The more environmental system irregularities were perceptible in social and economical systems, the more they gained in importance and the louder were voices calling for economic paradigm transformation.

However, the motives of ecologists and economists were different. First ones meant environmental care, its state and capability of uninterfered functioning. In the second case it was more about affecting qualitative and quantitative changes being done in economic processes and conditions of quenching consumer needs in the environmental system. The creation of research methodological basics into relations between economy and environment and its derivatives has begun questioning validity of neoclassical approach for environment and its resources. Economics has begun being ecologized.

2. From environmental to economic problems

In general approach the transfer of environmental problems to economics has led to formation of two movements:

- Environmental economics (economization of the environment)
- Ecological economics (ecologization of the economics)

In the literature the differences between environmental economics and ecological economics were plainly explained by P. Jeżowski[43]. Basing on his thorough study it is safe to conclude that environmental economics is one well-developed discipline, its beginning dates back to close twenties of XX century. On the other hand ecological economics is relatively young, developed intensely for last 20 years. It questions legitimacy of conventional approach of neoclassical economics towards environment and its natural resources, which is a preserve of ecological economics. It does not agree particularly with ignorance of thresholds of growth and lack of considerations for sources of environmental pollution. Ecological economics accounts natural assets as limited commodities and a constant factor of development, stating that the scale of human activity must adjust for its sizes and not the other way around. In other words, boundaries of economical development come out of ecological ability to sustain it. Besides, in opinion of K.E. Boulding, K.W. Kapp, J. Robinson and R.B. Norgaard, neoclassical economics did not develop categorical basics and tools fit for ecoeconomical research analysis.[44] For it is deeply anthropocentric. It soughs to appease human needs without asking how it should be done, only states how it is accomplished. It concerns the efficiency of economic processes leaving behind its

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[43] See P. Jeżowski: Ekonomia ekologiczna – nowa dyscyplina naukowa."Ekonomia i Środowisko" 2003, Nº 2 (24), pp. 8-12.

[44] S. Czaja, B. Fiedor, Z. Jakubczyk: Ekologiczne uwarunkowania wzrostu gospodarczego w ujęciu współczesnej teorii ekonomii. Ekonomia i Środowisko Publishing House, Białystok-Kraków 1993; S. Czaja: Teoriopoznawcze i metodologiczne konsekwencje wprowadzenia prawa entropii do teorii ekonomii. Habilitation thesis. Wrocław University of Economics, Wrocław 1997.

social and environmental outcomes.[45] In wider approach the comparison between the two movements is presented in Table Nº 11.

P. Jeżowski notices that difficulties in fully accepting foundations and recommendations of ecological economics has become a reason for new movements in social sciences, particularly in co-evolutional economics conceptualization, ecopolitical economics, political ecology and socioecological economics, which are firmly planted in heterodox courses of modern economics.[46]

Table Nº 11: Main principals of environmental and ecological economics

Environmental economics	Ecological economics
	
Efficiency priority	Equalization priority
Microeconomically orientated	Macroeconomically orientated
Optimal allocation of environmental resources	Optimal scale of environmental resources
Growth optimism; *win-win* choices	Growth pessimism; difficult choices
Partial, monodyscyplinary and analytic characteristics	Comprehensive characteristics and analyses, integrated and descriptfull
Short-term analysis focus	Long-term analysis focus
▪ static research and dynamic conditions of optimal usage of environmental resources and qualities, ▪ ignorance of growth boundaries, ▪ in presence of omnipresent substitutivity in economy, commercial mechanism is the best way to allocate limited resources, also environmental one, ▪ environment is treated as a dumping place, while natural resources are considered as a source of expenditure for economy, ▪ applying economical means for environmental protection above all	▪ development constancy, meaning considering ethical premises and relating to physical limits, ▪ generational and intergenerational fairness, ▪ natural assets is a limited, constant factor of development, thus economy and society should be adjusted to its size, ▪ usage of natural assets should not affect ecosystems neither locally, regionally or globally, ▪ environment is a primary concern, managing subject and managing system are its subordinates, ▪ striving for better quality of life, not for consumption of as many goods as possible;
Homo oeconomicus – rational human	*Homo sustinens* – man of sustainity *Homo naturalis* – man of nature *Homo politicus* –man, who conceders what is best for society
Methods of neoclassical economics	Interdisciplinary character, methodological pluralism
Extrinsic costs, expense internalization, readiness to pay (evaluation of environmental constituents)	Natural capital, sustenance, ethical conditions and physical sustainability preservation

Source: own elaboration based on characteristics made by P. Jeżowski: *Wybrane kategorie teoretyczne i instrumenty w ekonomii ekologicznej*. in: *Zarządzanie w sektorze publicznym – rozwój zrównoważony – metody wyceny*. Warsaw School of Economics, Warszawa 2002, pp. 50-53; B. Poskrobko: *Teoretyczne i praktyczne podstawy nauki o zarządzaniu środowiskiem.* „Ekonomia i Środowisko" 2003, no 1 (23), pp. 68-72; J.C.J.M. van den Bergh: *Themes, Approaches, and Differences with Environmental Economics*. Tinbergen Institute, Erasmus Universiteit Rotterdam, Universiteit van Amsterdam and Vrije Universiteit Amsterdam, September 2000, p. 12.

[45] S. Kozłowski: Przyszłość ekorozowoju. KUL Publishing House, Lublin 2005, p. 133.
[46] Ekonomiczne problemy ochrony środowiska i rozwoju zrównoważonego w XXI wieku. Red. P. Jeżowski, Warsaw School of Economics – Publishing House, Warszawa 2007, pp. 21-22.

Co-evolutional economics is a derivative of ecological economics. It states that human is an inherent element of the environment. An important significance bears the feedback between socioeconomic system and environmental system based on two main principles, firstly the economic development assisted by new arrange of production and new technologies should be a function of approximation to environmental transformations, secondly that human does not affect the environment only negatively, he is also capable of doing so positively. In ecopolitical economics or political ecology, the axis of principles is determined by authority theory. Considering the area of local authorities and country is a new component accentuating at the same time the meaning of the institutional grounded reforms. Moreover, specific recommendations are being formed to abandon the technical and objective approach on environmental ecology on the basis of these disciplines. In case of socioecological economics, same as in co-evolutional ecology, it is taken that human is an integral part of the environment. The society and social groups are subjects of reflections. On one hand ethical values appropriate for individuals are being considered, on the other the culture of organization, especially local authorities and government organizations, also group and singular learning processes, which explain the role and meaning of social knowledge. According to socioecological economics, social knowledge is the basis of proper valorization of the environment and its resources and also the prerequisite for determining, accepting and realizing strategies of sustainable development.[47]

3. The sustainable development concept

Ecological economics spreads and realizes its recommendations through the idea of sustainable development, which is universal and undoubtedly leading in modern economics, i.e. relates to many different aspects of human activity. Although the idiomatic expression "sustainable development" is relatively new, it actually dates back to XVIII century. It was created by Hans Carl von Carlowitz[48] in order to determine the way of managing the forest by cutting only as many trees as could be replaced, so that the forest would not cease to exist and had a chance to rebuild itself. It was called "*Sustained Yield Forestry*".

Explaining the essence of the sustainable development term should be preceded by noticing the fact that there are also other terms in Polish literature, which come from English term "sustainable development". This may cause some kind of chaos and confusion, also difficulties in applications. The difficulty begins with translation of the word "sustainable", which in Polish language has no explicit match. Considering such argumentation all those terms may be treated as synonyms.

Although, in Polish literature it is not always taken in such fashion B. Piontek[49] regards that the reference should be made by more precise term, which better projects the essence of its meaning. Similar position is represented by S. Czaja, B. Fiedor, A. Graczyk and Z. Jakubczyk[50], who treat sustainable development as a narrow, specific term. A detailed analysis of the range of meanings of those terms was conducted by T. Borys[51]. He concludes that interchangeable use of these terms has no relevant or semantical substantiation.

Without partaking in terminological dispute the term of sustainable development will be used for present considerations, which is admissible by Polish legal regulations. In Environmental Protection Act, art. 3, the definition of sustainable development is accepted as "social and economical development, which integrates political, economical and social initiatives, with preservation of environmental balance and sustain of elemental environmental processes, in order to guarantee the ability to satisfy the basic needs of respective communities or citizens of present

[47] Id pp. 22-23.
[48] U. Grober: Deep roots – A conceptual history of sustainable development (Nachhaltigkeit). Wissenschaftszentrum Berlin für Sozialforschung (WZB), February 2007, p. 3
[49] See B. Piontek: *Koncepcja rozwoju zrównoważonego i trwałego Polski*. PWN, Warszawa 2002, p. 15
[50] See S. Czaja, B. Fiedor, A. Graczyk, Z. Jakubczyk: *op.cit.*, p. 234.
[51] See *Wskaźniki zrównoważonego rozwoju*. Red. T. Borys. Publishing House: Ekonomia i Środowisko, Warszawa-Białystok 2005, pp. 22-56

generation as well as the future ones".[52] There was also considered constitutional annexing of the term. The Constitution of the Republic of Poland[53] (art. 5) states that it is a state duty to provide environmental protection, guided by the principles of sustainable development. It has to be noticed that these principles are not defined in the Constitution, but it is accepted on the basis determined in former Polish legal acts or EU documents (among others Maastricht Treaty).

One of the first attempts to explain the essence of sustainable development was one made by J. Coomer in his publication from 1979, which examining limits of development imposed by environment, implements a term of sustainable society. He describes it as a society, which in developing process considers environmental limits. He indicates at the same time that sustainable society should not be equated with „zero-growth society", which completely negates the need of developing. Sustainable society is by all means focused on development, however – to meet the terms of environmental limitations, seeks for alternative ways of developing.[54]

In foreign as well as in Polish literature, despite multitude and diversity of attempts on determining the meaning of the sustainable development[55], in most cases references are made to the one, stated in *Report of the World Commission Environment and Development*, enunciated in 1987 under the title of *Our Common Future*[56], which is commonly called as the *Brundtland Report* [57]. The document contains a wide list of threats and challenges for proper growth of future generations, thereby indicated that the growth of global economy should be located within the boundaries of ecological "capacity" of our planet. It was encouraging to start the new era, new stage in social and economical development, i.e. sustainable development, the development that was focused on satisfying the developmental aspiration of current generation as well as the future ones. The growth sustenance implicates generational fairness and in operationalized approach:

- Requirement of guarantying the availability of environmental resources for the need of future economical growth (quantity problem),
- Requirement of preserving the quality of environmental resources for the benefit of future generations (quality problem).

It was emphasized that the principles of sustainable development ought to be respected by all countries, in order to really accomplish all set objectives. Definition of sustainable development recommended for economics of sustainability consists: it is development, which heads towards the assurance of adequately high ecological, economical and social standards, within the natural endurance of the Earth, for every living person and for future generations, in compliance to the principals of generational and intergenerational fairness.[58]

In Polish literature the widest spectrum of approach to the definition of sustainable development is shown by B. Piontek[59], simultaneously confirming its semantic differential, collating forty four definitions[60], analyzing and rating them with regard to different aspects:

[52] Journal of Laws 2001.62.627 June 20 2001
[53] Journal of Laws 1997, Nº 78, item 483
[54] A. Bernaciak: Ograniczanie antropogenicznych obciążeń środowiska jako czynnik trwałego i zrównoważonego rozwoju. Poznań University of Economics Publishing House, Poznań 2009, p. 19
[55] Only in economic literature there is over a hundred definitions. J. Pezzey: Economic Analisys of Sustainable Growth i Development. Environment Department Working Paper Nº 15, The World Bank, Washington D.C. 1989
[56] Our Common Future. Report of the World Commission on Environment and Development. Oxford University Press, Oxford 1987
[57] Brundtland Report contributed in large scale to popularize and spread not only the definition, but the concept (principals) of sustainable development itself. However, the term has occurred before. For the first time it was used by B. Ward and R. Dubose in Only One Earth: The Care and Maintenance of a Small Planet (R.D. North: Sustainable Development: A Concept with a Future? Occasional Paper 11 Sustainability criticized. The Liberal Institute of the Friedrich Naumann Foundation, Potsdam 2005), prepared for the UN conference in Stockholm in 1972 (United Nations Conference on the Human Environment. Stockholm, June 5-16, 1972; Documents. Ann Arbor, MI: University Microfilms, 1973, 420 fiche). Important part in populating the concept of sustainable development, especially on economical and political grounds, was also taken by "Earth Summit" in Rio de Janeiro in 1992
[58] H. Rogall: Bausteine einer zukunftsfähigen Umwelt- und Wirtschaftspolitik. Duncker und Humblot Verlag, Berlin 2000, p. 100
[59] See B. Piontek: op.cit., pp. 15-27
[60] Definitions presented by following authors: T. Bajerowski, W. Bojarski, M. Burchard-Dziubińska, M.K. Byrski, M.E. Colbye, M. Dönhoff, K. Dubel, A. Hopfer, S. Kozłowski, R. Kreibich, S. Łojewski, S. Paczuski, R. Pajda, D. Pearce, E. Barier and A. Mar-

- Managing economical resources
- Managing natural resources
- Managing human resources
- Level of institutionalization of principle realization and accepted solutions on specific levels
- spatial range
- Level of consciousness and choice of living model
- Moral aspects
- Spiritual aspects, involving cultural development
- Integrative and criterion factor

He demonstrates how interdisciplinary the problem of sustainable development is and how uneasy to study. Analyzing the contents of the definitions of sustainable development featured by B. Piontek, it is possible in general approach to obtain answers for two basic questions: what is the purpose of sustainable development and what requirements should it fulfill to accomplish its objectives? Considering the matter in a wider range drives to following conclusions:

- Sustainable development is a process
- Sustainable development is a social and economical development, harmonized with functioning of the environmental system
- Sustainable development means enterprising with regard for the environment
- Sustainable development should be based on harmony between natural, human and economical resources
- Sustainable development determines conditions and requirements of the exploitation of environmental resources
- Sustainable development has ethical grounds
- Sustainable development must guarantee the stability of economical development and improvement of the quality of life for present and future generations
- Achieving all goals of sustainable development requires researching for new techniques and technologies, organization systems, new forms of managing enterprises

An important part in the concept of sustainable development is taken by the social substrate. It should be admitted that idea of sustainable development is primarily an implication of growth of the negative results of economic processes recognized increasingly in wider range in environmental system, thereby increase of percepting potency of socioeconomic consequences of environmental degradation. Assurance of uninterrupted economical system functioning, particularly production and consumption processes and maintaining balance in environmental system, may be considered as problem of entire societies.[61] Economy is in fact an area of social life (picture 1) and going further – managing it is regarded as social process and the scale of national per-

kandye, F. Piontek, B. Poskrobko, I. Sachs, Z. Sadowski, J. Śleszyński, B. Zaufal, T. Żylicz, and also definitions contained in Polish legislation and acts, reports and other elaborations, Polish as well as international, such as: The Fifth EC Environmental Action Programme, Environmental Protection Act, Raport of the World Commission on Environment and Development, Realization of ecological development principals in government economy policies (DEFRA, Warsaw, 1994), Resolution of the Sejm of RP on ecologic policies, May 10 (1991) Resolution of the Sejm of RP on sustainable development, January 19 (1995), Environmental Protection Act, January 31 (1980)

[61] see, e.g. G. Dobrzyński: Istota i cechy współczesnego kryzysu ekologicznego. „Ekonomia i Środowisko" 1999, Nº 1 (14), p. 8; G. Zabłocki: Rozwój zrównoważony - idee, efekty, kontrowersje. Habilitation Thesis. Nicolaus Copernicus University Publishing House, Toruń 2002, pp. 67-68

sonal income is commonly considered as the most synthetic indicator of growth, not only for specific economies, but entire society.[62]

It should not go unnoticed that in inter systemic approach the balancing process is based on the network of direct and indirect relationships between ale three systems: environmental, economical and social[63]. Direct relations are consisted in mutual influence of the following systems:

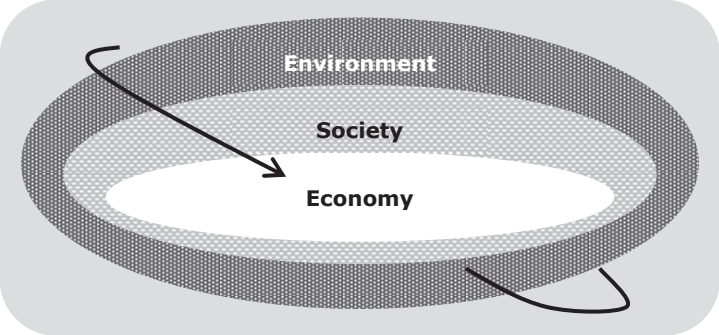
- Environmental and economic
- Environmental and social
- Economic and social

In indirect approach these relations are regarded as an influence of:

- Economy on environment through society
- Economy on society through environment
- Society on economy through environment

Therefore a social system is an inherent part as well as a benchmark of the process of balancing the economy.

Figure Nº 10: Economic-social-environmental System Hierarchy



Source: own elaboration

Human should also be considered as an individual. In this particular fashion – as the first principle of sustainable development states in the Declaration from Rio de Janeiro – he is a subject of sustainable development and he is entitled to a healthy and productive life in harmony with nature.[64] For every human being has a right to live in environment suitable for its health and welfare, and obligated at the same time to protect and improve the environment individually as well as cooperatively, for the benefit of present and future generations. It is recognized that appropriate protection of the environment is necessary for providing human with welfare and allowing him to profit from basic rights, including right to live per se. Therefore, everyone has an equal right to access to information and to participate in decision-making in environmental matters.[65]

According to A. Hopfer[66], B. Poskrobko[67] and B. Zaufal[68] sustainable development may be considered as a certain way conducting all kind of economic activities. The starting point for this

[62] L. Gilejko: Społeczeństwo a gospodarka. Szkoła Warsaw School of Economics – Publishing house, Warszawa, 2005, p. 9
[63] See Zrównoważony rozwój. Wybrane problemy teoretyczne…, p. 32
[64] The principal states: "Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature" In: Report of the United Nations Conference on Environment and Development. Rio de Janeiro, June 1992. A/CONF.151/26 (Vol. I) United Nations 12 August 1992.
[65] See, e.g. Convention on access to information, public participation in decision-making and access to justice in environmental matters. Economic Commission for Europe (UN), Committee on Environmental Policy. ECE/CEP/43.
[66] A. Hopfer: Funkcje obszarów wiejskich z perspektywy ekorozwoju. In: Ekorozwój obszarów wiejskich. Zeszyty Problemowe Postępów Nauk Rolniczych" 1992, Nº 401. Wydawnictwo Nauk Rolniczych PAN, Warszawa, 1992

particular train of thought is an interpretation of the meaning of economic activities. It is regarded, that legislative notion of the term was not taken under consideration[69], rather its general, even informal meaning – as a form of entrepreneurial activities. Therefore it may be considered that any entrepreneurial activity should meet the criteria of sustainable development, acknowledging the large contribution of business entities in environmental degradation.

J. Adamczyk's[70] opinion on this matter is similar, consisting the thesis that despite the idea of sustainable development is mostly considered in macroeconomic scale (or region), in free market economies decision are made independently by the companies, which indicates that mainly those enterprises should answer to sustainable development principals, due to their benefit from environmental resources. The fact that economical growth and increase of the quality of life are realized by efficient entrepreneurial activities, is also an argument.

Sustainable development should be based on harmony between three different types of resources: natural (N), human (H) and economic (E). This harmony should be expressed by involvement of those three types in specific proportions:

$$N : H : E$$

Development of these proportions considers inter systemic relation mechanism in the economic-social-environmental system, which was mentioned before. Sustainable development requires a specific way of exploitation of the environmental resources, determining it on the other hand. This specific way is suppose to ensure meeting needs, not only present, but also future generations. Although E. Kant reckoned that conserving for prospective generations is not entirely honest, stating that it is difficult to find a logical explanation of making sacrifices, when future generations will never be able to repay[71].

The motif of respecting temporary needs and those of the future generations in analyzed definitions is obviously taken from the Brundtland Report and constitutes principal backbone of the idea of conservation development[72]. However, it was not spotted or more precisely – appreciated at first in this document. Just in the mid-seventies of XX century a proponent of prospective ethics H. Jonas, in his famous publication *Zasada odpowiedzialności*[73], ordered certain type of behavior, so its results could be reconciled with sustainability on earth, in consequence implying that a correction in former understanding of human role in the world of nature is inevitable. Moreover – it is necessary to create a new ethical code and rules of conduct, appropriate to specific instance (determined by ecological crisis). It should be demonstrated above all by departure from focusing all attention on the present and restrain from willing to pursue glorious future without regard for expenses and ways of achieving it. H. Jonas tries to convince his reader that the progress does not have to be linear, causing changes for better in the future *a priori*.

[67] B. Poskrobko: Zarządzanie …op.cit., p 22

[68] B. Zaufal: Ekorozwój szansą przetrwania cywilizacji. AGH University of Science and Technology Publishing House, Kraków, 1986

[69] Economic or entrepreneurial activities due to the Act on Freedom of Business Activity (Freedom Of Business Activity Act July 2 2004 Journal of Laws 2004, Nº 173, item 1807) are all gainful activities, such as manufacturing, constructing, trading, providing services, mining and prospecting, also occupational activities performed in constant and organized way. Personal Income Tax Act (Personal Income Tax Act July 26, 1991. Journal of Laws 2000, Nº 14, item 176, as amended) defines economic activity as any occupational activities performed in constant and organized way, run on the own behalf, employed or self-employed, income of which is not classify to other, mentioned further in of the act. The Goods and Services Tax Act (The Goods and Services Tax Act March 11, 2004. Journal of Laws 2004, Nº 54, item 535) describes it as every activity concerning producing, merchandising and service providing, including mining and farming, also involving freelancing, even when the action was performed once in circumstances indicating an intention of performing it constantly. Economic activity also includes gainful usage of goods and intangible assets in constant fashion.

[70] J. Adamczyk: Koncepcja zrównoważonego rozwoju w zarządzaniu przedsiębiorstwem. Kraków University of Economics Publishing House. Kraków 2001, p. 31

[71] W. Tatarkiewicz: Historia filozofii, t. II. PWN, Warszawa 1983, p. 178

[72] Considering different (indicated before) semantic preferences of the sustainable development term, conservation is regarded as one of sustainable development characteristics. „Conservation development" term was introduced on UN conference in Stockholm in 1972 and defined in 1975 on 3rd session of United Nations Environment Programme.

[73] See. H. Jonas: Zasada odpowiedzialności. „Platan" Publishing House, Kraków, 1996

It is not clear, whether the problem of responsibility for future generations, within the idea of sustainable development, should be considered in approach of consequential balance of predicted profits and losses[74] or reference to a specific individual. In the second case the range of responsibility is significantly lesser.

While mentioning responsibility of an individual, criticizing *homo oeconomicus* gives an opportunity for different projections of human nature to occur, such as *homo politicus*[75]. *It is a human being*, who concerns about what is best for society. Therefore, he is in opposition with rational and egocentric *homo oeconomicus*. As P. Jeżowski[76] points out, the idea of *homo politicus* has some certain common factors with presented by M. Sagoff[77] category of citizen orientated on public best interest and common good. H. Rogall[78] has created very similar "new nature" image. She named it *homo cooperativus.* In comparison with *homo oeconomicus*, whose every decision is based on "short-term profits maximization" point of view, therefore making all the wrong choices regarding processes of long-term consequences, *homo cooperativus* is able to consider in decision-making the interests of others and course of actions in larger scale. He can restrain his intensiveness and act for common good with idealistic motives. People capable of such actions are able to develop readiness to cooperate within themselves and take responsibility or others.

Wondering about capability of protecting the production and consumption of future generations, B. Fiedor[79] is offering a solution, which would by a proper compensation for loses in natural resources caused by present usage, to future generations by present ones. Such compensation would be based on transferring larger amount of anthropogenic resources in return for resources of natural assets. As he indicates a doubt occurs, whether at all or in what scale, this substitution between two types of asses is possible. He reckons at the same time that the answer to that question cannot be general and unambiguous, because the meaning of economical, ecological and social scale of social welfare is diversified. There also exist differences between these scales correlations.

Regardless the above, it is to consider that in practice, pursuing for intergenerational compensation meet many obstacles. It requires fulfill basic conditions: above all proper functioning and abidance of universal procedures that determines the "guilty" and "aggrieved" system, mechanisms of identification of damages and loses or functioning of the compensation system. Moreover, the case of the "tragedy of the commons" has to be taken in regard, which refers the way of managing common goods. The idea of common goods denies their exclusion from consumption with simultaneous competition in consumption. Therefore the difficulty lies in rational restriction in allocation of this sort of goods from individual point of view. In other words, guided by the own interest burdens on social optimal administration of specific goods.

Sustainable development is focused on improving the quality of life, which means that improving the quality of life is an aspiration of sustainable development and also an index of its level, e.g. evaluation of the level of completion of the objectives. It has to be taken in regard that there is no precise definition of the way of thought, nor the quality of life criteria in literature, related to sustainable development definition context. This may cause problems in understanding the correct meaning of various definitions made by different authors, since there is a multiple way of perceiving quality of life (and its derivatives), therefore it is difficult to determine its explicit interpretation in specific case. Does the quality of life should be perceived in narrow approach, seen from the angle of GDP, or wider, excluding the financial notion? Or maybe the quality of life and its criteria should be seen differently at all, i.e. in the angle of welfare?

[74] Consideration of responsibility for future generations due to i.e.: D. Birnbacher. More in: D. Birnbacher: Odpowiedzialność za przyszłe pokolenia. Publishing House: Oficyna Naukowa Warszawa, 1999

[75] M. Faber, T. Petersen, J. Schiller: Homo oeconomicus and homo politicus in ecological economics. "Ecological Economics" 2002, Vol. 40, pp. 323-333

[76] P. Jeżowski: Ekonomiczne problemy ochrony środowiska… op.cit, p. 19

[77] See. M. Cammon, I. Reid, R. Balmey: Do existence values for cost benefit analysis exist? "Environmental and Resources Economics" 1997, Vol. 9, pp. 225-238

[78] H. Rogall: Ekonomia zrównoważonego rozwoju. Teoria i praktyka. Zysk i S-ka Publishing House, Poznań 2010, pp. 185-194

[79] See. S. Czaja, B. Fiedor, A. Graczyk, Z. Jakubczyk: op.cit., p. 239

The quality of life may be perceived not only as an objective set by sustainable development, but also as an index that determines its forming. L.C. Thurow developed a thesis, which constitutes that only the economic growth and progressive improvement of the quality of life triggers people interest in protection of natural resources. Considering the low quality of life, meeting basic needs is the biggest issue. At the higher standards, when one does not have to worry about surviving, better environment gains in significance and becomes a certain value, since it will determine the quality of life in the future.[80] L.C. Thurow is regarding only the material side of the quality of life, therefore he presented strictly an economical approach.

In pursue to obtain the future society model, in mid-nineties of XX century J.K. Galbraith mentions the worthy society[81], defining it as society in which every citizen has to be provided with personal freedom, basic financial conditions, racial and ethnical equality and a chance of achieving welfare. The model of worthy society should at the same time comply with principles of sustainable development, mainly - respect for the natural environment. Worthy society has developed three closely related economic requirements, which common relation is affecting the natural environment. These requirements are:

- Need of providing goods and consumption services
- Need of guarantying that this production, its usage and consumption would not affect current common social welfare in a destructive manner
- Need of assuring that they would not suppress the way of life or the welfare of future generations

J.K. Galbraith has also shown the way to guarantee the meeting of sustainable development principles by worthy society. He reckons that in worthy society, caring for natural environment has to hold strong grounds in highly motivated electorate, equipped by its members with necessary financial resources, considering an existence of presumption of its benefit in public discussions and political maneuvers. In this matter the leading part is appointed to the government and legislations, seeing the authority as a guardian of the interest and future of the society. It would be difficult not to agree with this thesis. Legislation having at its disposal enormous potential, should not only be the inspiration of specific actions and behaviors but also ought to intercept a certain range of responsibility for monitoring systems and control of meeting principals of the sustainable development.

The sustainable development is not always considered without criticism. The abstract or even utopian character of the idea is mostly accepted, claiming that these beautifully written rules are in fact impossible to carry out. Some even say that it is another trendy term, around which the extraordinary polemics are practiced. Others consider it as an overrated ideology. From the small group of Polish authors, speculations of W. Sztumski are emerged. He contemplates about possibility of the idea being just a perfidious tool of manipulation in hands of ruling elites and how many other similar utopias will be created for the use of these elites, which are at financial and political powers.[82] He also claims that many myths occurred related to sustainable development, which are being fed to the masses. They are concerning the idea itself, its implementation with all consequences and expectations. According to reflections of German authors, ten myths of sustainable development are specified[83]:

- Myth 1 – believing in ability of realizing the idea of sustainable development. There is no certainty that the sustainable development will ever become real and it is not mere an illusion or utopia, without even a chance of achieving it.
- Myth 2 – overvaluing the importance of the strategies of sustainable development for further growth of global economy. Currently, basing on the level of actual knowledge sustainable development is positively rated. It is considered as a major

[80] See, e.g. L.C. Thurow: *Powiększanie bogactwa*. HELION Publishing House, Gliwice 2006, pp. 211-212
[81] J.K. Galbraith: Godne społeczeństwo. BELLONA Publishing House, Warszawa 1999, pp. 73-77
[82] W. Sztumski: Idea zrównoważonego rozwoju a możliwości jej urzeczywistnienia. "Problemy Ekorozwoju" 2006, vol. 1, Nº 2, p. 76
[83] W. Sztumski: Mitologia rozwoju zrównoważonego. "Problemy Ekorozwoju" 2009, vol. 4, Nº 2, pp. 13-23

boon, because within lie the hopes for better world and better life. Yet there is no certainty if it will change anything, or whether it will cause economic stagnation with its disadvantages.

- Myth 3 – believing in capability of restoring sustainable economy, as a result of implementing strategies of sustainable development without conducting changes in the train of economical thought of the financial and political elites.
- Myth 4 – considering sustainable development as a asset, which will eliminate global social contradictions e.g. inequities between economically highly and poorly developed countries, between wealth and poverty.
- Myth 5 - belief that the social, historical and cultural conditions in modern world are allowing to realize the strategies of sustainable development, which could not be more illusive. Modern lifestyle, way of thinking and also consumers behavior constitutes substantial obstacle in the way of realizing the idea of sustainable development.
- Myth 6 – believing in uninterrupted by crises functioning of the economy according to neoclassical model of economy, which is the very principle of sustainable development.
- Myth 7 – believing in ability to separate increase in welfare growth from increase in natural resources usage, or in welfare growth with decrease of natural resources usage.
- Myth 8 – belief that sustainable development can be accomplished within currently reigning monochronic culture, which is determined by its creation - a lifestyle of constantly accelerating pace.
- Myth 9 - belief that sustainable development strategies can be built without proper, precise and quantitative, instead of just qualitative determining of its consumption growth boundaries.
- Myth 10 – naïvely believing in miraculous abilities of computers, robots and computerization in the process of realizing strategies of sustainable development.

Contents of these ten myths may suggest W. Sztumski's adverse attitude towards sustainable development. As the author indicates himself, such conclusion should not be drawn, since his remarks are coming only from his common-sense approach towards sustainable development.

However, L.W. Zacher[84] considers that the contemporary ecological discourse is more varied and by definition involved in accepting the utopian or normative principal formula, most of the time without criticism. Therefore – in his belief – the idea and practice of sustainable development should be considered within the system framework that it functions in. The substance of this framework is composed mainly by capitalism, market and areas of decision and actions. Only then, the implementation, effectiveness and real perspectives are the reasonable conclusion.

These reflections concerning sustainable development certainly do not exhaust the subject, nevertheless they prove the interdisciplinary and complex character of the idea as established earlier. However, they allow assume that the concept of sustainable development is based on three principal uncertainties:

- What should be the size of optimum economic scale, so relation with environment could be uninterrupted, meaning without any threats for its future existence?
- How the conditions of fair and just division of environmental resources should be determined for present generation as well as future ones and between them, and hot to deliver those conditions?

[84] L.W. Zacher: Trwały rozwój – utopia czy realność? "Problemy Ekorozwoju" 2008, vol. 3, Nº 2, pp. 63-68

- What is the best way to preserve efficient allocation of resources in time?

It allows ascertain that sustainable development is a type of socioeconomic development, which provides present and future generations with improvement in quality of life through rational exploitation of natural resources, which leads to preservation of proper proportions between economical, human and natural assets. Rational exploitation has to ensure the equal chances of accessing those assets for present and future generations by reaching the economic equilibrium in the long distance, which can be indentified in angle of following equivalent determinants:

- Expenditure of renewable resources in a scale, which would not threat the reproduction system of environment;
- Restriction of usage of elemental resources to enable efficient waists assimilation by the environment;
- Expenditure of non-renewable resources in pace harmonized with development of methods and ways providing regeneration of renewable substitutes.

Sustainable development ought to provide the continuity of social and economical growth in harmony with environment, being an obligation of present generation to future ones. It is a mean of bridging the gap of two goals: development – progress – growth and stability – security – environment.[85]

Sustainable development is considered as a process[86], described in addition as socioeconomic, or economic, but socially desirable[87], demanding research for new techniques and technologies, organization systems, new forms of economic activities. It is not an act or state but intended process of transformation, reaching to accomplish a certain state of economy, determined by set objectives. It is thus regarded as a dynamic category. It seems to be reasonable, because development is in fact historically opened, multilayered continuum of transformations leading to perfected form or state.

Major field of research and reflections is focused on objectives, conditions and mechanism of the process. Although, it is to consider, whether sustainable development is to be approached as accomplished or not. In other words – is it possible to consider achieving sustainable development as real or utopian? Answers to this question are quite difficult. It is in fact an open one and describes the fashion of questions like: is it possible to equalize the differences between wealthy and poor countries, is it possible to accomplish the state of total globalization through transportation? The difficulty in answering lies within two factors. Firstly, the conditions of the state of total balance are not explicitly determined as well as officially and commonly recognized, and secondly – even if these conditions are accepted, which are mostly mentioned in literature and various elaborations, is it really safe to believe in its reality in regarded time? Are they not too hasty or to boldly set forth (reference to NPP level)? Although, on the other hand the answer can be looked for in quite contrary manner, which would be asking what is more probable, achieving the state of sustainable economy or state of "unlimited" economy? This matter can be clarified straight away. Being aware of already existing restrictions, it seems that the "unlimited" state of economy is impossible to accomplish.

[85] I. Dembińska-Cyran: Turystyka zrównoważona wyrazem koegzystencji turystyki i zrównoważonego rozwoju. in: Polityka turystyczna, red. A. Panasiuk. II Polish Conference on Science, Szczecin-Copenhagen May 31 – June 2, 2005, p. 39

[86] See T. Bajerowski: Obraz rozwoju zrównoważonego w portretach fazowych. in: Sterowanie ekorozwojem, vol. I, Białystok University of Technology Publishing House, Bialystok, 1998

[87] See W. Bojarski: Problemy rozwoju społeczno-gospodarczego z poszanowaniem dóbr przyrody. "Ossolineum" Publishing House, Wrocław 1988; K. Dubel: Uwarunkowania przyrodnicze w planowaniu przestrzennym. "Ekonomia i Środowisko" 1998, Nº 2

4. Conclusion

Regarding three aspects of sustainable development – environmental, economical and social, the following may be accepted:

- Environmental system is a reference of sustainable development
- Economical system is a primary carrier of the sustainable development achieving instruments
- Quality of life is an aspiration to sustainable development

Looking into increasingly richer literature on sustainable development, it is easy to notice the isolation of common subject speculations, especially world-related, ideological, economical, political and scientific. Undoubtedly sustainable development may be considered as a worldview in objective approach. It makes a specific view on the world visible. It is forming beliefs, principals and creating new values, which are defining the words new meaning. It concludes that the very universe of things and phenomena is the source and definition of preferences and attitude towards human activity. The principals of sustainable development are being found in human relation to his own life and surrounding world. As it is commonly accepted, the worldview is considered of being universal. This characteristic might be related to sustainable development, for it is related to both philosophy and religion as well as to areas of life, such as material, social, political, technical, etc.

Interpretation of sustainable development in ideological approach comes down to the set of opinions expressing its general objectives and means of accomplishing them. In such regard the development is a systematized assembly of views, which is a definition of sense and interests of specific social group. Social character of the sustainable development noticeably emerges, which is displayed by its influence on various types of social life sectors.

Considering the economical aspect of sustainable development one may wonder, how the economy can contribute to fulfilling the obligations of sustainable development, at the same time pondering, how the sustainable development is influencing the economy considered as integrity as well as on its individual elements and relations between them. Economy is in fact an obligatory field of interactions of the principals of sustainable development. Sustainable development has set a new path of evolution for modern economies – its structuring and functioning.

Relations between sustainable development and politics may be approached in several ways. Forging the term of "policy of sustainable development" implies that it is being seen from the angle of politics. Considering such point of view it is expected that the principals and goals are going to be determined within the sustainable development, which would point out the direction of necessary actions to provide proper protection of environmental resources and a tool to achieve it. In practice, this specific approach is applied on different levels – global, international, national and local. Moreover, an increasing number of companies is informing of implementing the policies of sustainable development, thus spreading the specter of their relations with environment, which formerly were regulated through principals of ecological policies or certificates in compliance with ISO 14001. Necessity of respecting the principals of sustainable development is increasingly apparent in strategies and policies of specific areas of management. Objectives, which are determined by sustainable development, are set on the same level with economical and social goals appropriate for specific sector, as an example: transportation, industry, energetic, agriculture, tourism.

The fact that sustainable development was from the beginning subject of intensive discussions within various academic communities do not seem to be strange. It is in fact a perfect way of scientific comprehension if any gradation of the scientific issues is accepted. Detailed and multidirectional analysis of the term and principals of sustainable development is being conducted with the highest intensiveness as well as classification and partitioning of its meaning specter. Various theoretical models regarding implementing and functioning of strategies of the sustainable development are also being created. There are two interesting things regarding this matter.

Firstly, the discourse about sustainable development is carried out above scientific divisions. It takes place in almost every real scientific discipline, mostly in sciences, humanities and socioeconomics. Secondly, examining various scientific polemics an impression occurs that it is not yet clear in which time dimension should the sustainable development be allocated, whether it is the state of present or set to be accomplished in the future. In other words, whether the science is moving forward in traditional fashion and examining something which is already discovered (a real being), or proceeds in less conventional manner and examines something that does not exist (an imaginary being)?

Accepting the fact that the study of sustainable development as a specific idea is approachable by two streams – normative and positive, allows conclude that examining the conditions (legal, organizational, fiscal, material) which have to be met for the rules and principles to be fulfilled, is a normative stream concern. However, the positive branch regards the study on creating and modifying principals of sustainable development on one hand, on the other – the outcome of its fulfilling.

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Chapter 6
In Pursuit of Sustainable Consumption

Józef Perenc, Joanna Hołub – Iwan and Leszek Gracz[88]

1. Introduction

During the last 40 years the number of people on Earth has doubled. There are already 7 billion people. In other terms there are 7 billion consumers. UN population forecasts assume the continuation of the increase in the number of people. Perhaps in the next 40 years, if the number will double, there will be 14 billion of us, meaning there will be 14 billion consumers. These data demonstrate the exceptional urgency of the issues concerning the current and future consumption.

In the 60s of XX century in the United States, as an opposition to the ideals of progress cultivated by the previous two centuries, postmodernism[89] was born. In a broad sense, it challenges the rationality of action and the objectivity of science; it undermines the sense of universal ethics as well as philosophical and political doctrines[90]. For as the Age of Enlightenment was the time of reason cult and every research element was a subject of rationalization efforts so postmodernism contests the foundations of science and philosophy.

2. The faces contemporary consumption

Postmodernism, also called post-modern era, has reached various areas of life, such as literature, architecture, cinema and not consumption as well[91]. Contemporary, post-modern consumption is not easily explained or described. Contemporary consumption is as varied as color and tones in the paintings of the Impressionists.

The most important trends in this area are:

- De-globalization (homogenization of consumption of different intensity in various groups of consumers)
- Overconsumption (consumerism)
- Postmodern consumption (growing popularity of conspicuous consumption, which is fast and unstable; self- appreciating through purchases; free time in the "temples of consumption")
- Consumption "on loan"
- Consumerism
- Massification of consumption (standardization of production, large number of produced series)
- Shortages of consumption (as opposed to overconsumption - a situation that causes social exclusion)
- Euroconsumption (the disappearance of differences in consumer behavior in the European market, similar socio-economic trends)
- Consumer ethnocentrism (preference of national and local products)
- E-consumption (the virtual world, Internet shopping)

[88] University of Szczecin. Faculty of Management and Economics of Services. Chair of Services Marketing

[89] Postmodernism is a cultural phenomenon characterized by the pluralism of styles (consumption) and the ideology as well as the need of surreality and self-expression through consumption (Antonides G., Van Raaij W.F.(2003), Zachowanie konsumenta, Wydawnictwo Naukowe PWN, Warszawa 2003, p.75).

[90] Głowiński M., Kostkiewiczowa T., Okopień-Sławińska, A. Sławiński J. (2002), Słownik terminów literackich, Wrocław 2002, p. 413.

[91] Grzegorzewska-Ramocka E. (2005), Koncepcja społecznej odpowiedzialności przedsiębiorstwa w marketingu strategicznym, Wydawnictwo Politechniki Świętokrzyskiej w Kielcach, Kielce 2005, p.120.

- Service consumption (increase in the share of services in the structure of consumption),
- Globalization (preservation of cultural regionalism and local identity)
- Durable and sustainable consumption (reducing consumption to the necessary level in order for the consumption of the present generation will not limit the possibility of consumption of future generations)
- Ecoconsumption (oriented for the priority of protecting the natural environment),
- Conscious consumption (reasonable from the point of view of resources optimization, focused on health, ecology and sustainable development)
- Growing consumer culture (changes in economic and social sphere that positively affect the quality and dignity of life)
- Independent consumption (individualization of purchase decision)
- Elite consumption (of chosen, wealthy members of society)
- Ritualization (participation in suggestive, spectacular performances, such as Carnival, Valentine's Day, *Beaujolais Nouveau fest*[92], etc.)
- Ephemeralism (the quest for "new", the consumption of finished products)
- Home-centrism (transfer of multiple activities to the homes, equipping houses in devices for information and culture consumption)
- Safety consumption (in states as for example job insecurity),
- Dematerialization (consumption of intangible assets such as knowledge and information),
- Deconsumption (conscious reduction of consumption to a reasonable size by individuals bored and disenchanted with excessive consumption) [93].

The new, postmodern consumer creates new needs, seeks for new sensations. They are demanding, aware and sensitive. They are no longer loyal and constant in their choices. Today's consumer is also rational, which is manifested not only in the fact of increasing ability to manage household budget, but also in the fact that today's consumers try more and more to make their choices of least possible burden to the natural environment.

Zygmunt Bauman differentiates consumerism from consumption that was typical for human from the beginning. Consumption – in its archetypal form – is defined as the metabolic cycle of absorption, digestion and excretion[94], while consumerism is identified with the rise of new social system, in which satisfying human needs, wants and desires is the main driving force of society[95]. Zygmunt Bauman also indicates the correlation of this phenomenon with contemporary style of life, marked by speed, dynamics, the brevity of the plans and investments. As noted by Jean Baudrillard, the whole logic of modern consumption is based on the anthropology of the natural pursuit of happiness[96]. Today's consumers want to reach a state of satisfaction and contentment with themselves as well as they want to achieve the appropriate social status. J. Baudrillard claims that the myth of happiness is achieved through the objects and signs[97], which are the material equivalents of prosperity and abundance.

Changes that are currently taking place in the consumption of highly developed societies do not have a uniform direction. They show opposing, canceling or synergistic tendencies. The important issue considered in the context of future consumption in the world is the direction and the way of its development, which should happen in accordance with the principles of sustainable development. It would be naive to say that contemporary consumption can be significantly reduced in order to complete the sustainable principles. What should and can be done is a significant change, making something that will restrain the further development of wasteful consump-

[92] Beaujolais Nouveau fest is an ex ample of event marketing, that uses the ceremony and media buzz for increase of new wine sales (without it the sales of new wine would be definetly lower).
[93] Słaby T. (2006), Konsumpcja. Eseje statystyczne, Difin, Warszawa 2006, pp.16-17.
[94] Bauman Z. (2009), Konsumowanie życia, Kraków 2009, p. 33.
[95] Ibidem, p. 36.
[96] Baudrillard J. (2006), Społeczeństwo konsumpcyjne. Jego mity i struktury, Warszawa 2006, p. 45.
[97] Ibidem, p. 46.

tion. Changes in consumption should follow the track of such methods, which will result in lower consumption of raw materials and will reduce the amount of generated waste.

3. Conditions for sustainable consumption

The modern world is full of contrasts. One of the most visible one is the contrast on food availability and consumption. On the one hand, according to UN report, there are 825 million people in the world who are severely malnourished; 110 000 people die of hunger every day, which constitutes 40 million people a year, including 7 million of children. This is more than the results of wars, epidemics and natural disasters altogether. The worst situation is in Africa, south of the Sahara, as well as in India and China. Interestingly, the problem of world hunger is not due to global food shortages, as it might seem, but it is due to its poor distribution. The food production per person has risen everywhere since 1970 but Sub-Saharan Africa. It can therefore be assumed that it is more a political than economic problem.

On the other hand, it is estimated that in Europe there is wasted 89 million tons of food annually on the levels of production, transportation, storage, sale and also by consumers. According to the FAO[98] report from 2011 there is 1.3 billion of tones of food thrown away in the world, which is 1/3 of the total food produced for consumption. The report also indicates that in developed and developing countries there are wasted 670 and 630 million of tons of food, while consumers in rich countries waste approximately 220 million of food each year. The world's most wasted fruits and vegetables. A large part of it happens on the stages of cultivation, harvesting and storage.

It should be indicated that the FAO report makes a distinction between the loss of food and waste of food. The term "loss of food" refers to the developing countries, where the main causes of wasted food is a lack of knowledge about proper storage, inadequate infrastructure, food spoilage and difficult climatic conditions. Food losses occur mainly at the production stage. At the level of consumption losses are much smaller. Whereas the term "food waste" is a problem of developed countries and it refers mainly to consumers and retailers of food, concerning situations when products that are fit for human consumption are discarded in the trash. In New York, nearly 16% of garbage is food; in the UK there are more than 30% of the food that is bought thrown away to the trash, most of all fresh fruits and vegetables, secondly the bread, then the meals prepared in homes and fast food, then meat, fish and dairy products. An average person throws away 95-115 kg of food per year in Europe and North America. For comparison, in Sub-Saharan African countries, that figure amounts to 6-11 kg.

Food wastage means costs not only for buyers, who spend money on something that are later thrown away into the trash, but also costs for the environment. Each ton of food waste is 4.5 tons of CO2 emitted into the atmosphere (that was used for the production, preparation and transportation of food). Food thrown away stored in landfills produces methane - a gas that is far more harmful to the global warming than carbon dioxide. The amount of energy consumed to produce, process and transport the food is enormous. What should be added to that is the energy that is consumed get to the shops, bring purchases home, food storage, cooling or freezing, then cooking or baking.

The consumption analyzes also include the electricity and drinking water. According to OECD[99] data, energy use in OECD countries had grown by 36% from 1973-1998 and is expected to grow by another 35% to 2020, despite increases in efficiency. As for the water, households are relatively low consumers of water and household demand for freshwater has stabilized or declined in 9 OECD countries. But in many others population growth and expanded water use have outweighed the effects of water saving technology and behavior.

[98] Gustavsson J., Cederberg Ch., Sonesson U., Van Otterdijk R., Meybeck A. (2011), Global food losses and food waste. Food and Agriculture Organization of the United Nations, Rome, 2011.
[99] OECD (2003) Towards Sustainable Household Consumption? Trends and Policies in OECD Countries. Organisation for Economic Cooperation and Development 2003, pp. 4-5

The huge appetite for consumption is increasingly difficult to satisfy. Our Planet's resources are limited and gradually depleted. Only in the last half century, people degraded 60% of Earth's ecosystem. It had been a huge economic growth – world production had increased seven times. During this period the world population has doubled, the demand for energy has increased five times, oil consumption - seven times, and carbon dioxide emissions - four times. Contemporary production and consumption are based on the unsustainable use of materials and energy, which affects the depletion of renewable and nonrenewable resources on Earth. Their development in the near future should seek ways to deliver such products and services that will result in lower consumption of raw materials and reduce waste generation.

Ecological footprint is one of several measures used to illustrate the human demand on the Earth's ecosystems. It is presented in global hectares per capita. Ecological footprint can be calculated for individuals or for a group of people – the organization, society, and nation as well as for the manufacturer or a type of production, such as the production of a specific product. Takes into account all the biological materials consumed, and all emissions of carbon dioxide produced during the year. This measure, however, has its limitations, even though it is relatively easy to understand: it allows estimating the area of land and sea necessary to supply the resources a human population consumes and to assimilate associated waste.

The Earth's resources are estimated at 1.06 billion global hectares, hence there is 2.2 gha per capita. The difference between the trace of the ecological and productive capacity of the country indicates whether the country is ecological creditor of or debtor. In the European Union's ecological footprint is 4.7 gha per person. All Member States produce a total of 9% of the Earth resources and consume 16% of it. Poland is on the 20th place with a score of 3.3 gha. According to the WWF report the worst situation in Europe is in Sweden (6.07 gha) and Finland (7.64 gha). The economic model of these countries is based on the predatory exploitation of the biosphere. On the other extreme are Third World countries - Malawi, Haiti, Nepal, Bangladesh (0.5 gha). There are also examples of countries, which at the same time develop and decrease or sustain their ecological footprint. Such country is for instance Germany. This country has reduced the pressure on the environment by phasing out the coal and the by the development of renewable sources. In the long term sustainable development can be ensured only if following both criteria will be fulfilled by countries: the ecological footprint will be smaller than 1.8 gha per capita and human development index (HDI) will be higher than 0.8 [100]

Another condition for the development of sustainable consumption is information that can be obtained from the analysis of so called ‘Ecological Debt Day’ (also known as Earth Overshoot Day). Ecological Debt Day is the calendar date each year in which the total resources consumed by humanity will exceed the capacity for the Earth to generate those resources that year. On this day the total amount of resources are run out and humanity starts to incur debt with the planet. The Global Footprint Network has estimated that in 2010 humanity made use of all environmental services, from filtering CO2 to the production of raw materials, which nature has been able to safely provide for the entire year on August 21st. Hence from August 21st until the end of the year the demand for environmental services generated by the people was supplied by diminishing resources and the accumulation of greenhouse gases in the atmosphere.

In recent decades, our demand for natural resources has increased on an unprecedented scale. The key drivers of this growth are the increasing population growth and increasing wealth and consumption. Most of the increase in the population happened in developing countries, while the highest levels of wealth and consumption are recorded in developed countries. In Europe, there is a constant state of ecological deficit (the difference between our footprint and the biological potential), which is covered by imports of goods and services from outside the EU borders. In addition, we export some of our waste. Basically, we become less self-reliant.

As a result of the growth in global trade, increasing pressure on the environment and the effects of consumption in the EU are felt elsewhere. Some of them are moved between EU countries,

[100] Nieckula E. (2011) Ślad ekologiczny – koszt naszego bycia na Ziemi [online]. Aviable at: http://ulicaekologiczna.pl/zdrowy-styl-zycia/slad-ekologiczny-%E2%80%93-koszt-naszego-bycia-na-ziemi/ [accessed 6.01.2012r.]

but most of them go to areas outside the EU and beyond the reach of current EU policy on production. It is equivalent to export of the impact of our consumption to the countries where environmental policy is often poorly developed, which effectively leads to enormous pressure on local communities and the natural environment. Global consumption has an enormous and irreversible impact on global ecosystems: there are 130 000 km2 of tropical rain forests felled annually. In addition, since 1960 one third of the world arable land has been abandoned or sterilized due to the over-exploitation and land degradation.

4. Consumerism

Consumerism is a phenomenon observable from the late nineteenth century, which is the time of first appearance of mass culture of industrial societies[101]. Mass culture was established as a resultant of many factors such as economic development, increased production of goods and services, urbanization and migration, changes in working conditions of the masses, reducing the free time and the availability of products and services for broad masses of the population that previously could not buy them. Previous cultural values had been replaced by the pursuit of satisfaction through consumption. What is more, a reversal in the relation consumption – needs happened; a desire to fulfill a need appears earlier than the needed itself[102].

Consumerism can be described as an excessive consumption of material goods and services; while 'excessive' means the one that is not justified by the real needs of people and does not take into account the environmental, social and individual costs[103]. B. Rok in the paper "*Model of consumption in the context of European integration*" (*Model konsumpcji w kontekście procesu integracji europejskiej)* cites the claim that excessive consumption does not fulfill the primary needs, but secondary needs, which are desires associated with, for example, lust of power, influence, domination, prestige or high social position. Primary needs are those that could be fulfilled completely with a given level of consumption, but the desires, secondary needs, are unlimited in quantity, variety, degree of saturation[104].

Scientists present numerous negative consequences of consumerism. It contributes to the waste of goods, human labor and natural resources, thus threatening the survival of humanity. The cult of individual consumption also causes social problems, not least because of the lack of consumer interest in the future of other people, generations, etc. At the individual level, consumerism became more of a sense of human life - the members of developed societies perceive themselves and others with what they buy and how much they have. The man is unconscious of, citing the famous B.R. Barber's statement, "the velvet tyranny of the consumer totalitarianism[105]." It leads to the destruction of interpersonal relationships, loss of values and limitations of forms of self-realization. According to calculations made by environmentalists around the world, to maintain a lifestyle of a typical of the U.S. (Americans are considered the most consumption society) would require the use of environmental goods and services for more than four times the physical size of the resources available on Earth[106]. The need to reduce consumerism may seem to be obvious; however from the point of view of industries the spread of such attitudes would limit the opportunities for their development. And so today's consumers are still urged to continue increasing consumption, to the purchase of products regardless of their actual needs, and these activities often involve the use of social engineering designed to increase the demand for the products, or even the use of manipulation. [107]

[101] Perchla-Włosik A. (2004), Współczesny konsumpcjonizm. in Patrzałek W. (ed.), Kulturowe determinanty zachowań konsumenckich, Wyd. Uniwersytetu Wrocławskiego, Wrocław 2004, p. 38
[102] Ibidem, p.41
[103] B. Rok: Model konsumpcji w kontekście procesu integracji europejskiej. [online] available at: http://www.ineisd.org.pl/rozne/mat06.htm [accessed 2 January 2012]
[104] Ibidem, p. 2
[105] Barber B.R. (1997), Dżihad kontra McŚwiat, Muza, Warszawa 1997, cited according to: M. Janoś-Kresło, B. Mróz (ed.), Konsument i konsumpcja we współczesnej gospodarce, Wydawnictwo SGH w Warszawie, Warszawa 2006, p.78
[106] Kiełczewski D. (2005), Przedsiębiorstwo a kształtowanie proekologicznych wzorców konsumpcji in: Zrównoważony rozwój w przedsiębiorstwie i jego otoczeniu, Wasiak A., Dobrzański G. (ed.), Wydawnictwo Politechniki Białostockiej, Białystok 2005, p.199
[107] More: ibidem, p.199

In the literature of western countries dominates the progressive criticism of excessive consumption and its ideological superstructure - consumerism, which is sometimes referred as the civilization disease and called 'Affluenza'[108] – the name created from a combination of two English words: Affluence (abundance, prosperity, wealth) and influenza (flu). This term is intended to mean a disease entity, "...which symptoms are: feeling of continuous dissatisfaction, fatigue, nervous tension, rush, a feeling of constant lack of something, and the following symptom: excessive purchasing (also called shopaholism, oniomania or CB - compulsive buying). The painfully felt effects of affluenza are states of workaholism, permanent debt in the banks, excess of wastes (mainly consumer goods), the deterioration of relations with social environment, etc. It all leads to diseases such as diabetes, heart disease, allergies, obesity, depression, etc. The primary source for these phenomena is the desire, which is designed and driven by marketing, to possession and consumption: *to have, to have more and more*[109]". The rationality of consumption (not the techno-economic effectiveness of acts of consumption, but their content and consequences) is evaluated as very poor by the researches of contemporary consumption – increasingly faster, bigger and "trifling" consumption leads to the waste of human energy (e.g. waste of products due to changing fashions and waste of packaging, which are often more expensive than the product itself), to the waste of time (the most valuable, unique resource, stolen humanity by e.g. television soap operas, video games, poor quality newspapers) or "gadgetry" [110]. Israeli writer Amos Oz states about the "gadgetry": "Most of my friends work harder than they should, just to make more money than they really needed to buy things they do not really need, so as to impress people, whose they in fact do not like. (...) The worst danger is global infantile, the change of people into children fooled by the lust of toys, born to buy".[111]

Contemporary consumer societies and consumerism no longer rely on fulfilling the needs, because consumer activity results from the desire - much more elusive and capricious phenomena. Recent interpretations of consumerism indicate that not the desires displaced needs from the first place among the motives of consumption, but even desires are not strong enough to avoid being ousted by another force motivating consumption - cravings[112].

5. The essence of sustainable consumption

In the modern world both massification of consumption (standardization of production, large series) and the growing trend of independent consumption (individualized decision of purchase) can be indicated. E-consumption grows in strength, and simultaneously the new phenomenon of home-centrism grows, which means the transfer of multiple activities to the homes, equipping houses in devices for information and culture consumption. There are such a phenomena noted as de-globalization (homogenization of consumption of different intensity in various groups of consumers), consumer ethnocentrism (preference for local products), glocalization (preservation of cultural regionalism and local identity), but also euro-consumption (the disappearance of differences in consumer behavior in the European market). On this background there is a development of eco-consumption, or to put it the other way responsible consumption or sustainable consumption.

Over the years, a number of definitions of the sustainable consumption have been developed. The definition adopted by the UNESCO states that the concept of *sustainable consumption* refers to the idea of *sustainable development*, whose essence is to ensure sustained improvement in quality of life for present and future generations by maintaining the balance between the three types of capital: economic, human and natural[113]. It is "such a structure of consumption system, in which the shape of the individual systems and the relationships between them allow the rea-

[108] The maker of this word is J. de Graaf – culture expert and filmmaker who in 1997 made a movie. Affluenza, an in 2001r., together with Nobel Prize winner T.H. Naylorem and ecologist D. Wannem wrote a book Affluenza. The All – Consuming Epidemic, cited according to Bywalec C. …, op.cit., p.150
[109] C. Bywalec, op.cit., p.150
[110] Ibidem, pp.161-162
[111] Zjadacze chleba –wywiad z A. Ozem, „Gazeta Wyborcza", 1-2 lipca 2000, cyt. za: Bywalec C. …, op.cit., p.162
[112] Janoś-Kresło M., Mróz B. (ed.), op.cit., p.79
[113] Ibidem, p.75

lizations of objectives of sustainable development. As a result, consumption of the present generation does not limit the possibility of consumption of future generations." [114]

According to the definition adopted by the working group on sustainable consumption, one of four groups that support the work of the committee for corporate social responsibility, which is a subsidiary body of the Polish Prime Minister on issues of corporate social responsibility in Poland, sustainable consumption is optimal, conscious and responsible use of available natural resources, goods and services at the level of individuals, households, communities and local communities, business communities, local governments, national governments and international structures, in accordance with the principles of sustainable development. It is designed to meet the needs and improve the quality of life for everyone in the local and global levels, while respecting human rights and labor rights, taking into account the possibility of satisfying the needs of other people, including future generations, and preserving and restoring natural capital for them. The attitude of sustainable consumption takes into account the reduction of: wastage, waste production and pollution. The attitude of sustainable consumption contributes to the choice of such goods and services that in the most degree fulfill the ethical, social and environmental criteria.[115]

According to the definition of D. Kiełczewski durable and sustainable consumption is sustainable in the following aspects:

- Economic (the setting of such proportions between the current and future consumption, which do not contribute to economic imbalances)
- Ecological (maximizing the utility of consumption while maintaining the usefulness and quality of natural resources and environment)
- Social (relatively equal distribution of consumption, which is accessible to people regardless of time and space and the preferences for these methods of consumption that do not cause social problems)
- Psychological (consumption contributes to the increasing quality of life)
- Demographic (demographic barriers are not a permanent barrier of consumption increase)
- Spatial (ways of fulfilling needs do not violate the spatial order)
- Intertemporal (presented assumptions are realistic for the unlimited term) [116].

Sustainable consumption is characterized by, inter alia, respect for renewable resources (which is reflected in ensuring possibilities of their renewal) and non-renewable resources (which is related to their effective use). An important issue is the gradual elimination of hazardous and toxic substances from the economic processes and any other applications. The natural environment is an essential "object of interest" of sustainable consumption as it aims to reduce the environmental burden of consumption and not exceeding the limits of environmental resistance. Sustainable consumption also aims to give people a sense of ecological safety (in terms of creating conditions supporting physical, mental and social health). An important aspect of this concept is also a postulate to create conditions for fair competition for businesses in access to limited resources and capabilities of the discharge of pollutants.

Durable and sustainable consumption results from attitudes and patterns of consumption presented by people, which are based on culture and environmental awareness. Czaja S. and E. Weiss understand the ecological culture as a total "... achievements of humanity accumulated over the centuries of civilization, of a tangible and in tangible characteristics, concerning the relationship between a human, society and the natural environment and its elements. (...) and environmental awareness encompasses all of ideas, values, attitudes, opinions and beliefs shared by social groups that describes how the group and its members think of ecological issues and

[114] Kiełczewski D., Consumption…, op.cit., p.57
[115] Polish Ministry of Economy: Przez zrównoważoną konsumpcję do zrównoważonego rozwoju. Ministerstwo Gospodarki, Warszawa
[116] Ibidem, s. 57-58

the relationship between humankind and the natural environment." [117] Development of environmental awareness is a complex process that starts with the identification of negative ecological phenomena. It begins with the individual perception, then, in the case of an ongoing ecological crisis, the perception of its effects is broadened. Both individuals and social groups begin to recognize the value of the natural environment, which makes the increase interest in ecology and the need for information on the state of natural environment. As a result, there is social pressure aimed at reducing environmental degradation, continuous widespread of acceptance of ecological behavior and attitudes, including the patterns of consumption.[118]

Sustainable consumption combines a number of social, economic and political actions at the level of individuals, households, communities, business communities and governments, which aim to:

- Reduction of direct environmental effects caused by processes of production, use and disposal of goods and services
- Ensuring the possibility to fulfill the basic consumption needs concerned with key goods and services, such as food, water, health, education and shelter for everyone
- Increasing opportunities for sustainable development in the southern countries
- Development of the consumption of such goods and services that have a positive impact on the health and well-being of women and children
- Development and use of devices to save energy and water
- Development of public transport and pro-ecological transport
- Development of ecological goods and services to meet the global requirements for environmental protection
- Promoting lifestyles of emphasis on social cohesion, local traditions and intangible assets

Sustainable consumption means finding solutions to the imbalance of social and natural elements with more responsible behavior. Sustainable consumption has a strong relation to the production and distribution, use and disposal of products and services. The main criterion of sustainable consumption reconsideration of product life cycle once again.

One of the ideas of sustainable consumption is "factor 4-10" - a theory which assumes that we should live twice more over the next ten years, and meanwhile consume about half of our energy sources. In 2050, developed countries should be able to generate ten times more energy. Procedures for production and consumption should be a 4 and then 10 times more efficient, so that everyone can have enough energy. Most definitions include the following elements:

- Meeting human needs
- Good quality of life and good standard of living
- Energy division between rich and poor
- Considering future generations
- Not forgetting the "cradle to grave" - the effect of time consuming
- Minimizing energy consumption, waste and pollution

Sustainable consumption is characterized by: respect for renewable resources, but also non-renewable, which means efficient use of them and the gradual elimination of hazardous and toxic substances from the economic processes. The natural environment is the subject of the greatest interest of sustainable consumption; it aims to reduce the environmental burden of consumption and to ensure ecological safety of the people.

The current problem is not the awareness of the negative effect of excessive consumption on people and the world but the issue of resigning from excessive consumption – a change in habits and give up routines and tempting news in order to protect the environment, future generations, others people and own internal development. Among the many real, although difficult to

[117] Czaja S., Weiss E.,(2002) Instrumenty kształtujące świadomość ekologiczną i postawy przyjazne środowisku przyrodniczemu w sferze konsumpcji [in:] Instrumenty rynkowe w ochronie środowiska, S. Czaja (red.), Wydawnictwo I-BiS, Wrocław 2002, p. 424
[118] Ibidem, pp. 424-425

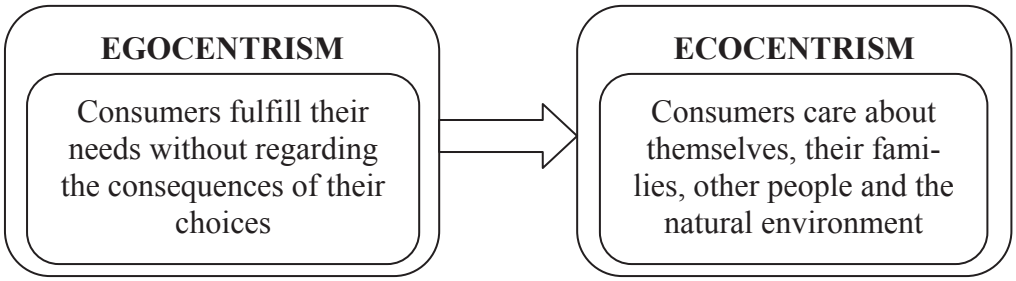
achieve possibilities to reduce consumption, one of the more interesting is the concept of responsible consumer.

There are five main areas defining the concept of sustainable consumption:

- Fulfilling basic human needs (rather than satisfying the desires)
- Prioritizing of quality of life over material conditions
- Minimizing consumption of natural resources, waste production and pollution
- Consideration of product life cycle impact on the environmental (in the processes of production and disposal) when making consumer decisions
- Undertaking action for future generations

An essential condition for the practical realization of the concept of sustainable consumption is a reorientation of consumer behavior, encouraging consumers to change the quality of life – the change egocentric attitude towards the ecocentric attitude and making choices taking into account the needs of other people and the natural environment.

Figure Nº 11



International Institute for Environment and Development has formulated the ten commandments of sustainable consumption as a specific strategy aimed at shaping the demand for the use of environmental resources and economic services to meet the needs and improve the quality of life for all, while restoring the natural capital for future generations. The strategy consists of the following key elements:

1. Structural Changes: It is a strategy for long-term structural changes, involving the transition from an economy and lifestyle associated with the industry to sustainable one, which means further than incremental improvement in efficiency
2. A fair consumption: The strategy emphasizes the importance of equitable consumption, not just the "ecology of wealth"
3. Focus on service: The strategy focuses on the relationship between environmental resources and services required to fulfill all the human needs and improving the quality of life (e.g. in terms of nutrition, housing, mobility, leisure time)
4. Change of market opportunities for entrepreneurs: the strategy requires the introduction of a new generation of sustainable goods and services and expands entrepreneurs' responsibilities to cover impact caused during the full life cycle of goods and services
5. On the demand side: the strategy implements actions on the demand side to ensure the social, economic and ecological benefits in all the product chain
6. Patterns and driving forces: the strategy deals with patterns and driving factors such as income, demographic factors, technology, culture and values, methods of land use and social policy and consumer behavior
7. Priority for the North: the starting point is a triple imperative of changing consumption patterns in the North, resulting from 1) high direct environmental costs of consumption in the North, 2) the importance of North's consumption to trade with other regions and the flow of investment capital and technology to them, and 3) the importance of lifestyle changes in the North as an example for the ecology implementation in the South

8. A common concern, different reactions: sustainable consumption is an increasing concern in various countries, both rich and poor. Since they have different priorities, the action must be embedded in a variety of cultural conditions
9. Individual and collective consumption: the strategy recognizes the individual and collective dimension of consumption – in the supermarket and the library
10. Building on values: the strategy is based on ethical values and seeks to encourage greater responsibility for consumption choices

6. European Union policy on sustainable consumption

Sustainable consumption of households is not yet covered in well-defined political objectives and measures. Changing in human behavior is a difficult issue, with often deeply involved in politics. Some policy instruments such as eco-labels, environmental taxes and subsidies, promotion of awareness and product standards are already (with varying degrees of success) used to change patterns of consumption into more sustainable ones. Increasingly, attention is focused on the politics of sustainable consumption and production. It is a common challenge to which all entities, including public authorities, businesses and consumers accept responsibility and take joint actions. Solutions are sought at the global level, in Europe and other regions of the world and at the national and local level.

The role of public authorities is to provide framework for action for businesses and consumers with the use of market legal information and other tools. Companies struggle with the challenge of producing goods and services with the sustainable character during their lifetime. The challenge for consumers is to choose sustainable goods and services, basing on their knowledge and financial capabilities. Sustainable consumption is found in Agenda 21, which was adopted at the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992. During the World Summit on Sustainable Development in Johannesburg in 2002 there was an agreement reach for developing a framework of programs on sustainable consumption and production. In 2003 global Marrakech process was launched in order to elaborate this framework. In 2010 and 2011, the UN Commission on Sustainable Development assessed the global process with a purpose to achieving more sustainable consumption and production.

In order to broaden the knowledge of consumers, as well as to influence their behavior and improve the environmental performance of products and services there are currently in use several policy instruments. Examples include the eco-labels for food products, such as organic food and energy labeling of household appliances. The issues of energy consumption are also undertaken in other EU policy areas, such as the EU action plan on energy efficiency, the strategy for limiting CO2 emissions by new cars and trucks as well as the Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.

On 16 July 2008 the European Commission presented the Sustainable Consumption and Production and Sustainable Industrial Policy (SCP/SIP) Action Plan. It includes a series of proposals on sustainable consumption and production that will contribute to improving the environmental performance of products and increase the demand for more sustainable goods and production technologies. It also seeks to encourage EU industry to take advantage of opportunities to innovate. It is designed to support products made in accordance with the principles of sustainable development.

Among the elements the strategy of sustainable consumption and production in EU is based on, there can be distinguished the following groups of policies:

- Integrated Product Policy (IPP)
- Thematic Strategy on the Sustainable Use of Natural Resources
- Thematic Strategy on Waste Prevention and Recycling
- Environmental Technologies Action Plan (ETAP)

- European Compliance Assistance Programme (ECAP) - Environment & SMEs;
- and following group of tools
- Green Public Procurement (GPP)
- Eco-design of Energy Using Products Directive (EuP)
- Eco-Management and Audit Scheme (EMAS)
- Ecolabel – Ecolabel Scheme

Both the strategies and tools that are included in the package "Sustainable consumption and production" may be the cause of beneficial changes in construction, as due to them to the market share of innovative technologies and products will increase, while reducing negative environmental impact.

7. Ecological products

Ecological (sustainable) products are goods or services resulting from the sustainable production, which respects environmental and social requirements to a higher degree than similar conventional products, at every stage of their life cycle (at every stage of the manufacturing process and supply chain) from demand for raw materials, production methods and processing, through packaging and distribution, to utilization and disposal, including aspects of transport. Due to the fact that there is no unified and coherent definition of the concept of sustainable product, it may be helpful to define their attributes, which are to be considered as target requirements, assuming that one of the main goals of balancing the production is continuous improvement. Among the most important features of sustainable products there can be mentioned following ones:

- They are safe and meet international environmental and ethical standards at all stages of life cycle
- Their manufacture and consumption should positively affect both consumers and the local community, for example, contribute to the improvement of the local labor market through the activation of those at risk of social exclusion
- Production and distribution process of sustainable products should stimulate the service sector, using mainly labor resources, and thereby contributing to the reduction of unemployment
- These products should be accompanied by reliable information on environmental and social aspects as well as guidance for their sustainable use, including the processing and disposal
- Sustainable products should equal or exceed the conventional products in terms of functional characteristics, quality and availability, and be easy to upgrade during the time of their usage time

Ecological products are also defined in terms of production conditions. For organic products they are manufactured in clean conditions, with no additional substances - artificial colors, stabilizers or preservatives. In Poland detailed specifications for organic food are included in the Act of 20th April 2004 on Organic Farming (Polish Journal of Laws, Nº 93, item 898).

According to the one of the last report prepared on behalf of Greenpeace 17 to 32% of the greenhouse gases emitted into the atmosphere are caused by cultivation and animal husbandry. Conventional – industrial production – is associated with a substantial environmental pollution, harmful gases, and massive use of pesticides, herbicides, steroids and antibiotics. It constitutes a threat to the ozone layer, soil fertility and purity of the groundwater. Many controversies raised around the use of genetically modified organisms, which by some experts will contribute to the decline in biodiversity of species of plants and animals. Choosing organic products influences not only to changes in food production, but also the health and wellbeing. The results of research confirm that organic food is richer in vitamins and nutrients.

Seasonality of food means that certain fruits and vegetables are available only in certain seasons, such as in Europe strawberries are available in June and plum in September. It is the time when it is best to eat them and maintain. There are many opportunities for food preservation such as drying, freezing, souring, pasteurization, and more. However, not every method is environmentally friendly. Therefore, the problem arises of how to do it in a most preferred way. The popular method – freezing – involves a significant expenditure of energy. This processing requires the use of appropriate equipment in the whole distribution cycle and the use of large quantities of frozen water. This applies mainly to frozen foods bought by individuals at the store.

The January strawberries are grown in greenhouses, which not only has a negative effect on the flavor of the fruit, but also affects climate changes. It contributes to greenhouse gas emissions by artificial irrigation systems, heating and lighting. For such production there are often used harmful substances such as pesticides. What became quite common is also transporting food over long distances, often from other continents. Fruit and vegetables travel by ships, planes and trucks from other countries and then within the country from store to store. These negative effects of such "food kilometers" can be overcome by the consumption of the seasonal fruits and vegetables. Choosing seasonal foods also contributes to increased interest in local products and to maintain biodiversity, because producers interested in attracting customers' attention go back to growing old varieties of vegetables or fruits.

Another problem is modified food. At the end of the twentieth century the development of biotechnology gave humankind the ability to transfer genes between organisms of different species and types, which is impossible in the natural conditions. It started the creation of whole new, previously unknown organisms, so called genetically modified organisms (GMO). An example of the widespread use of genetic modification techniques in the food industry is the transfer of the rennet gene into organisms of fungi, yeasts and bacteria. It allows the production of rennet to make cheese on an industrial scale instead of the traditional animal origin (digestive enzyme chymosin is located in the gastrointestinal tract of calves).

Genetically modified foods are primarily crops, which due to changes in the structure of DNA gain new properties. Supporters of genetic engineering often cite three objectives explaining the development of new genetically modified varieties. These are:

1. Increasing crops, fight with hunger. Varieties resistant to pests and herbicides dominate the genetically modified crops. They are designed to increase yields and in the same time limit the use of chemicals to protect plants. Effectiveness in achieving these goals is very controversial. There was a significant increase in the use of plant protection products in the case of GMOs. Moreover, the fight against hunger with genetically modified crops also appears to be misguided. The problems faced by least developed countries are mainly the lack of access to land, water sources, protection of local markets and reduce poverty while the purchase of genetically modified grains and relevant, necessary for their crops, chemical pesticides are associated with high costs.
2. Improving the durability, processing capacity, reduction of transportation and storage losses. An example of modification resulting in improvement in the characteristics of raw food is the oil obtained from genetically modified soybeans, which contains a large amount of monounsaturated oleic acid, making it more resistant to high temperatures than natural oil. It increases the possibility of its use in food preparation processes.
3. The enrichment of nutritional value. Genetic modification can also affect the nutritional value, what is supposed to be an opportunity for prevention of deficiency of certain nutrients. The flagship example of such a modification is golden rice that has been enriched with the genes for the synthesis of beta-carotene, and increasing levels of iron (natural varieties are low in these ingredients). This modified rice would help in preventing deficiency of vitamin A and iron, especially in less developed countries. At present it is difficult to assess the impact of golden rice to the actual health benefits.

Cultivation of genetically modified crops increased from zero in the mid-nineties, through more than 50 million hectares worldwide in 2001 to almost a billion acres in 2005. Breeding of transgenic organisms is developed the most in the United States. In 2002, approximately 70% of global area of GMO was in the U.S., 20% in Argentina, 6% in Canada and 3% in China. The Europe constituted for only 0.03% of the world crop of GMO in 2000. It is estimated that in 2000 25% corn and 55% of soybeans produced in U.S. were genetically modified varieties. The production of genetically modified seeds is a new technology that brings huge profits. Only in 2001 it generated sales of 3.67 trillion dollars.

Effects of introduction into the natural environment previously unknown organisms are difficult to predict and estimate. Many fears are also related to the way of GMO cultivation. Intensive production and the use of monocultures (one variety) on huge areas is a major threat to biodiversity. One of the issues is also increasing use of chemical pesticides on crops of transgenic varieties. It is estimated that 81% of all genetic modified crops concerns varieties resistant to herbicides (chemical means of weed control). Such crops encourage greater use of chemicals because they do not damage crops but only undesirable variations. Cultivation of genetically modified plants has significantly intensified the problem of plant resistance to herbicides.

Most of the genetically modified corns are variety resistant to glyphosate (the active ingredient in herbicides). Currently the rapid growth of weed resistance to these chemicals is observed. Paradoxically, it increases the use of this herbicide (the use of glyphosate in the United States has increased 15 times from 1994 to 2005).

Genetically modified food affects human health. New genes introduced into traditional food usually mean the creation of new proteins, which can cause allergic reactions. Another problem is the possibility of the emergence of or increase in the level of toxic or unwholesome substances. From the ecological point of view the conditions for food production are also important. Milk in Polish culture is seen as a symbol of health and nature. Meanwhile, dairy production and consumption are controversial because of both health and environmental impacts of its production. What should be taken into account are such factors as energy and water use, greenhouse gas emissions, animal welfare, biodiversity, waste and transport.

In recent years, milk production in Poland is dominated by large farms, which constitute a heavy burden for the environment. Cows are often housed there in the pits and they never leave the barn. They live nearly motionless, not necessarily in hygienic conditions; they are fed with highly processed feed, based on genetically modified soybeans and corn. To avoid disease, there are antibiotics added to feed, which then goes to the milk consumed by consumers. Cows are often given hormones in order to increase their milk production and regulate the reproductive cycle. Another problem is the production of methane, a greenhouse gas, which is a byproduct of cattle. The transport of milk on long distances, which became possible due to the invention of the pasteurization process, also contributes to the climate change. Pasteurization also has a social impact – small local farms cannot afford the expensive equipment necessary for conduct it, so they are driven out of the market by large farms.

Recently attention was drawn to the threat of bio-diversity of grassland areas in some Polish regions. Excessive use of grasslands for grazing, plowing and sowing special blends of seeds for animal feed threaten more and more species. Even native varieties of animals began to slowly disappear from Polish pastures. Meanwhile, some experts believe that the extensive, traditional grazing of animals naturally occurring in these areas can restore the balance. Fortunately there are already established programs that deal with restoration of the original breeds of Polish origin, such as the red cow and others.

In response to the problems associated with the production of milk certification for organic dairy products was introduced. Dairy organic milk is produced from animals raised on farms that meet the standards of organic farming. Cows, goats, etc. are fed on green feed, free of GMOs. Animals are raised in spacious buildings, lined with natural litter and have access to pastures and free range. Their horns and tails are not cut off. Organic dairy contains no artificial flavors or sweeteners. Organic products can be identified due to special certified labels.

Regardless of whether one chooses organic milk or traditional mild, it should be stated that the production of animal protein consumes much more energy and natural resources than crop production. As in the case of meat, dairy is a luxury that only a few can afford. It is estimated that to produce one calorie of animal food one needs 10 times more resources and 20 times more land area than for the production of vegetable calories. It is not a coincidence that countries with the highest consumption of dairy products – USA, EU, Australia and Japan - are the wealthiest countries.

Similar problems arise in the production of eggs. This area is also dominated by huge farms that utilize so-called battery cages. Hens pressed in cages start to behave aggressively. Their beaks and claws are therefore cut off, so they do not hurt each other.

What is positive, in the case of eggs, conditions under which the hen was bred can be easily determine. The obligatory marking on the shell give information of the country of origin, type of farm, and even what type of breed of a given egg. Only the smallest farms (up to 50 hens) may sell eggs without stamps, but with written information about the origin.

The code stamped on eggs determines:

- The farming method; 0 = organic, 1 = free range, 2 = barn, 3 = cage
- Country of origin (two letter code, e.g. PL – Poland)
- The farm coded as the farm identification number

Another problem that has been publicized for years is overfishing. Currently 75% of the world's fisheries are overfished. This means that the size of the fish population is rapidly declining. There are too many fish caught, without giving proper time for the renewal of the population. In addition, hundreds of thousands of sea birds, turtles and mammals are killed annually in the networks, some of which are discarded as unprofitable by-catch. It should be indicated that in some regions only 1/10 of caught animals are used. In many cases there is a lack of control over the impact of extensive fishing on the ecosystem. Typically, fishing companies have access to the fisheries before the expertise of impact of fishing on the marine environment will be conducted. Large units catch much more fish than they should. Many species of popular fish are about to extinct mainly due to the shortsighted policies of fishing. The Population of major sea predators is now depleted in 90%. The disappearance of these species will have a huge impact on marine ecosystems in which small fish feeding on plankton will dominate. The most endangered species are Cod, European plaice, Atlantic halibut, Baltic salmon, Sharks, Rays, Sole and Bluefin tuna.

A certain solution is to breed the most common and popular species of fish on the farms. Unfortunately, such farms have a negative impact on the environment. For example, a typical farm of extremely popular farmed salmon may consist of a dozen pens, falling from 10 to 15 thousand of fish in each. Salmon is a carnivorous animal, so to grow about half a kilogram of salmon, one need 3-4 kilograms of other fish, used as food. They are fishes fished in huge amounts from other ecosystems, where they are also needed to other, not farmed species.

Fish farms are real factories polluting the environment. Toxic fecal, uneaten pellets of food, parasites, dead fish, chemical wastes and residues of antibiotics spread over the entire ecosystem. According to Greenpeace, a farm of 200 thousand salmon fish produces roughly the fecal content of a town inhabited by as 62 thousand people. It requires no great imagination to realize the scale of pollution caused by this type of activity.

The shrimp are produce and caught in a non-organic way. The most popular way to catch shrimps is bottom trawling. Trawlers scrub the bottom of the sea in a manner reminiscent of a forest clearing – they take and destroy everything along the way. They are as effective as roller riding through the forest. Trawling is catching with big networks that are so loaded that glide along the bottom, destroying everything in the path. Sea creatures living in deep, very slowly reconstruct their resources. The return to the biological equilibrium, disturbed by trawling, may take a decade or even century. As a result of such activity the sea bottom is converted into the in

the cleared void, where no species settle. That is the true cost of tropical shrimps. During the fishing, 75 - 90 percent of the total catch is thrown back to the sea, leaving only the shrimp. The rest of the economically unprofitable, usually already dead creatures are thrown into the sea.

Equally devastating is the breeding of shrimp on special farms located on the shores of tropical seas. For the purposes of the coastal farms the mangrove forests are grub up, which are the site of many animal species. The mangrove forests also protect the coast against erosion. In the case of destruction, the coast is destabilized, coral reefs and seaweed growing on the sea bottom are damaged. This leads to the collapse of the ecological balance at every level of the tropical ecosystem.

The concept of food miles is related with organic food issues. It became popular in Europe in the nineties of the twentieth century. In a globalized economy, before the food reaches the consumer, it travels thousands of kilometers. In 2007 the U.S. the average distance that food traveled from the field to the plate was 8.240 km. The more kilometers are traveled, the greater the external costs of transport. In addition to the negative impact of transport on the natural environment, there are still other problems, such as:

- Food miles reduce freshness and nutritional values of food - the more miles, the more time elapses from the moment of harvest to purchase
- Food miles make countries import food, which can often be produced on their territory,
- The less food miles, the easier it is to see exactly where food comes from and monitor the whole process of production
- Less food miles means lower transport costs incurred by consumers
- Less food miles are also fewer cars on the road and less accidents
- Food miles are also plane transport, which means noise and a large amount of fuel burned
- Food miles contribute to tropical deforestation in poor countries, where local people want to keep up with demand, ignoring the costs to the natural environment

Hence the solution is promoting locally grown food, which is eaten in the season.

8. Campaigns for sustainable consumption in Poland

Since 2002, the Polish Green Network (Polska Zielona Sieć – PZS) broadcast the thematic program on sustainable consumption and production under the slogan "Buy responsibly", which aims to increase the awareness and the ability to make responsible choices of Polish society and increasing the impact of Polish consumers on policies of companies, including global corporations, to raise standards for their operation in the field of environmental protection and human rights. In addition to the provision of information to the general public there are organized numerous conferences, seminars, meetings, debates, film screenings, happenings, exhibitions, festivals and training. Publications are also issued, including guides for non-governmental organizations, businesses and consumers, and even lesson plans for teachers and educational booklets for children and youth.

Polish Green Network uses modern communication tools, including social media, to strengthen civic engagement in consumer affairs. It coordinates, among others, the creation of guides for sustainable consumption places in different cities, consumer boycotts and mailing events to international corporations. The next step is to publish a database containing a list of socially responsible companies operating on the Polish market.

There can be specified the following examples of campaigns on sustainable consumption conducted by the Polish Green Network:

1. Walking guide of sustainable consumption – developed together with the eFTe Group from Warsaw and the Foundation for Sustainable Development for Warsaw, Krakow and Wroclaw. The guide contains: shops and cafes selling organic and fair trade products, selling points of the recycled products, the location of services offering replacement or repair of products and other places promoting aware, responsible consumption, such as influential clubs spaces, places in which free workshops, cultural events, film screenings, debates are held
2. 3R Academy, or "Reduce, Reuse, Recycle" - a pilot educational project to reduce packaging waste, which objective is building and shaping environmental attitudes in the waste management principles to children and youths in Poland. The project developed educational package for teachers, containing a set of lesson plans, along with sample exercises activating the pupils to the practical application of knowledge, including the actions taken for their community and environment
3. Buy toys responsibly – part of the European campaign to improve working conditions in the toy industry, carried out together with NGO from Austria, France, the Czech Republic and Romania. The campaign disseminates knowledge of the abuses associated with the production of toys in the developing countries and ways to influence the toy companies to urge them to use fair practices for workers and users of toys. The local, ecological production is popularized, creativity of parents and children is developed, as well as traditional national crafts manufactured in accordance with the principles of Fair Trade
4. Buy clothes responsibly - a campaign carried out in cooperation with organizations from Austria and Germany, drawing attention of consumers and the public to the abuses occurring in the garment industry. The project launched the first Europe-wide, innovative training program for representatives of small and medium enterprises of the clothing industry.

The three-day exhibition of fashion made in a friendly way to natural environment and humans is also planned. The presented campaigns are largely focused on the act of purchase. Store shelves filled to the brim with colorful packaging and hundreds of products that one just wants to put into the basket, present a wide choice that a consumer finds hard to resists. In the same time any decision to purchase has an impact on other people, environment and nature. So, how to buy wisely and responsibly? Research indicates that unplanned, reckless purchases represent about 67% of all purchasing decisions. To prevent unwanted purchases, a few simple tips can be used:

1. Always check what is written on the package – anyone can be a responsible consumer and it is not associated with any serious sacrifices. For starters, it is good to compare products, look for "green" products, read labels and ask the dealer if you some information cannot be found, for example, country of origin

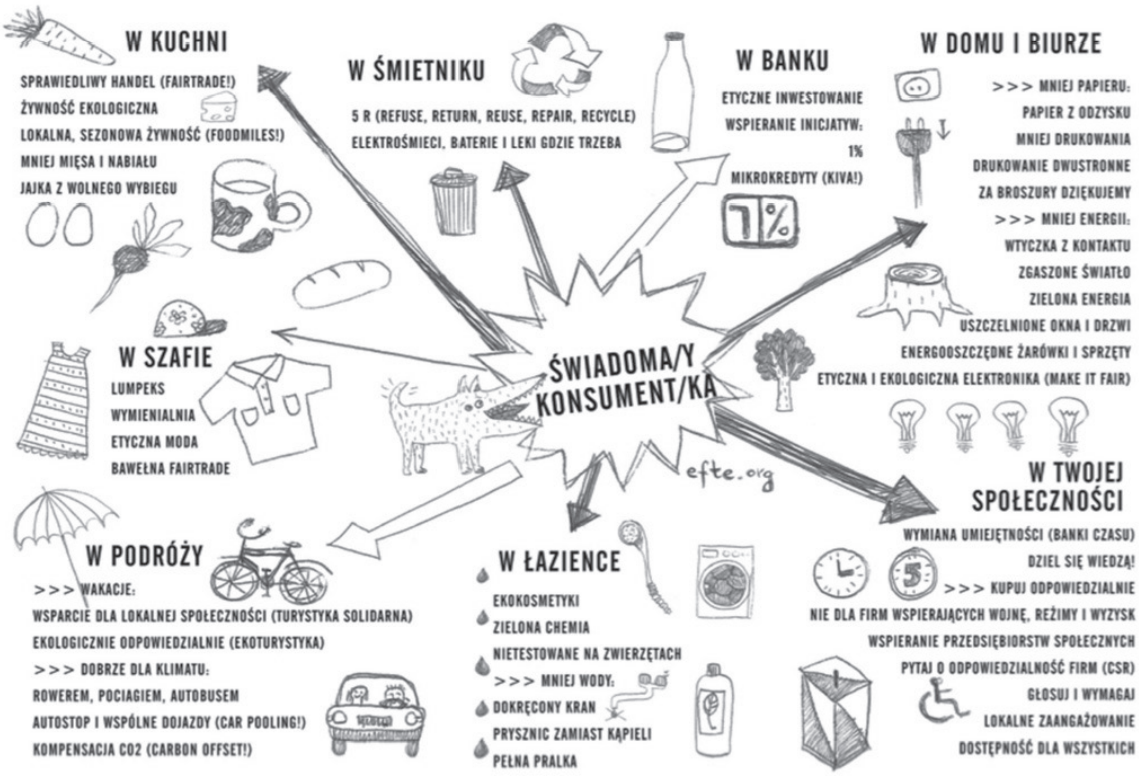
2. Resign from unnecessary packaging and recycle – the products without packaging or packed in a friendly environment should be chosen, as well as to household waste should be segregated, so that some resources could be used again

3. Support your small community – it is worthwhile to buy in local shops and supporting neighbors. It can help reducing the food miles. Fewer miles driven means lower emissions of carbon dioxide into the atmosphere. It is also beneficial for our health, because it is the best diet should be based on regional and seasonal specialties

4. Buy Fair Trade products - a more conscious consumer look for products labeled with Fair Trade. This symbol is a guarantee that the production does not violate the human rights, there is no exploitation or slavery. It is worthwhile to support the companies that care about social and environmental effects of their activities, engage locally and practice sustainable development

5. Think before you buy - before buying, it is good to consider twice whether the product is really needed. It is good to resign from the hip but unnecessary gadget, that shall hardly be used

Figure Nº 12: The map of conscious consumption according to the Warsaw eFTe Group



Source: www.efte.org

The other example of campaign for ecological purchasing is 3R conception, which states for reduce, reuse, recycle as alternatives for purchasing. The 3R principle is especially important when consumer choices are analyzed in the context of resource consumption of fossil fuels.

Figure Nº 13: The 3R principle

Reduce, so less means better

The production of every product links to the consumption of natural resources such as fossil fuels or water. By choosing the responsible shopping, it is enough to obey just a few simple rules:

- Buy only what you really need. Do not buy for such reasons as: "to improve your mood", "because there was promotion on it", "for it surely come in handy"

- The same principle applies to free gadgets, gifts or newspapers - if you do not need them, refuse to take them. The fact that you get them for free, does not mean that production costs are not burden to the natural environment
- Avoid unnecessary packaging, after returning home packages will go to the trash bin anyway. Search for stuff packed sparingly (or not at all), in returnable or recyclable packaging, and if you do use particle product a lot and regularly, buy one large container instead of five small
- Choose good quality products that that will serve as long as possible. If you buy a piece of equipment or appliances, check the warranty, spare parts availability, a list of points of service in your area. Do not forget to check the energy consumption and read the instruction carefully to be able to properly care for purchased equipment

Reuse, so the second life of a product

Disposable products are in most cases a huge waste of resources, plus the growing rubbish mountain. The principle of re-use concerns not only disposable products but also products that have are thrown into the trash although someone could still use them. One can deal with it, for example, by the following actions:

- Say "no" to disposable bags cookware, pencils, batteries, razors and other objects, not only for environmental reasons, but also aesthetic. If you are using disposable plastic bags, remember to put them into plastic bins
- If you possess something you no longer need, but it still could be useful to someone else (such as furniture, clothing or household), do not throw it away. The things you used are relatively easy to sell, give away or swap for something useful to you
- The purchase of used items is not only saving money but also resources. See the second hand clothing stores, browse websites or simply chat with friends
- Much of what people throw away to the trash, can still be useful - one side printed paper for taking notes, newspaper as wrapping paper, damaged clothing as cloth. Our parents and grandparents were "eco", often without being aware of this

Recycle, so new from old

Recycling, or waste processing, can reduce the consumption of natural resources, ensuring the recovery of raw materials needed for production. The condition for efficient recycling is adequate segregation and disposal of waste. It is worth noting that recycling is much more than the correct segregation of waste, it is also a creative adventure and above all a new way of thinking about the production processes in industry. Things to remember:

- Recycle at home and at work
- Care for hazardous waste: batteries, medicines and thermometers, electrical equipment, light bulbs, oils and lubricants. Drugs should be disposed in pharmacy, car batteries to the workshop, the addresses of the other points of collection can be found in many places, especially on the internet (some Polish sites are e.g. elektrosmieci.pl, reba.com.pl)
- When buying new electrical and electronic equipment, a shop is required to accept used equipment of the same type. It is worth remembering, especially since some stores also offer free shuttle service of used equipment
- If possible, choose products made from recycled materials - their choice continuously increasing. It is not only recycled paper, but bags from old advertising banners, coats of polyester made from plastic bottles and many other items and packaging

9. Is Greenwashing increasing the awareness of sustainable consumption among consumers?

In the United States, Western Europe and increasingly also Central and Eastern Europe there is a debate on the phenomenon of greenwashing – unreliable communications of companies that communicate their environmental responsibility in a way that does not reflect the reality: the producers who wish to enroll in the minds of consumers as socially responsible and increase demand for their products, argue that they are doing the environment much more than they actually do. Such actions are met with growing criticism, not only from non-government organizations, but also the government and consumers themselves. What is more, the long-term effect of greenwashing is a significant decrease in confidence of pro-ecological business activities, so the final effect of mentioned actions is counterproductive. Why, then, manufacturers are risking the trust of customers and reputation, considering that the so-called "green lies" are worthwhile? Does greenwashing scale occurrence depend on the degree of consumer awareness?

Recent crisis in financial markets is often referred to as a "crisis of confidence". Rebuilding relationships with customers and business environment, based on reliable communication and ethical behavior, has become a priority for many market entities. It was understood that a good reputation to a great extent determines the market value of companies and the trust of customers and business partners is one of the most important assets of the company. The proof for that is provided bankrupt or balancing on the edge of bankruptcy banks, investment funds and other institutions, which by the irresponsible management of risk had been exposed the to the widespread criticism. More than ever, trust turned out to be a core value - the size of the crisis and the strength of its impact on other industries quickly showed that this value can be estimated at a huge amount. The amount is so high that in the business world no one should want to pay it. Ernst Ligteringen, CEO Global Reporting Initiative (GRI) said: "Given the flames of the financial crisis were fanned by a lack of transparency from our financial institutions, scaling back on public disclosure would be like pouring petrol on the fire… Now more than ever companies need the element of trust."[119] However, it appears that not all market participants fully understand this lesson. The phenomenon of greenwashing is increasing and simultaneously the question appears: why, despite the trauma of the crisis, some companies still do not value trust and do not perceive the trust as the ground for building long-term and thus profitable relationships with stakeholders?

The publication of Business for Social Responsibility and Futerra Sustainability Communications "*Understanding and Avoiding Greenwash*" [120] helps understand what drives companies to implement greenwashing and presents practical tips how to change communication. The most common 10 signs of greenwash are[121]:

1. Fluffy language - words or terms with no clear meaning (e.g. "eco-friendly")
2. Green product vs. dirty company - such as efficient light bulbs made in a factory that pollutes rivers
3. Suggestive pictures - green images that indicate a (unjustified) green impact (e.g. flowers blooming from exhaust pipes)
4. Irrelevant claims - emphasizing one tiny green attribute when everything else is not green
5. Best in class - declaring you are slightly greener than the rest, even if the rest are pretty terrible
6. Just not credible - "eco friendly" cigarettes, anyone? "Greening" a dangerous product doesn't make it safe

[119] The co-operative AccountAbility (2009), What Assures Consumers in an Economic Downturn? Reviewing the agenda in the global economic crisis. [online] aviable at: http://www.accountability.org/images/content/1/1/115/

[120] Horiuchi R., Schuchard R. Shea L.and Townsend S. (2009), Understanding and Preventing Greenwash: A Business Guide [online] available at: http://www.bsr.org/reports/Understanding_Preventing_Greenwash.pdf

[121] Horiuchi R., Schuchard R. Shea L.and Townsend S. (2009), Understanding … (o.cit.) , p.9

7. Jargon - information that only a scientist could check or understand
8. Imaginary friends - a “label” that looks like third party endorsement—except that it’s made up
9. No proof - it could be right, but where’s the evidence?
10. Out-right lying - totally fabricated claims or data

Greenwashing communication can be delivered via all kinds of channels – from advertising through sponsorship to the word of mouth marketing. There can be given any more examples but they all share the one feature: greenwashing messages are based on information that are completely or partially false, that are inconsistent with the actual actions of the company. It destroys the basis for consumer-business relationship, which is trust. Communication based on trust helps building relationships with consumers and increases their loyalty. What's more - the supporters of green products are such group of consumers who are more likely than others to pay attention to the reliability of products.

The risk that they shall find false messages is increased. The disappointment of consumers, the negative opinion of society, loss of reputation are all the factors that can lead to a situation in which restoring the prestige of the brand will require costs that will be bigger than the profits from the sale of pseudo-organic products. So why do companies using greenwashing? Why are the companies determined to follow the path of kamikaze? The answer is simple; it is due to the prospects of short term easy to achieve profit. According to the authors of the publication "Understanding and Avoiding Greenwash" the most important reasons why companies decide to greenwashing are:[122]

1. Consumer demand for more environmentally responsible products is growing. (Once confined to a small market of environmentalists, consumers who choose green products over other options now represent 40 percent of the American market, according to Cone’s “Green Gap 2008 survey”[123].)
2. Sales of environmentally oriented products have increased (According to a CBS News report, major U.S. manufacturers launched 328 products labeled as “environmentally friendly” in 2007, up from just five in 2002.[124])
3. Demand for ecological products remains strong despite the economic downturn
4. Regulations and government actions forcing or stimulating ecological investments are pending
5. There are generally no industrywide standards for communicating environmental messages (no directives setting standards of what greenwahsing is and defining unacceptable practices)

Since the environmental awareness of consumers in the United States grew to such an extent that 40% of them choose organic products for many manufacturers (especially in the FMCG sector) changes in production or to extend the portfolio of eco-type products may soon mean “to be or not to be” on the market. For some manufacturers change of technology and production process for environmentally friendly involves significant investments. Does greenwashing is result of the fact that it is easier to stick the "eco-friendly" label than incur the cost of upgrading? Or maybe the producers are not used to the group of consumers of organic products and they have not yet developed appropriate methods of communication and use the old patterns of communication that used to work in market segments in which they functioned so far?

[122] Horiuchi R., Schuchard R. Shea L.and Townsend S. (2009), Understanding … (o.cit.) , p.9.
[123] Cone (2008) “2008 Green Gap Survey.” [online] Available at www.coneinc.com/news/request.php?id=1135
[124] CBS News (2008). “A Closer Look at ‘Green’ Products.” [online] Available at www.cbsnews.com/stories/2008/05/18/eveningnews/main4105507.shtml

According to Kathee Rebernak[125] companies that have integrated sustainability do not implement greenwashing, as they have also integrated their communication of sustainability commitments, initiatives, and performance. Those messages are consistent, balanced and widespread in reports and adverts, and on websites, intranets, product packaging, even coffee cups. So greenwashing is the domain of companies that do not have, or have implemented incompetently the principles of corporate social responsibility into their business. Thus their communication with the environment is inconsistent.

The dichotomy between the content of messages and companies' actions is a risky path that from the point of view of long-term development strategy of the company is extremely unfavorable. Socially responsible companies do not allow double ethical standards and not risk their reputation for profit.

The use of such irresponsible practices like greenwashing is also the inability to build long term relationships with customers, which could result in increased loyalty. This kind of investigation, according to Kotler is one of the most important problems of modern marketing in general.

One might ask whether the practices like greenwashing actually lead to profit. Do consumers really want ecological declarations that are not based on facts, and are they willing to buy any product touted as "environmentally friendly"? A study by Havas Media in January 2009 on a sample of 20 thousand consumers from around the world do not give a clear answer: 64% of respondents considered that the concern for sustainable development expressed by producers is only a marketing tool and those respondents do not trust brands that send such messages. At the same time, almost 50% of respondents said that they were prepared to pay up to 10% more for green products despite the crisis. On one hand, there is quite a common belief that the so-called "green marketing" does not reflect the actual value, which is guided by the company. On the other hand, consumers are aware of the importance of ecology and half of them are willing to pay a higher cost to buy green products even in times of crisis.

From this perspective it may appear that any efforts of producers towards communicating the environmental values to the consumers and the importance of environmental products for the company are unnecessary because buyers not only do not believe in them, but they do not need them as an incentive. On the contrary – according to another study conducted by Nature Marketing Institute, 34% percent of the population feel "bombarded" by green messages. As the authors of the publication "*Understanding and Avoiding Greenwash*" indicate, when all manufacturers declare that their products are environmentally friendly, a company can no longer be differentiated in this way – ecological attitude of a company is no longer a source of competitive advantage. The consumers are so tired that they no longer notice the differences between brands. In the flood of eco-babble, even the most sincere message is only part of the "noise" that consumers do not want to hear. Therefore the greenwashing has done a lot of wrong for the organic producers.

It can be assumed that producers using greenwashing do not understand the real needs of customers, whom they try to reach. Communication with the consumer is done on a monologue basis – one-way communication to the client is built on a superficial or completely inappropriate meaning of what ecology is. Consumers and non-governmental organizations, which were ignored so far by the pseudo-organic producers, have already sent a loud warning tone: without the true dialogue there can be way of building a mutual value with business as a social partner.

The similar conclusions are presented in analysis of the research results carried out in April 2009 by well-known "AccountAbility" think-tank and the Association "The Co-operative" – "What Assures Consumers in An Economic downturn?"[126] The object of the study was the attitude of British consumers towards social responsibility in times of crisis. The report shows a clear lack of confidence in the private sector – when looking for CSR evidence, consumers will

[125] Ethical Corporation: Green marketing – The dangers of clueless communication. [online] Availabe at: http://www.ethicalcorp.com/content.asp?contentid=6549

[126] The co-operative, AccountAbility (2009), What Assures Consumers in an Economic Downturn? Reviewing the agenda in the global economic crisis. [online] aviable at: http://www.accountability.org/images/content/1/1/115/AccountAbility_What%20Assures%20Consumers%20in%20Economic%20Downturn.pdf

turn to independent sources, such as NGOs and consumers organizations, rather than listen to the producers' messages. At the same time, most respondents said they did not intend to give up buying organic products because of the crisis.

Barry Clavin (Ethical Policies and Sustainability Reporting Manager, The Co-operative Group) states in the report[127]: "What consumers seem to be saying to business is that if corporate responsibility mattered in good times then it should matter in tougher times. Businesses should, therefore, not think that they can hope to rebuild consumer trust by turning on and off the 'corporate social responsibility' tap. Indeed, when the economy turns around, consumers may well be holding such businesses to account and asking: 'So what did you do in the downturn?'"

The debate on the greenwashing goes primarily in the United States and Western Europe so far. Eco-entrepreneurs' attitudes are more common there, as manufacturers realized that ecology is strategically important for long-term, sustainable development of companies and that consumers recognize the value of ecology (it is certainly a good message if only the environmental measures will be included in the DNA of the company and not only in marketing communications). In Poland there is little debate about greenwashing and it remains rather a niche subject (although the producers themselves are doing more and more to the ecology, which is confirmed by examples of good practice in the Reports of FOB). The market for organic agricultural products and the market for "eco-friendly" products are also still niches (although both apparently develop and demonstrate significant potential). This may be caused by the fact that Polish consumers' environmental awareness does not transform into their purchasing behavior. As the answer to the low demand, producers do not introduce green products on a larger scale (thus a spiral occurs: low demand, prevents the reduction of production costs, resulting in a high price of eco products, which is a barrier to potential buyers). Poles are quite willing to declare their interest in the environment, but it is not transformed into their purchase decisions.

The research conducted by the Instytut na Rzecz Ekorozwoju (Institute for Eco-Development) in Poland in 2008 showed that only 11% of consumers pay attention whether a food product is produced in ecological way. The most important criteria for the selection of products (not just food) for Polish consumers remain price and quality. Similar results are presents in the study conducted in September 2008 by Gemius S.A. for the "Forum Odpowiedzialnego Biznesu" (Responisble Business Forum) titled "The awareness of Polish Internet users" – 77% of respondents confirmed that they were concerned by the state of the natural environment in Poland, but only 12% of them pays attention whether a purchased product is safe for the environment.

Low demand for organic products is not the only reason why producers in Poland do not implement them on a larger scale. Poles have still little knowledge about how to identify the organic product (lack of information on labeling, which can be used by manufacturers with environmental standards) and their knowledge of the importance of sustainable development is still insufficient. One can argue that the "quality" of Poles' ecological awareness remains low and the knowledge on how to effectively reduce the negative impact on the natural environment is still superficial.

However, consumer attitudes are evolving rapidly, the quality of life and society's prosperity grows and environmental issues are becoming increasingly important element for both business and public sector. With the accession to the European Union environmental regulations have changed the way Poles think about the economy and sustainable development. The change is also in awareness of business - growing from year to year number of responsible practices and interest in CSR indicate that business increasingly perceives their role in promoting the mutual benefits. Caring for the natural environment is not only a priority, it becomes a duty. If Poles are reached by the ecological trends, if the demand for eco-type products will be greater and the communication of environmental qualities of products will be wider – will they be able to distinguish between greenwashing and real information? Is the larger and deeper consumer and business environment awareness cure for greenwashing? Certainly yes, but these are not the

[127] The co-operative, AccountAbility (2009), What Assures Consumers in an Economic Downturn? Reviewing the agenda in the global economic crisis p.4. [online] aviable at: http://www.accountability.org/images/content/1/1/115/Accountability. What Assures Consumers in Economic Downturn.pdf

only issues. As in countries where the ecology is a subject of public debate for a longer time than in Poland, the solution can be enhanced, honest dialogue with all stakeholders. A Dialogue in which both parties listen to each other with understanding.

A better understanding of environmental issues will certainly help consumers choose the right products and enhance their attitude towards malpractice. However, not only consumers can be an ally of the natural environment. The changes must take place also in the minds of producers, media, NGOs and GOs. Ecological education is in the interests of all people. The better humans understand how to prevent environmental degradation, the more they can achieve in the common objective of sustainable development. Greenwashing can be overcome only reliable knowledge and common, consistent actions.

Among the activities carried out by producers in Poland special attention should be paid on these initiatives, which introduce consumers with ecology related issues. The companies that implement eco-innovation understand that the aware consumer is more their supporter. It is important to a company that educates its environment, that it could give an example of good practice of their own experience.

A very important role in educating consumers play NGOs – their experience and knowledge can help in enhancing consumer awareness. The research of Instytut na Rzecz Ekorozwoju (Institute for Eco-Development) indicates that environmental NGOs in Poland are not very recognizable. The authors of the report point out: "*These results should encourage these organizations to entering into closer interaction with the public and to conducting wider promotional activities, disseminating the results of their projects and campaigns"*. It should also be beneficial to use the experiences of international organizations such as Greenpeace, which has developed interesting methods to combat greenwashing, placing consumer education first and engaging consumers in common ecological initiatives.

Equally important in enchasing consumer awareness are actions taken by the Governmental Organizations and Public Institutions. The Public Administration may conduct educational campaigns, support environmental initiatives, and encourage citizens to act to protect the natural environment. The Public Administration can also run informational campaigns about the importance of environmental certificates, promote proper labels (e.g. European Ecolabel sign or the logo used by companies registered under EMAS). It can create incentives for promoting the gaining and usage of the eco signs among producers. A positive aspect is the observed growing involvement in the ecological issues of Polish Ministry of the Environment.

Only sustained and integrated efforts for increasing the ecological awareness of producers and consumers, undertaken by all participants of social life, can neutralize and eliminate greenwashing.

Chapter 7
Measures for Sustainable Products

Michael Malachinski[128]

1. Introduction

Within the research project "Sustainable Production Logistics" a concept for the implementation of sustainability for the production and production logistics is to be developed. This is based on the concept of sustainability, used by the United Nations commissioned Brundtland Report published in 1987[129]. The concept was presented at the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, in a more concrete way and connected to the following three key demands [130]:

1. Ecological Sustainability: Balancing the interests between ecology and economy
2. Social Sustainability: Balancing the interests between "poor" and "rich"
3. Economical Sustainability: Long-term nature of the development / balance between the generations

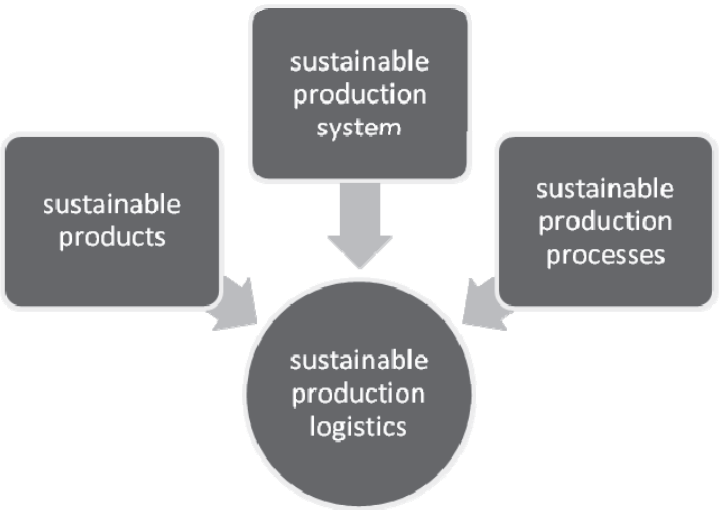
To develop a concept of sustainability for production logistics, the following aspects of the production have to be considered:

- The products
- The production system
- The production processes

For each of these three components, sustainability must first be assured in order to develop the overall concept of sustainable production logistics on this basis (Figure Nº 14). In this article, the aspect of products and ensuring their sustainability will be focused on.

To ensure sustainability concerning *products* that is achieving a sustainable product the product must comply with environmental, social and economic sustainability criteria. How this correspondence can be achieved and evaluated, will be examined below. Before, however, a classification of possible products will be presented as a basis.

Figure Nº 14



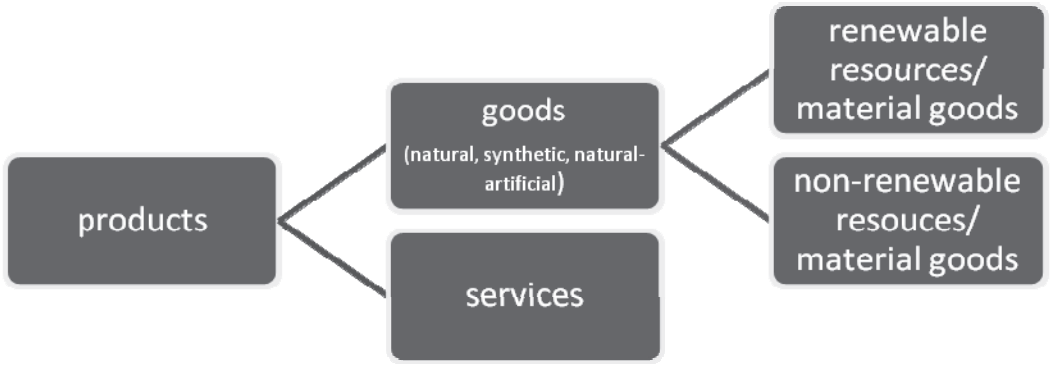
[128] Dipl.-Inform. Michael Malachinski, formerly: Hochschule Osnabrück, Department für Management und Technik, Lingen
[129] see Brundtland, G.H.: Unsere gemeinsame Zukunft. Der Brundtland-Bericht der Weltkommission für Umwelt und Entwicklung, 1987
[130] see Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Hrsg.): Umweltpolitik. Konferenz der Vereinten Nationen für Umwelt und Entwicklung im Juni 1992 in Rio de Janeiro. Dokumente. Bonn: Köllen, 1992

2. Classes of products

Generally, products can be divided into goods and services also under the aspect of sustainability.

Furthermore goods can be classified according to their materials: they can consist of synthetic materials and natural-artificial materials. In addition, material goods may be differentiated by whether alternative energy and renewable raw materials (e.g. agricultural products, firewood, solar energy), or incorporated and non-renewable resources (e.g. minerals) are used for their production. Often complex material is processed consisting of both renewable and non-renewable resources.

Figure Nº 15



3. Measures to improve the sustainability of products

As stated in section 1, a product intended to be interpreted in terms of sustainability, has to fulfill the three essential requirements for environmental, social and economic sustainability. In this section we will describe each of the three claims on the production of goods and discuss possible measures for improving and managing the respective aspect.

3.1. Ecological sustainability

Ecological sustainability, i.e. the balance between economic and environmental interests, is certainly the most common and most elaborate aspect of the sustainability concept.

In terms of products, this means in general that these have to be designed in a way to preserve nature and environment for future generations. This means, ideally, in particular, that solely resources are used that regenerate. Products and their production must not have any negative impact on biodiversity, climate, culture and landscapes.

Regarding environmental aspects of products, numerous factors can be influenced and differentiated accordingly, as explained below.

Product properties

If the product allows it and if it is technically possible, the ecological quality of a product may be improved by reducing its weight and/or its volume. In the same way, and often easier to implement, a reduction of packaging weight and volume efficiently leads to environmental improvements. Both measures initially lead to a lower demand for packaging material. In addition, the lower weight and/or volume of products and packaging during transport provide a higher shipping capacity, which reduces both the cost of transport for the manufacturer and negative environmental impacts.

Resource consumption of products

The ecological quality of a product depends on its energy requirements during its lifetime, therefore the reduction of the energy consumption (e.g. electricity, gasoline) should always be an aim. Since energy consumption is easy to determine and to compare with similar products, appropriate continual checks must be carried out and communicated to the customers, for example through energy efficiency labels for products with low energy demand. As examples the label "EU Energy Star" and the European Directive "Energy-using Products Directive, EuP" must be mentioned, which contain specifications for the energy consumption of products.

In addition the supplies needed are of interest (e.g. toners for laser printers). Since the sale of supplies required for the product often represents an additional and lucrative source of income for manufacturers, which, however, becomes important for the buyer after the purchase decision, this relevant aspect is often considered inadequate.
The general aim should also be the reduction of CO_2 emissions in the processing of goods.

Product lifetime

Increasing the lifetime of products leads to less environmental impacts incurred by otherwise disposing of the EuP and usually new production. To improve the durability of a product, repair options should therefore be available (restoring rather than throwing away) and upgrading should be feasible (rather than buying new).

Disposal

For the environmentally friendly disposal of old products, it is first necessary that these may be disassembled as easily as possible. Therefore, disassembly and recycling must be taken into account for the product design (design for recycling[131]), with the aim that a product can be easily disassembled into its individual components and materials. The environmentally friendly disposal of a component or material can then be achieved in part through recycling, i.e. the product / component is - usually after appropriate work-up - re-used for producing the same or another product ("recyclability"). Moreover, a simple environmentally friendly disposal is possible, when it comes to product components involved, which can be fed back to the ecosystem and naturally decompose.

Product components

The required raw materials for a product (including semi-finished products) should be selected with regard to general criteria of environmental sustainability. If possible, the use of recycled products / components should be preferred (see section "Disposal").

In addition, the use of substances hazardous to environment or health should of course be avoided or at least substantially be reduced in order to produce products which cause as low emissions as possible.

Integration of product design and production

Product development should not take place separately from the design of production processes, but it should simultaneously be examined if whether by minor and tolerable changes in product characteristics or design environmentally friendlier production processes can be achieved (e.g. through fuel-efficient machines and techniques).

[131] VDI: VDI 2243: Recycling-oriented product development. VDI-Gesellschaft Entwicklung Konstruktion Vertrieb, 2002

3.2. Social sustainability

The goal of social sustainability is to achieve a permanently sustainable society liveable for all its members through the balance of social forces. Regarding products, this means that all the people involved in production have to profit durably and fairly. Social sustainability is locally, regionally, nationally and globally important.

Regarding social sustainability the following aspects are essential:

Price of a product

Due to saturated markets the price war between competing companies in the industrialized countries is fierce, which sometimes leads to dumping prices and therefore to price depression in manufacturing costs. In order to run successfully, businesses must try to reduce the cost of production factors, especially labor and raw materials. These affects in particular the people at the lower end of the production chain whose pay is often much too low, but who are dependent on it because of social distress (e.g. small farmers in developing countries, child workers). To prevent such exploitation, which contradicts the idea of social sustainability, it is absolutely necessary to manufacture products in, and export raw materials from, third world and emerging countries at fair prices and with a fair pay of the people involved.

In addition to legal requirements and voluntary commitments of companies product labels are potential management tools. As an example the international Fair Trade label may be mentioned, with which products are honored that are traded at set fair conditions. It is noteworthy that in return compliance with minimum environmental standards is required of the participating small farmers and plantations, besides, additional social projects are financed with funds generated (e.g. the construction of schools).

Place of production site

Through the establishment of a production facility, jobs are created in the respective region which additionally benefits economically from the capital invested. At best, a corporate settlement serves as a nucleus for further foundations. The decision for or against one or another production site can therefore have far-reaching social and economic consequences. Therefore, location decisions of firms, particularly in the era of globalization, are a powerful factor relating to social sustainability.

Raw materials of a product

By selecting the raw materials for a product and according commodities, certain producing regions are promoted. This can either be the case if only goods from specific regions can be used (e.g. cocoa beans), or if a company prefers a particular production area for social reasons.

Here again to ensure sustainability economic, environmental and social criteria must be met, for instance to avoid exploitation of resources (human and natural), especially if belonging to other countries.

3.3. Economic sustainability

Economic sustainability requires a balance between the generations: a solid long-term foundation for prosperity and employment must be offered and economic resources need to be protected from exploitation.

From the viewpoint of sustainable products, this means that a generation must not affect subsequent generations in their consumption of products, commodities and funds. This can be ensured in two ways:

1. A generation consumes no more than can be regenerated or reproduced. As an example, fishing may be quoted: fishing grounds must not be over-fished by one generation so as not to harm the next generation.

2. If demand for renewable resources is higher than can be regenerated in the respective period or if non-renewable resources are involved, equivalent alternatives must be simultaneously developed in order to relieve subsequent generations. A generation must not consume more resources (e.g. petroleum) than can be regenerated; anything else would be impractical.
   This means that a generation that "robs of" resources is committed to the creation of alternatives. The consumption of oil is just one example. It can only be compensated by the development of alternative energy sources and propulsion technologies, and thus would not affect the next generation.

4. Conclusion

In this paper, possible measures to improve the environmental, economic and social sustainability of products have been presented.

Of these three, ecological sustainability is the most common and elaborated aspect. It can be improved by optimizing product properties, reducing resource consumption by ensuring, a longer lifetime of products combined with better repair, upgrade and recycling options and last but not least the integration of product design and production processes.

In application of the principle of social sustainability makes sure that all the people involved in the production of a product profit in a durable and fair way, and none are exploited. Measures of control are the price of a product that should be in accordance with the actual production costs, the place of the production site and the selection of suppliers for raw materials. As many of these decisions must be made by the companies, it is difficult but not impossible to regulate this aspect externally.

The aspect of economic sustainability – which implies that a generation must not affect subsequent generations by their consumption of products, commodities and funds - is the hardest to achieve, for the responsible use of existing resources and the development of new, alternative technologies can hardly be prescribed by countries or other institutions.

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Chapter 8

Sustainable Products: Measures and Methods of Valuation

Michael Malachinski[132] and Denis Behr[133]

1. Introduction

A product intended to be interpreted in terms of sustainability, has to be conform to the three key demands to environmental, social and economic sustainability[134, 135] . However, these three aspects are partly in conflict with each other. For example, the question of whether an ecologically acceptable product from a richer region is to be favored over an ecologically questionable product from a poorer region, or vice versa.

To guarantee the transparency of sustainability regarding a product and also to weigh up conflicts between the three dimensions of the ecological, social and economic sustainability, it would therefore be desirable to be able to evaluate a product in terms of sustainability; ideally by all three sustainability criteria separately. First of all this article presents relevant indicator systems for sustainable development in general. Then the evaluations of products regarding sustainability as well as appropriate methods for this purpose are substantiated.

2. Indicators for a sustainable development

The Agenda 21, which was agreed by the United Nations Conference on Environment and Development in June 1992, demands[136]

> *40.6. Countries at the national level and international governmental and non-governmental organizations at the international level should develop the concept of indicators of sustainable development in order to identify such indicators. In order to promote the increasing use of some of those indicators in satellite accounts, and eventually in national accounts, the development of indicators needs to be pursued by the Statistical Office of the United Nations Secretariat, as it draws upon evolving experience in this regard.*

For the implementation of those demands several key performance indicators for sustainable development were supposed on international as well as on national level. Two indicator systems of the United Nations and the indicators of the Federal Government of Germany are exemplarily presented.

2.1. CSD-indicators of the United Nations

CSD indicators were developed by the Commission on Sustainable development (CSD) of the Department of Economic and Social Affairs of the United Nations[137]. This set of indicators was first published in 1996 and expanded in 2001, while intense testing took place. Since 2006 the 3rd revised edition is valid. This set, containing 50 key indicators and all together 96 indicators,

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[133] B.Sc. Denis Behr, Quality Representative – Accommodations Department, MEYER WERFT GmbH, Papenburg
[134] cf. Brundtland, G.H.: Unsere gemeinsame Zukunft. Der Brundtland-Bericht der Weltkommission für Umwelt und Entwicklung, 1987
[135] cf. Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Hrsg.): Umweltpolitik. Konferenz der Vereinten Nationen für Umwelt und Entwicklung im Juni 1992 in Rio de Janeiro. Dokumente. Bonn: Köllen, 1992
[136] cf. Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Hrsg.): Umweltpolitik. Konferenz der Vereinten Nationen für Umwelt und Entwicklung im Juni 1992 in Rio de Janeiro. Dokumente – Agenda 21. Bonn: Köllen, 1992
[137] United Nations (Hrsg.): Indicators of Sustainable Development: Guidelines and Methodologies. Third Edition. New York: United Nations, 2007

may serve as a basis for the government to compile national indicators or indicator sets for the evaluation of sustainable development.

Those 50 key indicators can be described by the following regulations:

- They are relevant for a sustainable development of most states.
- They contain critical information, which has no influence or relation to other key indicators.
- For the evaluation just existing or easily accessible data is used.

All other indicators are relevant for only a few states, contain extra data or are not easily accessible for most states. The key indicators are subdivided into 14 theme cluster (e.g. education, clime, ecological development), which are then differentiated into subthemes (e.g. clime: climate change, ozone layer, quality of air). Every subtheme contains key indicators as well as other indicators (e.g. climate change with the key indicator carbon dioxide emissions). Most indicators have links to one or more subject areas (e.g. carbon dioxide emissions to the subject area country). These relationships are illustrated in an appropriate matrix.

2.2. MDG -indicators of the United Nations

For the implementation of the Millennium Declaration[138] signed by 189 member nations of the United Nations in 2000 the so called Millennium Goals[139] were constructed. The goals, which shall be reached by 2015, are:

- Eradication of extreme poverty and hunger
- Primary education for all children
- Promotion of gender equality and empower women
- Reduction of child mortality
- Improvement of maternal health
- Eradication of HIV (AIDS), malaria and other major diseases
- Ensure environmental sustainability
- Construction of a global partnership for development

Those superior goals contain 18 subgoals as well as 48 indicators. Many of the CSD and MDG indicators coincide or are similar though. The MDG indicators, however, include specific ones defined for the MDGs, while the CSD indicator set covers a much wider range of sustainable development, especially the ecological, economic and social aspects.

2.3. Indicators of the National Strategy for Sustainable Development “Perspectives for Germany”

In 2002 the Federal Government of Germany adopted the national sustainable development strategy "Perspectives for Germany"[140] based on four “guidelines”: Intergenerational equity; Quality of life; Social cohesion and International Responsibility.

To implement these guidelines, a management concept was developed, consisting of management rules with action plans, indicators and targets as well as monitoring of the achieved level of development.

To reach the goals of these four guidelines a total number of 21 indicators and targets were defined. For example, within the guideline “intergenerational equity” with its aspect of climate change the indicator “greenhouse gas emissions” and the aim of “reduction by 21% in 2010 compared to 1990”.

[138] cf. United Nations Millennium Declaration, http://www.un.org/millennium/declaration/ares552e.pdf
[139] cf. UN Millennium Project, http://www.unmillenniumproject.org/goals
[140] cp. Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit: Nationale Nachhaltigkeitsstrategie “Perspektive für Deutschland”, http://bmu.info/files/pdfs/allgemein/application/pdf/nachhaltigkeit_strategie.pdf

3. Procedures for assessing the sustainability of products

To evaluate products in terms of sustainability two basic approaches can be distinguished:

1. The exclusive evaluation of a product from an ecological point of view, or
2. Integrated processes, which also consider the economic and social aspects.

For both approaches widely used methods are presented in the following chapter.

3.1. Methods for ecological evaluation of products

3.1.1. Ecological Footprint

The in the early to mid-1990s developed concept of the ecological footprint[141] is used to determine our pictorial resource consumption. The biocapacity is measured in hectares (biologically productive area), which is permanently needed to provide resources for a person, household, region or even a state. This includes the manufacturing of clothing, food and energy resources needed as well as the areas required for the absorption and elimination of accumulated waste and the carbon dioxide emissions. The exact calculation methodology is described in Wackernagel, M. et. al.[142] .

The concept is based on a biologically productive area on earth of 8.3 billion hectares (global hectares), so the planet provides 1.8 hectares of biocapacity per person. Particularly in industrialized countries, the ecological footprint is much larger than the available biocapacity[143,144].

The concept of the Ecological Footprint can also be applied to an individual product, so that required resources for the production, operation and disposal of the product are taken as a basis for calculation. Instead of comparing the total available biocapacity, the comparative assessment is carried out by comparison of similar products with the general aim of the smallest ecological footprint possible.

The concept of ecological footprint, however, has to be criticized. For example the use of non-renewable energy is not adequately taken into account, no other pollutants then CO_2 are considered (e.g. greenhouse gases, chemicals, heavy metals) and the use of nuclear energy is not integrated into the assessment.

3.1.2. Ecological Backpack

The 1994 developed model of the ecological backpack[145] takes - similar to the Ecological Footprint – into account the amount of resources that are needed for the production, use and disposal of a product or service. The amount of consumed resources and energy for a product is shown in form of a weight, which illustrates the ecological backpack of the product. By comparison of the actual product weight to the weight of the ecological backpack a factor is created, which can at least approximately describe the required efforts for the product, particularly in comparison to similar products.

A disadvantage of this concept is among other things that not all required resources are considered and the resulting environmental impacts are partially mapped inadequate (e.g. pollutants).

[141] cp. Wackernagel, Mathis, und William E. Rees: Our Ecological Footprint: Reducing Human Impact on the Earth, Gabriola Island: New Society Publishers, 1996

[142] cp. Wackernagel, M., Monfreda, C., Moran, D., Wermer, P., Goldfinger, S., Deumling, D., and Murray, M.: National Footprint and Biocapacity Accounts 2005: The Underlying Calculation Method, Global Footprint Network, Oakland, California, 2005. http://www.footprintnetwork.org/download.php?id=5

[143] cp. Global Footprint Network. http://www.footprintnetwork.org

[144] cp. WWF: Living Planet Report 2006. http://www.footprintnetwork.org/download.php?id=303

[145] cp. Schmidt-Bleek, Friedrich und Bierter, Willy: Das MIPS-Konzept, weniger Naturverbrauch - mehr Lebensqualität durch Faktor 10. München: Droemer Knaur, 1998

3.1.3. Life Cycle Assessment

The Life Cycle Assessment (LCA) systematically analyzes the effects of a product to the environment. Therefore, all environmental impacts during the raw material extraction, manufacturing, transportation, use and disposal of a product are included.

The construction of an LCA is governed by ISO 14040[146] and includes the following elements:

- Definition of goal and scope
- Inventory analysis
- Impact assessment and
- Evaluation

The definition of goal and scope establishes what the ecological balance should be used for and defines benefits and features as well as the basic life cycle of a product. The inventory analysis quantitatively describes the product life cycle, the resources and energy consumption, the emitted pollutants and the waste produced. The results of the LCA are then divided into impact assessment or impact categories (e.g. greenhouse effect, ozone formation) and converted quantitatively into environmental impacts caused by the product. For the quantitative evaluation different methods are existent, e.g. the method of the ecological scarcity[147] or the Eco-Indicator 99[148]. Finally the evaluation identifies important aspects for the result and a report with conclusions and recommendations is generated. The result of an LCA study is still highly dependent on the initially set target and should not be regarded isolated.

3.2. Integrated processes for evaluating products

3.2.1. Product Line Analysis

In the product line analysis[149] - just as in the Life Cycle Assesment - products throughout the entire life cycle regarding raw material extraction, manufacturing, transportation, use and disposal are investigated. However, in addition to the ecological aspects, economic and social dimensions are taken into account. As within the LCA, different, non-prescribed procedures may be used. A verbal evaluation is possible, especially for economic and social aspects. Similarly, the weighting of the criteria is part of the user.

The product line analysis can be used to compare different variants of a particular product or different production methods, with the aim of finding the ecologically, economically and socially mostly acceptable alternative. Since all target dimensions of sustainability are considered, the "Product Line Analysis" can be described as potentially good, when using appropriate indicators to assess sustainability.

However, the "Product Line Analysis" can be criticized, especially because of the time and cost required for its implementation and the lack of comparability of the results due to the free choice of criteria and weighting[150].

3.2.2. Criteria System Sustainable Agriculture CSSA

For the field of agriculture, a concrete system of indicators to assess sustainability was developed by the Thuringian State Institute for Agriculture (TSIA), which will be presented, because of its completeness and practical applicability[151].

The "Criteria System Sustainable Agriculture" (CSSA) starts with the assumption that load limits for agriculture are existent inside the system, within which the economic success must be

[146] cp. International Organization for Standardization: ISO 14044: 2006 - Environmental management- Life cycle assessment - Requirements and guidelines, 2006

[147] cp. Frischknecht, R.; Steiner, R.; Jungbluth, N.: Ökobilanzen: Methode der ökologischen Knappheit - Ökofaktoren 2006. Bern: Bundesamt für Umwelt (BAFU), 2008

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[149] cp. Projektgruppe Ökologische Wirtschaft (Hrsg.): Produktlinienanalyse: Bedürfnisse, Produkte und ihre Folgen. Köln, 1987

[150] cp. Fromm, E.; Kratochvil, R.; Lindenthal, T.; Milestad, M.; Brunner, P.H.: Nachhaltigkeit erkennbar und planbar machen. Beitrag zum 2. SUSTAIN Bericht "Umsetzung nachhaltiger Entwicklung in Österreich", 2000

[151] cp. Breitschuh, Gerhard, und Eckert, Hans: „Kriteriensystem Nachhaltige Landwirtschaft." In Landwirtschaft und Landschaftspflege in Thüringen - Heft 8/2006, 10-27. Jena: Thüringer Landesanstalt für Landwirtschaft, 2006

sought. Inside this system of criteria, these load limits are regarded as corporative determined (ecological and social) tolerance ranges (goals) in form of a framework. Within this framework the agricultural enterprises can operate freely; so the companies are granted with action and freedom of choice, i.e. means and actions to achieve these goals are not specified.

In CSSA economic, ecological and social sustainability are treated equally. For this purpose all criteria of the three sustainability dimensions are evaluated using the same framework of measurement: a so-called rating 1 corresponds to optimal ensurance of sustainability, rating 6 corresponds to the tolerance level of sustainability and at rating 10 sustainability is highly endangered. A weighting is not used, because this is dependent on individual preferences and ideological subjects. The goal is a positive overall picture. In the case of competing goals between ecology, economy and social means a responsibly considered consensus has to be found.

The clear representation of the evaluated criteria with a rating can be done by means of a "spider assessment" (see Figure Nº 16). All criteria for which data is entered on the rating-scale from one to ten lead to an overall picture of sustainability in business. The in the CSSA applied criteria and indicators regarding the field of ecology have already been tested extensively[152], while the dimensions of economy[153] and society[154] have still to be tested and improved. The criteria sets are precisely tailored to the area of agriculture. To apply the criteria for individual products, the criteria have to be adapted and generalized.

3.2.3. Sustainability label for products

In her dissertation, Dr. Ulrike Eberle engaged with the creation of a sustainability label for products, which takes into account the environmental, the economic and the social dimension of a sustainable product[155]. The paper deals with the problem that consumers are not clearly informed about what sustainable products are and how to recognize and distinguish them from other products. A possible tool to solve this problem is the identification of sustainable products by using a sustainability label, which should support the customer within the purchase decision.

Besides the design, designation and marketing campaign of such a label, the dissertation deals with the organizational aspects and the criteria for awarding. According to Eberle it is most important, that – in contrast to already existing labels – this label shall be process-oriented. This allows a continuous measurement of sustainability over the whole product life cycle. Eberle identifies the following levels for the development of sustainability criteria (Eberle, 2001):

- Cross-product level: ecological, social and economic criteria for all products and product groups are equally valid.
- Product-specific level: product-specific environmental, social and economic criteria on global, national and local level. In addition, target group-specific aspects, product benefits and megatrends concerning the product.

The definition of concrete criteria for a sustainability label is regarded as a task for different groups of actors and is therefore not part of the dissertation, but appropriate proposals are made.

On the cross-product level resolutions of various international conventions (e.g. ILO conventions, environmental agreements) are proposed as possible criteria. In addition, fair trade structures are considered as an important criterion for the cross-product level (e.g. criteria of the “TransFair” label). For the product-specific level possible criteria categories are named, which have to be tested for each product concerning their relevance (Table Nº 12). On this basis, the identification and prioritization of product-specific criteria and the assessment are executed, e.g. by using the product line analysis.

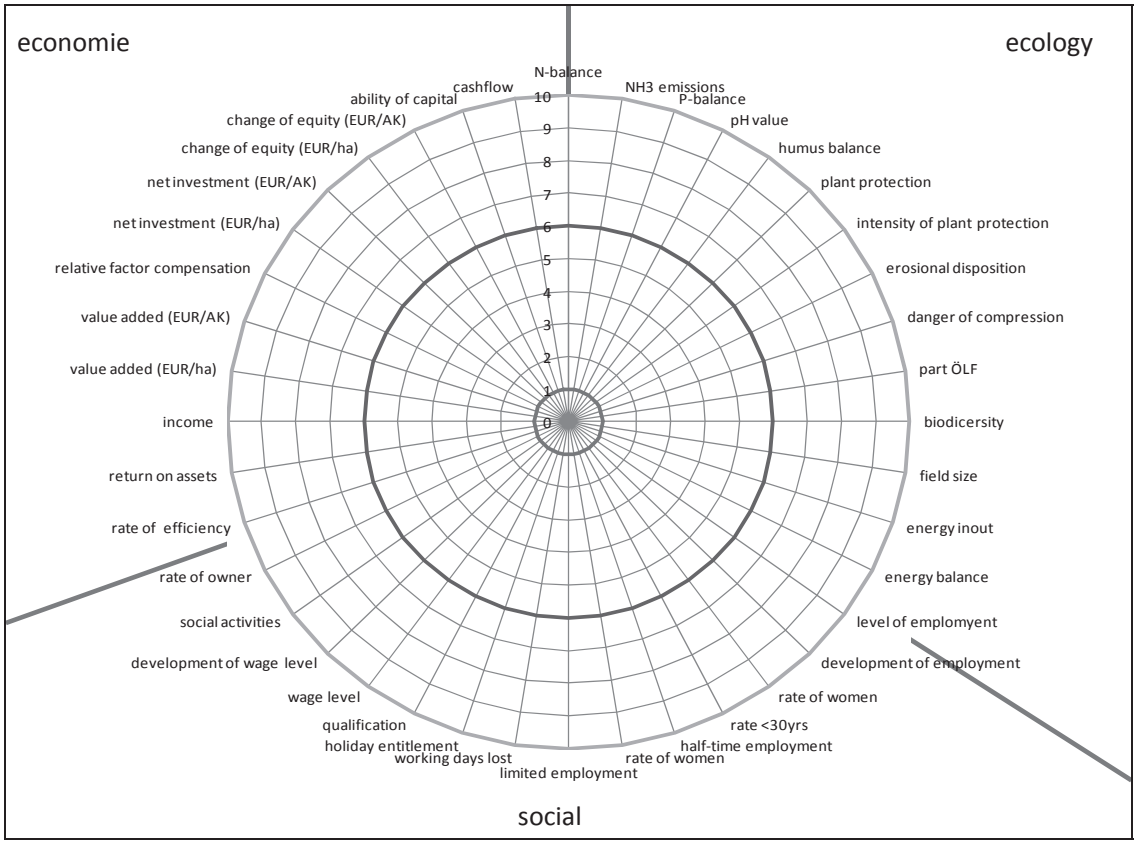
[152] Eckert, H. „Umweltverträglichkeit - Kriterien, Toleranzbereiche und Ergebnisse.“ In Landwirtschaft und Landschaftspflege in Thüringen - Heft 8/2006, 35-51. Jena: Thüringer Landesanstalt für Landwirtschaft, 2006

[153] Bachmann, Dietmar. „Ökonomische Nachhaltigkeit - Kriterien, Toleranzbereiche und Ergebnisse.“ In Landwirtschaft und Landschaftspflege in Thüringen - Heft 8/2006, 28-34. Jena: Thüringer Landesanstalt für Landwirtschaft, 2006

[154] Vgl. Matthes, I. „Kriterien sozialverträglicher Landwirtschaft.“ In Landwirtschaft und Landschaftspflege in Thüringen - Heft 8/2006, 52-65. Jena: Thüringer Landesanstalt für Landwirtschaft, 2006

[155] cp. Eberle, Ulrike. Das Nachhaltigkeitszeichen: ein Instrument zur Umsetzung einer nachhaltigen Entwicklung? Freiburg: Justus-Liebig-Universität Giessen, FB 09 Agrarwissenschaften, Ökotrophologie und Umweltmangement, 2001

Figure Nº 16



Source: Breitschuh, 2006

Table Nº 12

Ecology
▪ Protection of the atmosphere: greenhouse effect, ozone layer ▪ Protection of land resources ▪ Protection of forests ▪ Protection of fragile ecosystems: arid zones, mountain regions ▪ Protection of biodiversity ▪ Protection of oceans and coastal areas ▪ Protection of freshwater resources ▪ Environmental management of toxic chemicals ▪ Sustainable agriculture: fertilizers, pesticides ▪ Sustainable waste management: solid and liquid waste, hazardous waste, radioactive waste
Social
▪ Protecting and promoting human health ▪ Freedom and development opportunities: collective rights, in-house participation opportunities, equal payment for equal work
Economy
▪ Changing consumption patterns: resource/material consumption, energy consumption, use of renewable energy sources

Source: Eberle, 2001

4. Conclusion

In this paper indicators for a sustainable development were presented, which were defined by the United Nations (CSD indicators, MDG indicators) and the Federal Government of Germany (National Strategy for Sustainable Development). These indicators are a valuable basis for the evaluation of products in terms of sustainability.

The evaluation methods of the „Ecological Footprint" and the "Ecological Backpack", which are just focused on ecological aspects rather serve for raising the awareness than for evaluating and analyzing sustainability. The concept of the LCA, however, is – compared to the former methods - better suitable for a complete assessment of environmental sustainability. Within the product line analysis the concept is enlarged by the economic and social aspects. But all methods leave the choice and weighting of the evaluation criteria to the user.

Within the Criteria System Sustainable Agriculture (CSSA) a complete set of criteria for all three target dimensions with a uniform rating scale for evaluation is presented. But the system is specialized to the area of agricultural enterprises.

The also presented concept of a sustainability label is a comprehensive and universal framework for assessing the sustainability of products. However, it illustrates the problem that the sustainability assessment must always be carried out on basis of product or product group specific criteria as well as on global, national and local levels. Therefore the definition of appropriate criteria is connected with great efforts and impedes the comparability of different products and product groups.

One possible approach would be the combination of the sustainability label and the CSSA-concept, to get a clear and user-friendly presentation of evaluation criteria, consisting of ratings to obtain a “spider assessment”. The specific criteria and categories of criteria, however, have supposedly to be chosen on basis of product (group) specifications. Although a compressed representation of values (e.g. for criteria of categories) would be possible.

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Section Three

Logistic Systems and Transport Organization in selected Countries of European Union and MERCOSUR

Chapter 9

The polish Transport, forwarding and logistic Market (TFL) and Requirements of Sustainable Economic Development

Mariusz Jedliński[156]

1. Introduction

Undoubtedly, the geopolitical world presents a serious approach to global warming, which was proved by a peace Noble prize awarded to Al Gore in 2006 and Intergovernmental Panel on Climate Change (IPCC). This was yet another very important signal of growing global environmental awareness which increasingly often forces various sectors, including transport, forwarding and logistics in Poland, to take more decisive steps aimed at finding efficient and cost effective solutions reducing emission of greenhouse gas. Unfortunately, the single largest contributor to those changes, accounting for 50% of the greenhouse effect is carbon dioxide, which to a large extent is a by-product of transport and logistics. For this reason, the issue of green logistics is more frequently discussed. It is generally accepted that the main goal is to measure and reduce negative impact of overall logistic activity on ecology (*Greek oeicos* – house and *logos* – science).

The main inspiration for the paper originates from H.Ch.Pfohl, who said 'the goal of logistics is to ensure economic and ecological flow which provides for time and space transformation' [H.Ch.Pfhol, 2002].

2. Supporting global process of sustainable economic development

Previous environmental effort of the international community began with the Earth Summit in Rio de Janeiro in June 1992 and its Declaration on the Environment and Growth, continued during the Kyoto Conference in December 1997 which produced the Protocol to the Framework UN Convention on Climate Changes, World Sustainable Development Summit in Johannesburg that was crowned with the Declaration on Sustainable Development in September 2002, and led to the latest World Summit in Copenhagen in December 2009 which unsuccessfully aimed at developing a follow up to the Kyoto Protocol. The world faces another serious dilemma, namely politicians need to commit to fighting economic crisis and continuing environmental programmes.

Therefore, in 2012, assessment of the progress towards Rio de Janeiro goals will be very important. Rio +20 is going to be a special opportunity to revise previous targets and propose new directions for developing the environmental protection, including an International Environmental Governance, which undoubtedly should contribute to intensified global effort towards environmental protection. Poland during its EU presidency, which ended on 31.12.2011, made every effort to support the EU dialog to develop common EU proposals for the World Summit in 2012. Globally all those activities, however, aim at finding a balance between desired technological advancement and conservation of the natural environment. The term of 'sustainable development' was first used in a report of 'Our Common Future' developed by the World Environment and Growth Commission headed by Gro Harlem Brutland in 1987 and later in Agenda 21. It was the effect of work started with the Declaration of the UN Conference on the Human Environment adopted in Stockholm on 16 June 1972 r. [Encyclopaedia, PWN, 2010]. It is a declaration confirming that rights to meet development aspirations of the current generation cannot constrain rights of future generations to meet their development needs. Thus, the eco-

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nomic and civilization development of the current generation should not be based on uncontrolled abstraction of non-renewable resources and destruction of the environment. Contrary, it should guarantee future generations that they will enjoy similar rights and adequate opportunities for their development. Therefore, it is not important that from the economic point of view economic growth leads to increased real value of the gross domestic product (GDP) or increased real value per capita in a given period, since 'sustainable economic growth' involves both variable endogenous factors (e.g. growth of labour, productivity, capital outlays, employees' knowledge and experience) and exogenous factors (e.g. technological i organizational advancement [innovation], changes in allocation of resources in the economy, legal, cultural and social changes, access to natural resources) produce identical growth rates.

For this reason, still in May 1990, ECE countries held their regional conference to assess a period of five years from publishing the UN Report: Our Common Future. During the conference the previous term of 'sustainable development' was replaced with 'sustainable economic growth'. [United Nations Report: Our Common Future, 1987].

Also in Poland, one may notice a very strong trend towards protecting the environment. It is worth mentioning that the Polish Environmental Law of 31 January 1980 [JoL no. 94.49.196] introduced the term of 'sustainable development' as a socio-economic development aimed at providing adequate access to the environment for particular societies and their citizens – for the then and future generations – and integrating political, economic and social efforts to preserve natural balance and durability of basic natural processes. The Resolution of the Polish Parliament of 10 May 1991 on ecological policy uses the term of 'eco-development' or indirectly 'sustainable development' to describe necessity to subordinate needs and aspirations of a society and the state as regards environmental capacity. It was a clear signal that in the economic policy ecological criteria became equal to economic ones [Monitor Polski, 1991]. Thus, in politics and economics people started using a term of 'ecological space' which defined the capacity of renewable and non-renewable resources and absorption capacity of the environment for humankind (globally), races (at particular continents), nations (in particular countries) and local communities. The notion of 'sustainable development' has been defined in a similar manner in Poland. According to the Sustainable Development Strategy for Poland until 2025, it means such a model of development that meets current social needs as well as those of future generations treated at equal footing. It should be emphasised that the Polish Constitution adopted in 1997 in its Article 5 also specifies that 'the Republic of Poland guards independence and integrity of its territory, ensures freedom and human and citizen rights as well as safety for its citizens, guards national heritage and protects the environment following the principle of sustainable development'. Thus, all socio-economic processes and activity (including strategies, programmes and economic and social development plans, as well as plans for protecting environment and natural resources) should be integrated and mutually linked with objectives, tasks and implementation instruments, and fit into a single strategic sustainable development. [Constitution of the Republic of Poland, 1997]

The European Union adopted important regulations concerning renewable sources of energy, chiefly included in the White Paper: *Energy for the Future. Renewable Sources of Energy* of 1997 and the Green Paper: *Towards European Energy Security Strategy of* 2000, which were followed by directives and detailed annexes. As regards transport, the Green Paper of 2009: *Towards Better Integrated Trans-European Transport Network for the Common Transport Policy*, clearly states that the Trans-European Transport Network (TEN-T) should guarantee that transport services generate the best results due to integrated and innovative infrastructure following technological advancement in sectors of energy, infrastructure and vehicles. Additionally, we should emphasize the withdrawal from the idea of 'priority projects' within 'transport corridors, and move towards the idea of 'priority networks', which provide for more methodical integration of nodes as the main source of bottlenecks and other capacity barriers as well as seaports and airports as entry points in the networks and main intermodal links comprising a basis for tight integration of the networks. The geographically defined priority network should ensure continuity of current priority projects and, wherever justified, they should be treated as a basis for further activities.

It seems, however, that in the economic approach to the issue of ecology we should pay more attention to that fact that in recent years two phenomena became particularly visible, namely 'politicizing' of global economic issues, and growing 'economization' of numerous processes in politics. Additionally, we have observed one more paradox, namely clear privatization of 'profit' and at the same time progressing socialization of 'cost'. Undoubtedly, these phenomena do not support an appropriate compromise, so much needed for efficient and effective sustainable economic development.

The Communication of the Commission (2006) 0336 to the European Parliament on 'Logistics of freight transport in Europe – key to sustainable mobility' *emphasized the fact that efficient freight logistics as an integral part of the EU transport system is necessary for economic efficiency and competitiveness, optimum use of resources, job creation opportunities, protection of the natural environment and improved security and safety. The sector of logistics itself plays a key role in social, economic and territorial cohesion and better integration of peripheral regions in the enlarged EU. Considering expected growth of freight transport by about 50% in 2000-2020, the role of logistics in creating efficient, sustainable, accessible and safe system of transport is going to increase. The Commission recognized the significant impact of logistics on the environment, since the sector of transport is responsible for 20% of primary energy consumption in Europe, a consumption of which 98% is based on fossil fuels.*

The meeting of the European Council of 9 March 2007 adopted the following conclusion of the presidency [COCL 1 7224/07]:

- Reduction energy consumption in the EU by 20% in relation to the expected consumption in 2020,
- Until 2020 reduction emission of greenhouse gases by at least 20% in relation to that of 1990,
- Implementation of a binding goal of 20% share of renewable energy sources in the total EU energy consumption by 2020,
- Implementation of a binding goal of 10% share of bio-fuels in the total petrol and Diesel oil consumption in EU transport by 2020.

Considering the above, the transport, forwarding and logistics sector needs to contribute to the implementation of the set goals. To achieve this, it is necessary to improve the sector's efficiency. Since the position of logistics in freight transport is significant, it may play a key role in supporting efforts aimed at reducing CO2 emission and implementation of other goals, and in combination with other measures it may seriously contribute to reducing negative impact of climate changes. Reducing the green gas emission and dependence on fossil fuels are some of the main goals of the European Union, together with establishing a single market in the EU and globalization of trade lead to rapid development of the sector of transport and logistics and increased its economic significance. Freight transport in the EU grew by 28% in 1995 - 2004 (measured in billion tonkilometers), and the increase has surpassed the growth of the gross domestic product.

It is remarkable that on 16-18.05.2012 LOGISTICS, the 11th Polish Logistic Congress will be held, which is the largest logistic event in Poland and Central and Eastern Europe. The main theme of the congress is 'Sustainable logistics – man-environment-economy' [www.ptl.pl]. It is yet another proof that managing a supply chain is one of key elements contributing to sustainable development. Of course, the effort made by Polish companies to meet priorities of sustainable development is the stronger, the larger expectations and needs are among stakeholders (e.g. clients, suppliers, employees, local communities). Therefore, it is necessary to focus business thinking on benefits derived from sustainable economic growth, so all activities comprise a holistic approach – from preparing new products, processes, technologies, to creating new business models.

The main problem in the EU, however, is excessive use of road transport accompanied by insufficient use of cargo space in vehicles (The Report on Supply Chain Decarbonization). The Role of Logistics and Transport in Reducing Supply Chain Carbon Emissions of the World Economic Forum 2009 indicates that as much as 24% of vehicles make trips without cargo, the overall efficiency is 43%, and the average use of cargo space is as little as 57%. Additionally, according to Eurostat, the number of cars coming back empty increased from 25% (2007) to 27% (2009). Thus, it is important to support inter-operational transport and change of unfavourable proportions between road and rail transport. The optimization of supply chains should include their efficiency, effectiveness and larger sustainability.

3. Polish transport policy

Objectives of the Polish transport policy influence parameters of the transport system model to contribute to sustainable development of the country. Unfortunately, previously observed trends indicate that the system of transport in Poland heads towards larger congestion, reduced safety and excessive emission. It is particularly dangerous, since based on experience of other countries of higher development of road transport and analysis of specific Polish conditions (relatively low GDP), desired macro changes of logistic processes become particularly important, which is related to flow of goods in space and time satisfactory for clients.

Table Nº 13: SWOT Analysis of the Polish transport infrastructure [2010]

	Positive qualities	**Negative qualities**
Current	**STRENGTHS:**	**WEAKNESSES:**
	▪ large resources and potential of existing networks, ports, terminals and nodes ▪ existing full range of modal and technical forms of infrastructure ▪ favourable topographic conditions (no major natural barriers) ▪ location at cross roads of European transport corridors ▪ clear system of management of particular types of infrastructure	▪ major deterioration of line and point elements of infrastructure ▪ bottlenecks and missing links in network ▪ disparities in regional network distribution and accessibility ▪ lack of network adjusted for high speed traffic ▪ lack of continuity of technical class of links between agglomerations ▪ weak modules integrating various types of networks ▪ burdensome numerous elements of network for settlements and natural environment ▪ insufficient elements of intelligent and innovative networks

	OPPORTUNITIES:	THREATS:
Future	▪ creating links increasing international transport accessibility of Poland ▪ reaching good technical status of whole infrastructure between Polish agglomerations ▪ creating cohesive network of motorways and expressways ▪ creating seed of high speed railway system ▪ intermodal integration and European interoperability of networks ▪ elimination of missing links in regional and local networks ▪ completion of bypasses of cities and towns within international and national networks ▪ supplementing traditional networks with intelligent and innovative transport networks ▪ new sources of financing for infrastructure	▪ existing barriers continue to hamper implementation of strategy for modernizing infrastructure ▪ growing risk of natural disasters resulting from climate changes ▪ lack of long-term effects of modernization of networks due to its premature deterioration ▪ ecological community imposes stringent requirements on infrastructure projects ▪ disregarding major global trends in developing transport infrastructure ▪ creating modern competitive infrastructure facilities in neighbouring countries ▪ reduced access to EU grants in new programming period after 2013.

Source: J. Burnewicz, 2010

Table Nº 13 includes SWOT analysis of the Polish transport system. It includes strengths and weaknesses considered as internal qualities of the current system of infrastructure, and opportunities and threats as internal qualities of the future status; elements that may change due to internal as well as external factors (macroeconomic, European, global, social, ecological, technological and others). They seem to form a basis for creating a strategy for developing transport infrastructure regarding its use to intensify development processes in the economy.

For this reason, based on Polish transport policy objectives, three possible scenarios were determined for development of the transport system in Poland (Objectives of State Transport Policy in 2000-2015, 1999).

Continuation of previous trend, which foresees increase in road traffic is compared to growing number of vehicles, and at the same time further decrease in rail transport. This scenario should be rather considered irrational due to significant capital consumption while implementing and high operating and external costs. At the same time, previous experience of EU member states shows that such a model leads to growing congestion mainly in cities and necessitates temporary measures without effects at the macro scale. Negligence of systems, such as rail, waterway, pipeline, has become every evident and worsens the economic status of those modes. The scenario generates additional investment cost (rolling stock) and operating cost for operators, and for the public budget the necessity to invest in various transport systems without guarantee of their rational use (particularly negative for rail). Preventing such development requires, however, intensive effort in allocating public funding, legislation and fiscal policy, as well as methodical restructuring of the Polish rail.

Modified development, a scenario which is based on principle from the continuity scenario and adoption of Western European trends in developing the automotive sector and equipment, although with more realistic approach to financing capacity for such investment. This scenario may lead to further disproportions in development if compared with the preceding scenario, since it generates unjustified consumption expectations and at the same time lacks possibilities to meet such expectations using public funding. In the Polish context, it is extremely evident due to the fact that the development of road transport is much larger in relation to GDP than it was in a corresponding period in EU member states (on average, twice as many cars in relation to GDP). It seems that in order to prevent this scenario it is necessary to carefully allocate accession funding and broad measures focusing on restructuring the Polish rail.

Sustainable model of transport system is a scenario which seems the most desirable, since it implements the constitutional principle of maintaining balance between economic, environmental and social factors in relation to transport. On the one hand, it means ensuring an efficient, safe, economically justified system supporting employment in the national economy, and on the other, it does not distort balance in the natural and cultural environment, or provides for preserving non-renewable resources and accepted standards. It is evident that a factor influencing transport behaviour among citizens and companies is the cost (including external cost). Therefore, the supply of infrastructure needs to take into consideration equal distribution of 'traffic freedom' and possibility of choosing a mode of transport. Thus, a major task for the public administration is to influence such behaviour by spatial planning, appropriate allocation of public funding and introducing stable market regulatory measures. The implementation of the scenario will require major organization, legislative and education effort and promotion. Of course, the scenario should also include efficiency and competitiveness and linking of the Polish and European transport systems. It is worth mentioning that the European Union does not intend to reduce mobility, but to introduce a mechanism promoting the development transport with due respect to the natural environment as well as socio-economic situation.

Economic practice shows that the transport market in Poland is exceptionally dynamic. Changes of cargo handling in recent 20 years in Poland by major modes of transport are presented in Table Nº 14.

Table N^{o} 14: Cargo handling by mode of transport

Modes of transport	1990	1995	2000	2005	2008
000 tonnes					
Rail transport	281,658	225,348	187,247	269,553	248,860
Road transport	1,292,358	1,086,762	1,006,705	1,079,761	1,339,473
Pipelines	32,995	33,353	44,342	54,259	49,029
Sea shipping	28,477	26,019	22,774	9,362	10,447
Million tonkilometers					
Rail transport	83,530	69,116	54,448	49,972	52,043
Road transport	40,293	51,200	75,023	119,740	174,223
Pipelines	13,887	13,493	20,354	25,388	21,247
Sea shipping	207,429	166,048	133,654	31,733	30,279

Source: J.Barcik, P.Czech, 2010

The structure of cargo handling presented is determined by the current status of transport infrastructure and unfortunately uneven distribution of loads. Considering the above, we should state that the Polish road infrastructure remains still one of the weakest links of the sub-systems of the Polish economy. Additionally, Table Nº 15 presents excessive growth of load in the Polish road network by number of vehicles.

Table Nº 15: Excessive increase in load in Polish road network by number of vehicles

Year	Absolute figures			
	Total hardened roads (000 km)	**Motorways and expressways (km)**	**Road vehicles (million pcs)**	**GDP in fixed prices of 2005 (PLN million)**
2000	250	518	14.1	832 814
2001	248	536	14.7	841 975
2002	250	607	15.5	853 762
2003	249	605	15.9	887 059
2004	252	754	16.7	934 073
2005	254	755	16.8	967 700
2006	256	867	18.0	1 027 697
2007	259	993	19.5	1 097 581
2008	261	974	21.3	1 152 460
2009	269	1065	22.0	1 172 052
Increase in 2000-2009	19	546	7.9	339.238
Year	**Annual increase in %**			
	Total hardened roads	**Motorways and expressways**	**Road vehicles**	**GDP in fixed prices of 2005**
2000				
2001	-0.61%	3.54%	4.38%	1.10%
2002	0.80%	13.17%	5.44%	1.40%
2003	-0.60%	-0.33%	2.41%	3.90%
2004	1.40%	24.53%	5.04%	5.30%
2005	0.60%	0.15%	0.69%	3.60%
2006	0.69%	14.92%	7.25%	6.20%
2007	1.32%	0.27%	7.97%	6.80%
2008	0.90%	12.02%	9.58%	5.00%
2009	2.90%	9.28%	3.22%	1.70%
Increase in 2000-2009	7.60%	105.47%	56.13%	40.73%

Source: Diagnosis of Polish Transport (status of 2009), 2011

Considering the above, It seems that a method for reversing unfavourable trends is to promote solutions supporting reconfiguring of existing supply chains, which should enable increasing the share of rail transport and better use of road vehicles capacity. Certain solutions adopted in Poland in the form of single projects (Swedish IKEA and German BSH), undoubtedly support this solution.

The activity of rail transport operators in Poland should focus on gaining competitive advantage thanks to the following (I.Nowak, H.Zielaskiewicz, 2009):

- Wider share in supply chain,
- Creating logistic centres and organizing loading hubs and logistic services as well as modern container terminals,
- Modernizing and investing in railway rolling stock and modern technologies,
- Adding new logistic products to those already offered, and
- Ensuring high level of logistic service for the client.

To implement the above, it is necessary to separate transport infrastructure and operation. So far, however, in the case of rail and other sectors of the economy there is no proof that this solution is good. The position of the European Commission is clear, since it believes that separating infrastructure from operation is even mandatory in member states. It results from the attempt to eliminate discrimination of smaller operators in their access to infrastructure and enhance competitiveness. Thus, in the coming two years, Poland is expected to finalize the elaboration of the law separating rail infrastructure from the Polish State Railway.

4. Influence of macroeconomic situation on the status of transport, forwarding and logistic market in Poland

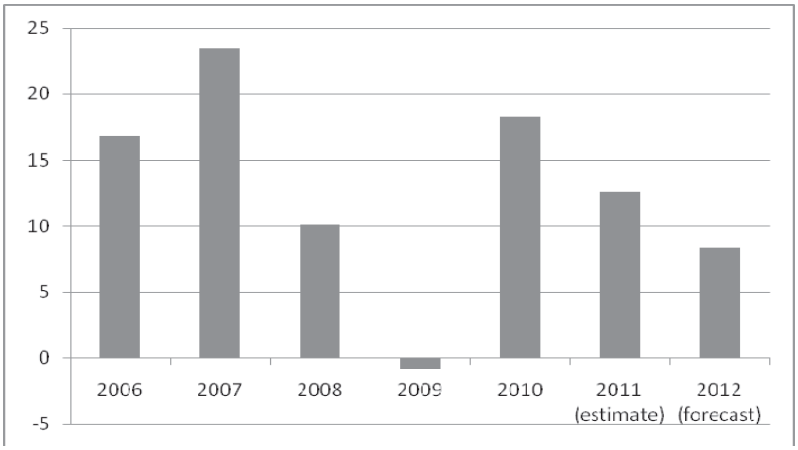
At the moment, despite global crisis, Poland with its 4% GDP growth enjoys a very good situation among other EU member states. In 2011, Polish Zloty lost to Euro 13% and even the intervention of the National Bank of Poland on the currency market (EUR150-200 million were quickly absorbed by the Polish economy) to countervail the depreciation of the Polish currency (4.47 to EUR) improved PLN exchange rate only for a while (increase by PLN0.03). The larger problems in the Euro Zone, the more eager are investors to sell Polish currency and bonds. Moreover, the weaker the Polish Zloty, the stronger is the risk that public debt in Poland exceeds the constitutional cap of 55% (part of debt is in foreign currencies). Therefore, keeping the PLN under control is particularly important from the point of view of the Polish economy. It should be emphasized, however, that the relationship between debt and GDP remains under influence of economic growth and debt of local governments, and although weakening of the Polish Zloty poses a risk of higher inflation (4.3% in December w 2011), there is a positive side of it, since the Polish export becomes more profitable. Already in 2009, weakening of the Polish Zloty helped avoiding recession, since Polish goods became more attractive for foreign clients. The Polish Chief Statistical Office (GUS) stated that export from Poland to Germany (3 quarters of 2011) increased by 14%, and import by 15%, which created a unique opportunity for developing intermodal transport [GUS, 2011]. For this reason, Polish freight rail operators improved their position on the European market. For example, PKP Cargo has a licence for independent operation in Germany, Czech Republic, Slovakia, an very soon also in Austria, to further expand to other countries, such as Belgium, Hungary, and the Netherlands (the latter in particular to develop services between Rotterdam and east of Poland).

This development is possible since the Polish rail transport market is the most liberalized in Europe, and the share of private operators is growing every year. An alternative to further development of freight rail transport is international and long distance transport, and a particular challenge for private operators was the opening of the EU freight rail transport market on 1.01.2007. According to information from the Rail Transport Office for three quarters of 2011, Polish rail transport companies handled nearly 187 million tonnes of cargo and generated over

40 billion tonkilometers. Therefore, in comparison with corresponding period of three quarters of 2010, it was an increase by respectively 8.4% and 13.4%. The main factor contributing to the growth was the increased demand for construction materials used for road building in Poland. In the same period, intermodal transport involving rail transport increased significantly to 340 thousand km (30% more than in preceding year) [www.wnp.pl].

This favourable situation highlighted opportunities for the rail sector to change adverse proportions against road transport. However, a report by Data Group Consulting (DCG) of December 2011 forecasts a decline in growth of sales in the whole transport, forwarding and logistic sector in Poland. In the group of forty logistic companies surveyed, a group which was selected to reflect proportions between large, medium and small companies, representing various specialist fields, the decline was from 18.3% in 2010 to 12.6% in 2011.

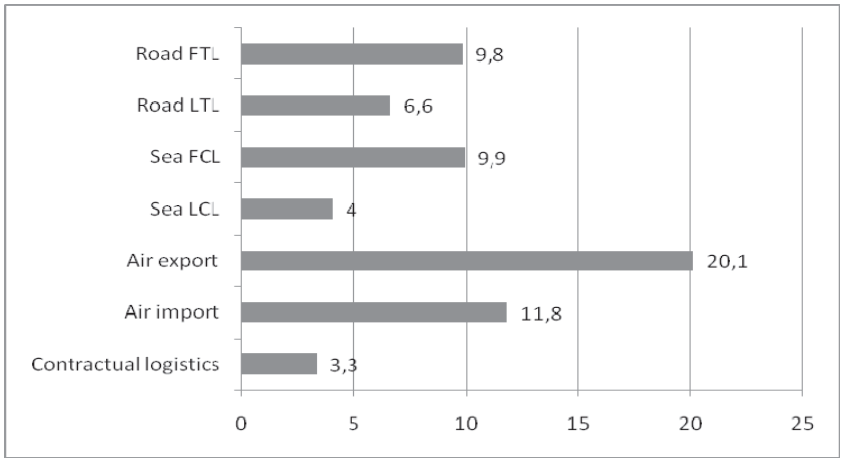
Figure Nº 17: Changes of sales in logistic sector in comparison to previous year (October 2011, N=40)



Source: Data Group Consulting, Logistic Operator of 2011, 2011

The 2012 forecast suggests further decrease in sales to as little as 8.3% (Figure Nº 17). Due to growing competition, the market position of leading companies, which was still large during the economic downswing, surprisingly weakened during a period of increased demand. Additionally, sales forecast included in the DCG report indicates modal split (Figure Nº 18).

Figure Nº 18: Forecast sales of logistic services in 2012 in comparison to previous year (October 2011, N=40)



Source: Data Group Consulting, Logistic Operator of 2011, 2011

In the context of the forecast, it seems that the main factor contributing to the appropriate operation of the transport, forwarding and logistic sector in Poland (TFL) is sufficiently modern transport potential marked by number and structure of modes of transport.

The Diagnosis of the Polish Transport (of 2009) by the Ministry of Infrastructure shows that the situation in the Polish road transport is very good, whereas the situation in other modes of transport is much worse. In the recent decade, growing importance of the Polish road transport in the European Union is based on the access to large fleets of vehicles, number of which is growing faster than the Polish GDP. The number of trucks in 2003-2009 increased from 2,192 thousand to 2,596 thousand (+18.4%). In 2003-2009, the total capacity of the Polish truck fleet increased by 24.5% (from 4.2 to 5.2 million tonnes), which is less than cargo handling (+123%). This means a significant improvement in productivity of a single vehicle which increased by 88.5% (from 39 to almost 74 thousand tkm annually). Thus, road hauliers could reduce cost of their activity on the EU market marked by tough competition between particular modes.

Although the average capacity of individual trucks increased slightly by mere 5.1% (from 1906 kg to 2004 kg), the number of trips with cargo increased significantly during a year by 25.5% (from 218 to 274), and the average distance increased even more (42.5% from 94 to 134 km), which is related to high internationalization of this mode of transport in Poland. The minor increase in the average truck capacity results from the fact that delivery vans of up to 3.5 t account for 40% of the total capacity of the fleet.

Nevertheless, the importance of large tonnage vehicles (above 10 tn) increased significantly. In 2003-2009, the share of 3.5 to 10 tn vehicles in the total capacity dropped from 42.3% to 34.8%, and in the case of vehicles exceeding 10 tn increased from 18.2% to 25.3%. It is a logical evolution of structure, since the sector of international transport which prevails in the market and which is the most efficient is large tonnage transport. Table Nº 16 presents SWOT analysis for the Polish TFL sector.

Since the European Commission focuses on improving energy efficiency in road transport, several innovative projects were implemented supporting the idea of sustainable development. In April 2010, the 'eCoMove' project was implemented suggesting intelligent solutions in this field. It is based on an assumption that a driver can reduce fuel consumption on a given route, and he travels on specially determined stretches of the road network with due care of the natural environment. It involves exchange of information between vehicles (car-to-car), infrastructure and centres using normalized interfaces. This broad flow of information should contribute to improved efficiency of traffic. Additionally, the project promotes Ecomove measures, reducing fuel consumption and producing desired benefits for the natural environment and transport economy. Another project of 'ecoTruck and Logistics' examines key elements of the transport system (planning of transport, implementation, analyzing and optimizing, driver training). A special role is played by the driver who influences the status of the vehicle and actually decides about fuel consumption**.**

Table Nº 16: SWOT analysis of business in Polish TFL sector

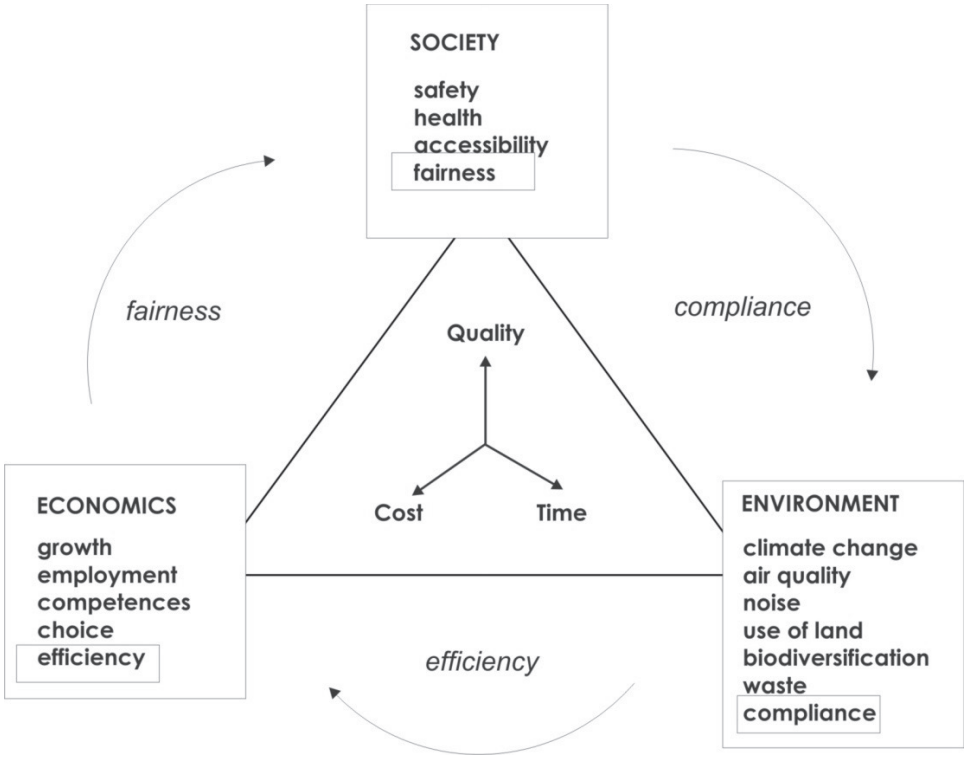
STRENGTHS	WEAKNESSES
▪ large and long-lasting demand for transport as a basis of stable operation of transport, forwarding and logistic companies ▪ large number of basic and auxiliary companies in land transport ▪ large number of people employed and high qualifications of staff in majority of companies ▪ large number and modern trucks ▪ efficient management of haulage ▪ companies and possibility to reduce cost ▪ liberalized transport markets and real competitive game	▪ asymmetry in demand for transport focused on road transport mainly ▪ antiquated means of rail and inland waterway. Low competitiveness on air and sea transport markets ▪ insignificance of air cargo transport ▪ poor quality of rail and bus passenger transport ▪ poor financial standing of TFL sector and large percentage of deficit companies ▪ large number of accidents, especially in road transport, but also rail, general aviation and waterway transport ▪ high burden for natural environment, in particular from road transport
OPPORTUNTIES	**THREATS**
▪ possibility to maintain or even strengthen position of Polish road hauliers on European market ▪ good demand and technological conditions ▪ growing interest among users in good quality public transport ▪ growing efficiency of measures applied to improve safety of transport ▪ strong intermodal and technological integration of transport system ▪ inflow of foreign capital strengthening potential and modernizing Polish transport	▪ insufficient funding for modernization of transport and logistics systems ▪ marginalization or elimination certain large Polish transport companies and operators from market ▪ inefficient measures reducing environmental burden from transport ▪ failure to stop rapid growth in number of individual cars ▪ tough competition on transport markets ▪ labour deficit in certain burdensome transport jobs ▪ further weakening of transit role of Polish transport system

Source: Diagnosis of Polish Transport (as of 2009), 2011

5. Conclusion

Summarizing, it is to state that the core issue for understanding contemporary logistics requirements in the context of the sustainable economic growth paradigm is the fact that it is based on an integrated approach to the triad of 'Economy-Society-Environment'. The main goal is to ensure efficiency between Economy and Environment, cohesion between Environment and Society and fairness between Society and Economy. Logistic activity necessitates compliance with the fundamental principle of the 'golden logistic triangle', including time-quality-cost. Therefore, contemporary requirements towards logistics boil down to acting faster, better, and cheaper on the transport-forwarding-logistic market (TFL). However, thus must take place with due respect for key elements of the triad of 'Economy-Society-Environment'. Economy includes development, employment (job creation), competences (quality), choice (available technique) and efficiency, whereas society includes safety (supplies), health (no harm), accessibility, fairness (equal footing), and finally the environment includes climate changes (counteracting), air quality (improvement), noise (reduction), availability (minimizing), bio-diversification (risk management), waste (reuse) and compliance. The idea of the comprehensive approach is presented in Figure Nº 19 below.

Figure N^{o} 19: Comprehensive model of logistics integrated with elements of sustainable economic growth



This means that the national system of transport should be used for mobility of goods and people according to principles of sustainable development policy of the state. The policy comprises the following factors: economic, social, environmental (ecological), and compliance with international requirements. Although the transport-forwarding-logistic market is an important element of the national economy, it should develop based on sound economic principles and market oriented policy of the central government and local governments. In Poland, despite relatively good geographical structure of the transport network, the current system includes deficiencies in supply in certain parts of the network, high operating and expanding cost and poor flexibility towards changes in demand. The implementation of an efficient and effective sustainable development policy that takes into account the concept of national spatial development policy is not possible without examining the impact of transport on its environment. Spatial, ecological and social aspects of the transport policy should be prioritized. An important instrument for implementing the above is a fiscal and pricing policy that follows the 'polluter must pay' principle and necessity to internalize external cost of transport.

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Chapter 10

Sustainable logistic in MERCOSUR

Alicia B. Giacchero[157]

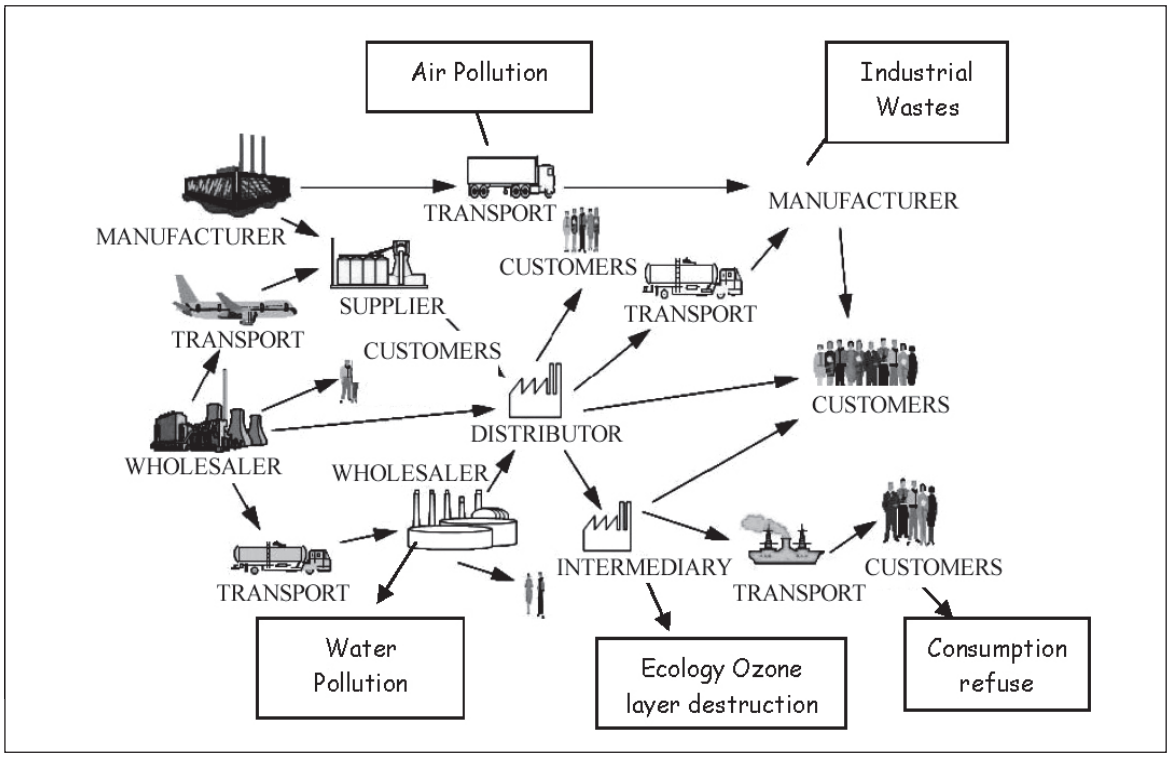
1. Introduction

The freight shift in Latin America in relation to other partners all over the world as well as within the different countries in this subcontinent is coming dynamic because its growing economies in the last time. These changes are quantitative and qualitative nature as well because the meaning for products quality coming from transport, storage and distribution of production; management of inputs and raw material. This approach means a new modern concept of freight logistic in order to reach a more efficient organization within the supply chain.

2. From scraped to integrated logistic

The minimization of transport costs means minimization of logistic costs, which yields a new supply, production and distribution structure. The changes from one scraped to other integrated logistic produces a deeper environmental awareness. It is necessary to take account of the environmental changes and sustainability and their impacts on the enterprises projects. The supply chain yields products and services, which are necessary to obtain consumption and benefits, but refuse as well (Figure Nº 20).

Figure Nº 20



Source: Own elaboration on the basis of Fiadone, R., 2011

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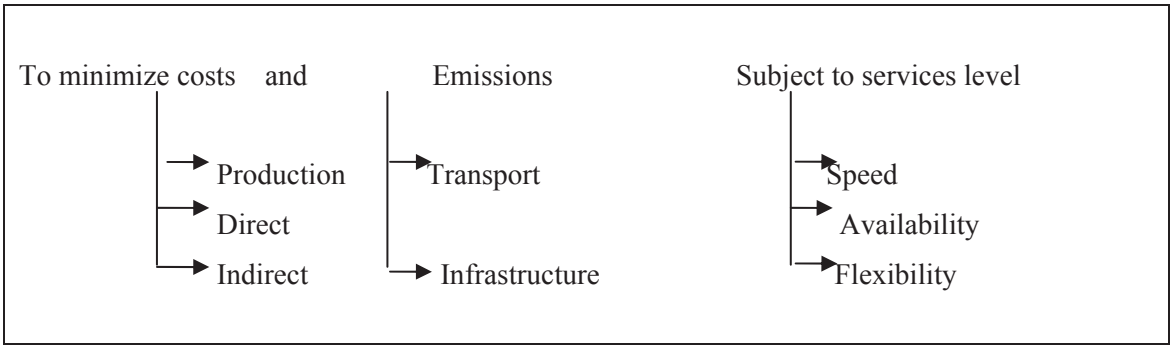
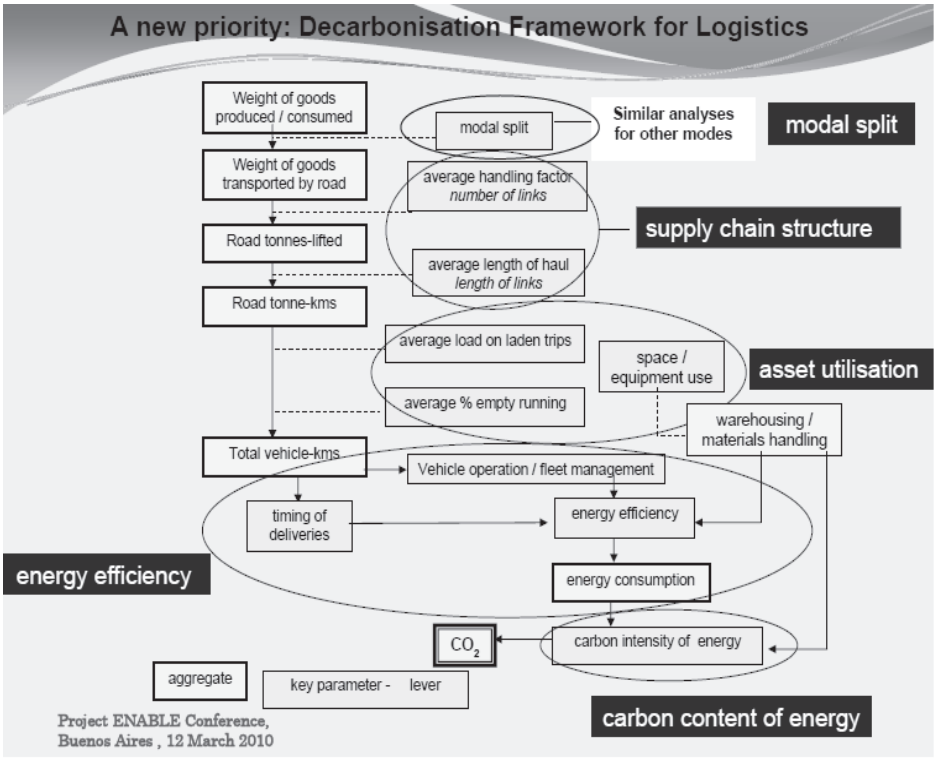
The optimization of supply chain could be considered as one optimization problem subject to some restrictions because of the need to manage some in conflict powers such as costs, emissions and services production.



Some important proposals in order to reduce the intensity of carbon dioxide (CO_2) give new opportunities for transport and logistic enterprises (Figure Nº 21).

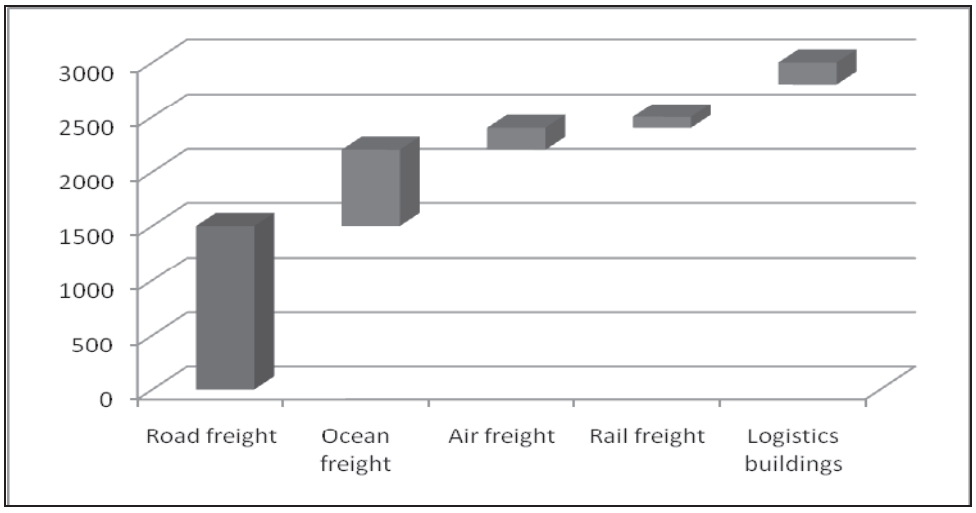
Figure Nº 21



Source: Giannopoulos, G.A., 2010

The logistic activity and its impact on the environment get near 5,5% of all over the world carbon dioxide emissions (2.800 mega-Tons). Freight of foods and mining is the most important contributor to this statistics.

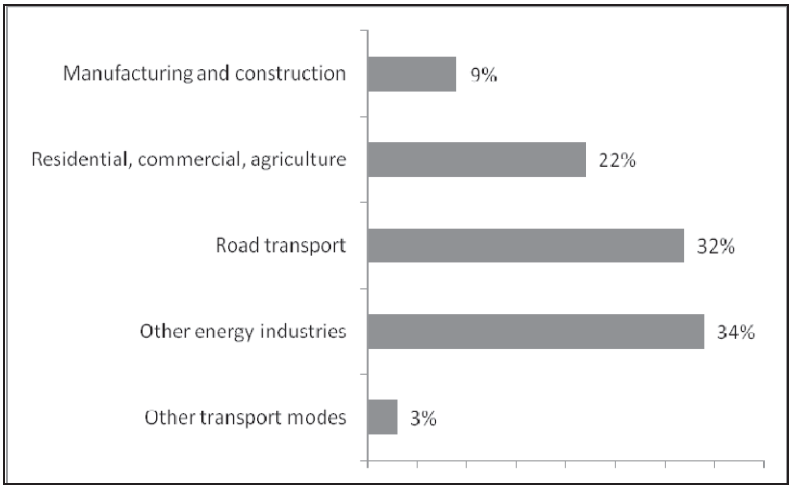
Figure Nº 22



Source: World Economic Forum, 2009

These data depends on the used technology and the location and then the information changes from place to place. In Latin America for example the transport sector is one of the most important sources of carbon dioxide emissions (Figure Nº 23).

Figure Nº 23



Source: Huici, R., 2010

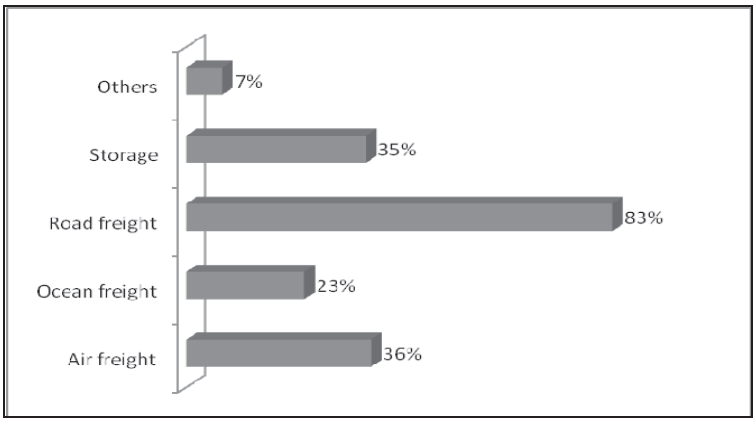
The emissions of carbon dioxide in Argentina are near 6,4 tons per inhabitant but USA and Australia are the most important pollutants countries all over the world (25,4 and 26,8 tons per inhabitant [158], each one). The agriculture and the cattle raising get 47% while the transport gets 17,8% of carbon dioxide emissions in Argentina.

3. The green logistic choice

The green logistic has good chances to reduce the carbon dioxide emissions coming from land transportation, which is recognized as the most important source of them.

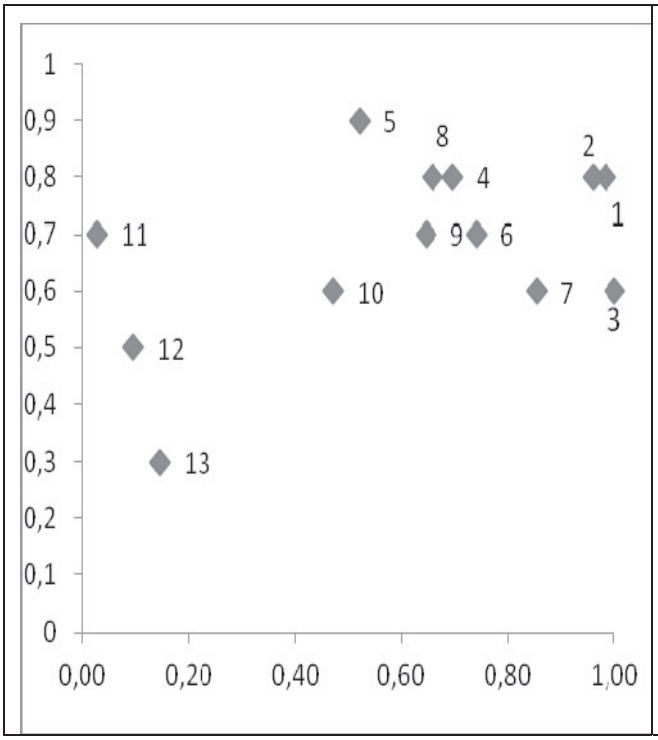
[158] Argentine-British Workshop on Climate Change, 2007

Figure Nº 24: Green logistic improvements possibilities



Source: Balzarini, 2009

The most important opportunities to reduce the carbon dioxide emissions are coming from the transportation sector self and other could be reached from changes in the transportation and logistic configurations. The three most important cases with potential for carbon dioxide reductions are clean vehicles technologies; speed reduction in the supply chain and the networking optimization.



1. Clean vehicles technologies
2. De speeding the supply chain
3. Enabling Low Carbon Sourcing: Agriculture
4. Optimized Networks
5. Energy efficient buildings
6. Packaging design initiatives
7. Enabling Low Carbon Sourcing: Manufacturing
8. Training and Communication
9. Modal Switches
10. Reverse logistics /recycling
11. Near shoring
12. Increased home delivery
13. Reducing Congestion

Source: World Economic Forum 2009

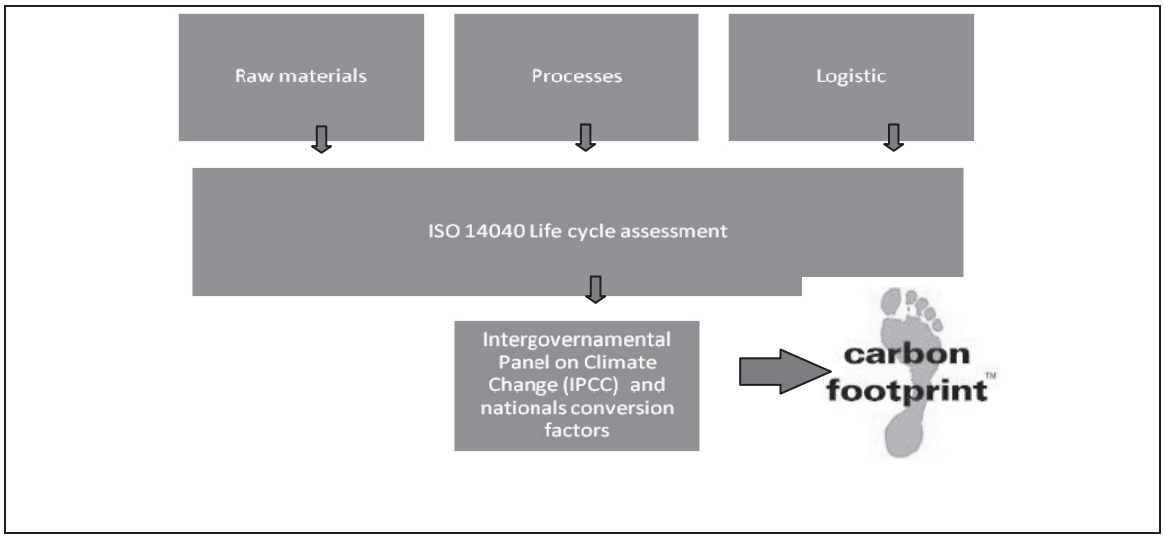
4. Methodology: The carbon footprint

One applied methodology to take into account the emissions coming from the total supply chain is the so called Economic Input Output Life Cycle Assessment, which shows the carbon trace for each product through which it is possible to see inside the contribution of logistic and transportation to the dioxide carbon emissions.

In terms of the ecology economy is possible one "top-down" environmental evaluation of the process efficiency - the so called Materials Flow Analysis - whose aim is to research the extraction, transformation, manufacturing, recycling and distribution of materials.

The procedure takes into account substance bulkiness (carbon dioxide or nitrogen monoxide, etc.) or materials such as raw wood or iron employed in the production processes in order to determine some indexes. The "ecological footprint" technique is near related to the Material Flow Analysis procedure: There are estimated the materials and energy requirements for the processes carried out in some specific geographic area (country, region or city) and these flows are translated into a quantity of productive ecological earth which would be necessary to produce the applied resources and to remove the consumption refuse.

Figure Nº 25



Source: Efrón A., Dwyer B., 2009

It is like to speak about the carbon footprint (considered for the Global Footprint Network 50% of the ecological footprint) which means the specification of the pollution trace in terms of carbon dioxide along the complete trace of products through a supply chain from its origin until the final customer. The "carbon footprint" is then an indicator of environmental performance.

This indicator of environmental efficiency allows the policy maker to postulate objectives and policies in terms of emissions reduction and help the customers to decide which products to buy on the basis of produced pollution from production until commercialization. In the last case it would be necessary to inform the customers through a label about their contribution to the pollution effects.

The intention to reduce the intensity of carbon in the supply chain brings some competitive advantages and costs reductions because it is possible to identify opportunities to reduce the energy consumption and emissions. The following matrix shows the most important reasons in order to apply this technique within the green logistic.

Table Nº 17

Aproach / Causes	Inside	Outside
Corporation	Indicators of Social Corporative responsability	Reports of Social Corporative responsability ▪ Government ▪ Inverstors pressure
Supply Chain/ Product	▪ Suppliers selection ▪ Buy decisions ▪ Supply chain decision	▪ Brand ▪ Label

Source: Agudelo, I. , 2010

The measurement of the carbon footprint related to he Social Corporative Responsibility gets the enterprises the environmental credibility which improves the public image of the enterprise and is accountable in the long term. The following matrix shows how the environmental policies of the enterprises in Spain, Italy and Japan help them to grow their sales.

The data sources in order to estimate the carbon footprint are public international reports, entrepreneurial initiative or international congresses whose aim is to reduce the carbon emissions. The transparency of the activities and the sustainability of organizations are of interest to enterprises, worker organizations, ONGs, investors and judge-advocate.

Table Nº 18

I buy sure products and services from companies that…….	Austria	USA	Spain	Germany	France	Italy	UK	Japan
They active environment improver	2	3	1	2	2	1	2	1
They are transparent in their business procedures	3	2	2	3	3		3	
They give a good deal to their employees				1	1	2		3
They pay just prices to their suppliers						3	1	2
They help active their local community	1	1						
They give out a part of their benefits for carity porpouses			3					

1. First place; 2. Second place; 3. Third place

Source: Sosa, A., 2011

The data sources in order to estimate the carbon footprint are public international reports, entrepreneurial initiative or international congresses whose aim is to reduce the carbon emissions. The transparency of the activities and the sustainability of organizations are of interest to enterprises, worker organizations, ONGs, investors and judge-advocate.

The private reports are volunteer emissions reports such as those realized for Wal Mart with its sustainability index of products or the carbon label from Tesco (british retail company for consumption products, telecommunications and services).

5. The carbon footprint in MERCOSUR

The use of carbon footprint as ecological measurement in the world commerce operations means that two aspects must be considered: the production of these goods in the Mercosur area and the international logistic.

The application of carbon footprint label for products subject to international trade is a strategy with some contradictions because of the unbalanced use of clear technologies in different countries and the presence of customers located far away from the production places in case of emissions measurements. A dilemma between clean and sustainable development is then forthcoming because of ecological but economic and social factors must be taken into account.

The analysis of transportation services has one important meaning as logistic stage along interchange because of its growing contributions to carbon dioxide emissions. This awareness about the climate change related to transportation made possible the concept of "food miles" (Frutura, 2010), whose meaning is the quantity of miles that the products must go from production to costumer.

Another concept is the "fair miles" (Papendiek, S., 2010) associated to the social development of commerce. The relationship between transportation and international trade is not so much negative as the concept of "food miles" implies. Then the determination of the carbon footprint is a valuable instrument for the international trade. There are no measurements of carbon footprint within Mercosur countries but one survey of Carbon Trust[159] says that 66% of the customers pay attention to the carbon footprint when they decide to buy something (ladyverd.com, 2008).

5.1. The Argentine case

Argentina has subscribed the United Nations Convention on Climate Change (CMNUCC) and in 2007 was created the Direction of Climate Change in the Secretary of Environment and Sustainable Development. Other offices have even environmental aims such as the General Direction of Environment Affairs (Foreign Affairs Ministry), the Environmental Management Unit (Sanitary and Quality Foods National Service) and the Environmental Management Area of INTA (Agricultural Technology National Institute).

Argentina has subscribed international conventions related to the environment such as the Kyoto Protocol (Act 25438 von 2001), the additional protocol to the Asunción Treatment on environment (1998) and agreements with some others countries. A study on environmental change carried out in 2000 estimated the National Storage of the Argentine Republic on warm gases emissions and absorptions sources outside the Montreal Protocol (Fundación Bariloche, 2005).

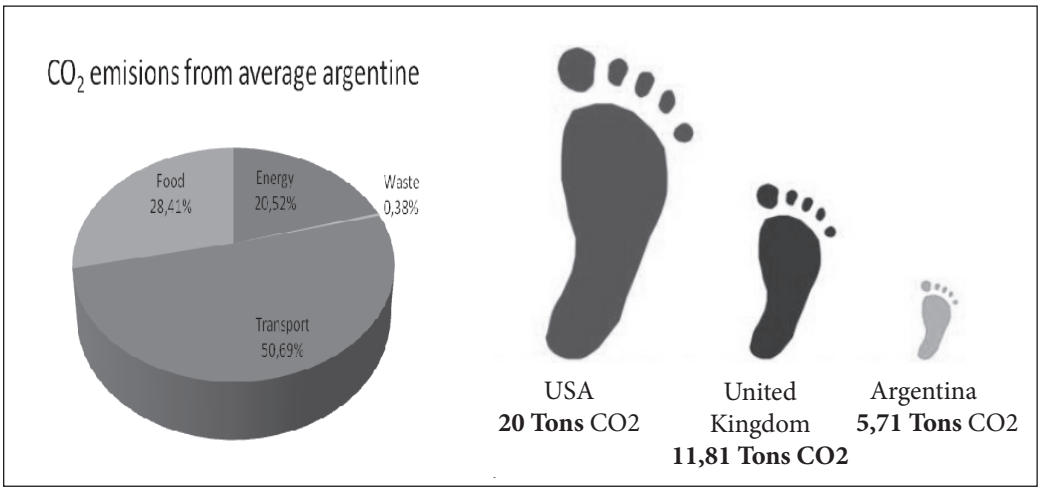
The participation of argentine institutions in the GRI (Global Reporting Initiative) is 3% of the Latin America countries while the participation of Brazil is 53%. Some argentine enterprises are *Dupont, British American Tobacco Argentina, Los Grobo S.A. Group, Sancor Seguros Group* and other multinational enterprises located in Argentina. However, the use of the carbon footprint indicator is newly found in this country. The Environment and Sustainable Development

[159] Institution of the United Kingdom government

Secretary stays that the transportation is responsible for 5,72 CO_2 tons pro inhabitant at year, which is a very little value in comparison with United States and United Kingdom.

This little development of the carbon footprint is explained because this measurement is saw as potential competitiveness reduction in order to get new markets, specially in case of products exports with high CO_2 emissions and high "food miles" proportion involved in the international transportation. There is no specific attitude towards the compulsory labeling of carbon trail although it is acknowledged that it must be avoided that it becomes a limit to commerce. It is regarded of difficult fulfillment and also this measure should be accompanied by other realities of sustainable development such as the economic and social progress (Papendiek, 2010).

Figure Nº 26



Source: www.ambiente.gov.ar/cambio_climático

Although there are not official programs to measure the carbon footprint indicator of specific products, there can be observed some initiatives from INTA and other private enterprises. Among these it can be mentioned wine products in order to avoid the loss of markets against Chile that has introduced measurement rules and labeling. Among the enterprises with environmental measurements and carbon trails it can be mentioned *Aguas Danone* from Argentina, the oil producer *Dehesa Company*, *Las Camelias Company* (poultry small and medium sized enterprise), the projects of market carbon from CREA and CSCS - Carbio Sustainability Certification Écheme - (Papendiek, 2011) and the enterprise *Dow Argentina*.

The two enterprises that apply the carbon footprint to logistic are *Aguas Danone* and *Dow Argentina*. The first one works out the water and carbon footprint associated to all the life cycle of its mineral water. So as to obtain concrete numbers it was rendered varied information, from the packaging data and product composition, the manufacturing process and data related to the inputs transport from the purveyors factories to *Aguas Danone* factory, as well as from *Aguas Danone* factories to the consumers (Infoagua program, 2009). The measurement tool entails four parts: In the first one there are considered the primary data of the product and its main features of its life cycle such as packaging data, product composition, manufacturing process (energy consumption and efficiency process). Besides there are taken data regarding the upstream logistic, which includes transport data from the supplier factory to *Aguas Danone of Argentina* factories, and the downstream logistic, that means the contrary was from *Aguas Danone* factories to the consumer or customer including transportation, average distance, consumption and fuel type.

Finally, they are entered the characteristics of the storage in the sales point. The second part is the data base of factors of emissions and water consumption for the country. This module al-

lows us to calculate the carbon and water footprint of one specific product. The third part enables us to work out the results from the primary data - the emissions and water quotients - and the necessary formula to develop the model of the stages life cycle. In the last stage there are shown the results of the carbon and water footprint for one specific product, stated in liter of water or beverage or pro unit of product (Example CO2 gr. /bottle).

Dow Argentina published its second balance of sustainability for the period 2009-2010 and inside a process of overhaul challenges and processes of Social Enterprise Responsibility looking forward to 2015, the enterprise updated its code behavior, began a self assessment with Ethos indicators and measured its carbon footprint in its logistic, whose results allowed to optimize the logistic circuit, the transportation way, the volume of the carried product and the fuel used. Some research works have tried to measure the transport and the distribution emissions of certain products such as soy with carbon dioxide emissions from 13,43 grs/MJ (second cycle soy) to 27,47 grs/MJ (first cycle soy with high technology) per hectares (Muzio, J, y Hilbert,J. 2008).

INTA has developed a model (Agroecoindex) to assess the environmental management in farms and although it does not work out the whole carbon trail for each product, it brings an effective tool to examine the trail of the primary production. In case of SME there exists a program of clean production as a strategy for enterprises.

As far as logistic is concerned, we can quote the *Andreani Logistic Group*, whose policy as regards the environment consists of two axes, the environmental management and green logistic. The first focus defines actions for rational energy consumption and to minimize the production of refuse and its treatment. The green logistic tries to determine the trail of carbon of the whole operations of the *Andreani Logistic Group* and the setting of a work program that allows its reduction in the long run. The adopted methodological scope has the intention of developing a correct refuse management, to create indicators and to minimize the garbage through recycling, the reuse and extension of the life cycle. The actions of load consolidation and optimization of traffic (clean logistic) and the reduction of packaging comprise the enterprise policies.

The enterprise *Andesmar Cargas* developed the first evaluations of small, medium and large trucks for national transportation supplied with VNG (Vehicle Natural Gas). This project is carried out joint with *ESI Gas* in order to use one of these vehicles in the so called “blue corridor” as part of the World Congress of CNG (Comprised Natural Gas) and other gaseous fuel during last November in Buenos Aires city. Through the use of this technology both companies will contribute to improve the carbon footprint because the VNG reduce the pollutant gas emissions. The development of “blue corridors” will enable to link the most important cities in Argentina using gas fuel trucks which will protect the products from pollutant gas oil particles.

In spite of all these elements do not exist in Argentina one environmental agenda ordered neither for the international trade policy, for the relations within other Mercosur countries nor for specific logistic operations.

5.2. The Brazilian case

Brazil is the fourth most important dioxide carbon worldwide emitter and it has attempted to introduce the ecological dimension in the production processes, for example through the Environmental Sustainability for Agribusiness of the Environment Ministry. There were developed some methodologies to measure the carbon footprint for the logistic activity and its consequences for the international trade.

The certification program *Cafés sustentavis do Brasil* takes into account the concept of “fair miles” which objectives are the environment conservation but at the same time the social and economic sustainability (Mostaert Lócio, F and Araújo de Moraes Filho, R., 2007). The strategy in order to measure the carbon footprint is growing in different activities and sectors of Brazilians economy. The public and private awareness about the environment is put off in such programs as the Livestock Pact, the Soy Moratorium, the Initiative for sustainable Food, etc. which prove a greater place for this thematic in the public and private agenda (Papendiek, 2010).

6. Conclusion

The results of some studies on the use of resources and environmental policies carried out in Mercosur (PNUMA, 20119) show low efficiency and sustainability. The report signals the necessity to build one institutional context in order to grow the scale of the local successful experiences. The challenges within Mercosur are to adapt its economies to the sustainable policies of developed countries because it will have a positive impact on products sales. The carbon foot print is a measurement of greenhouse effect emissions since production until supermarket for each product. The European Union countries are most advanced in order to measure its impact and to improve its reduction through the appropriate legislation. One measure is to foster the use of labeled products which sign the carbon footprint generated along the supply chain of goods.

In the logistic sector there are fourth factors (Balzarini, 2011) which must push this trend: the new regulations such as the carbon footprint, the public investments in order to promote the adoption of sustainable policies, innovation in new technologies to foster the use of alternatives fuels and the adoption of values for awareness on the environment care. The green logistic can be realized in the praxis with the implementation of some techniques such as the energy spar, the improvement of transportation, the use of renewable energy, the improvement and reuse of packaging, the awareness of the human resources and the use of bio diesel in heavy work motors. A challenge is the use of the logistic services of inter modal transportation or the exploitation of one few used resource such as the rail way so that the measurement of the carbon footprint is yet more important. All these measurements mean opportunities to reduce the dioxide carbon in the supply chain. It is necessary then to draw new scenarios where the efficiency and sustainability grow. Although there is a lack of environmental legislation, the four Mercosur countries decided in 1995 to define and to formalize one Green Stamp within Mercosur, which in turn means an opportunity in order to do not loss business and in this sense the logistic has big possibilities to contribute for diminishing the carbon emissions.

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Chapter 11

Freight costs: global and local measures

Valentina Viego[160]

1. Introduction

The documented general decline in tariff and nontariff barriers during the last 30 years in the global economy emphasizes the role of transportation costs in the flow of goods between countries. However, few studies estimate the incidence of transport costs in productive activity.

We present here some indicators available for cargo transportation sector that, in most cases, are only indirect measures of freight impact. Most of the available information is based on extrapolations from small samples of countries and even when a region offers punctual data about freight magnitude is not common to identify its trend. In addition, the latest updates in most cases cover a time-span up to 2000, a matter which requires fixing the analysis horizon at that time. Anyone interested in information about price or quality of service in the sector should work with rather restrictive assumptions in order to create databases comparable across countries.

The World Bank has conducted several studies that attempt to measure the magnitude of transport costs and their impact on industry and on the overall economic performance (Aschauer, 1989; Queiroz and Gautam, 1992, Canning, 1999, Calderon and Serven, 2004, Micco and Serebrisky, 2004; Guasch and Kogan, 2006). Key findings of those studies indicate that one of the factors that affect logistics costs (costs incurred to bring a given commodity from producer to consumer) are strongly determined by the availability and quality of infrastructure, because their direct effect on transport costs and indirectly on inventories and financial costs.

A similar conclusion is supported by Limao and Venables (1998) and Feenstra (1998), highlighting the burden of transport infrastructure and telecommunications in total transport cost and trade flows. In operational terms, the variables that naturally should be evaluated from this recommendation are the stock and density of the freight transportation network (road, rail, sea and river). Other indicators proposed are: i) perceptions of entrepreneurs and managers, and ii) the relative magnitude of inventories (Guasch and Kogan, 2006). Any of the above measures reveals that Latin America is at a disadvantage compared to other countries (especially those developed ones). Guasch and Kogan, op cit) show that in the U.S. this level represents approximately 15% of GDP while in Latin America and other developing countries the ratio is 2 times higher for final goods and 3 times in intermediate goods.

Guasch and Kogan (op cit) estimate that in OECD countries and U.S. logistics costs account for approximately 9% of sales. Tavasszy and Demko (2000, cited in Cristini et al, 2002) report a similar figure -between 6 and 10%- for all developed countries. In turn, transportation costs account for one third of this amount. In Latin America this figure is found near a range from 18 to 32%, varying by country.

During the last 15 years Latin America has experienced a progress in the coverage and quality of infrastructure in global terms. However, the evolution of the road network has not closely followed this path, while the quality of automotive transport network experienced some improvement, appreciable progress in coverage is no clear.

Depending on the major issues raised by this review, some available data on infrastructure and transportation system are presented below. It is worth remembering that, as is necessary to appeal to a variety of sources to get a relatively complete picture of the functioning of the cargo transport system in Argentina, the figures do not have a satisfactory degree of updating and most of the cases the time range does not exceed 2000.

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2. Flows of goods and industry organization

2.1. The importance of different transportation modes

In developing countries trucking has a majority use in freight transportation, unlike the U.S. and EU, where the railway ranks first as the transport medium followed by river transport, with 30% in both cases (Table Nº 19). Beyond the extension of their road network, the greater use of rail and river transport in DC´s is due to lower costs.

Table Nº19: Different transport modes: 2000 (% of total volume)

	Truck	Train	Ship
MERCOSUR	65	21	2
EEUU	25	35	30
UE	25	45	30

Source: Agroalimentos Argentinos, Transporte e Infraestructura Vial

In Argentina in particular, the preeminence of truck is even greater than in the rest of Mercosur. From the traffic figures released by the National Authority of Highways (Dirección Nacional de Vialidad, DNV), the participation of the truck is around 90% of cargo (the proportion is higher when calculated in terms of ton-km). It is also the only way that shows an increasing share in contrast to the rest. As trucking Argentina has a substantially larger share than in the rest of MERCOSUR countries, goods are relatively more expensive.

In any case, evaluating the above figures requires caution because competition between transport modes occurs only in a small fraction of the total cargo. Müller (2001) estimated that about half of the load by truck does not compete with the train. So the difference in units of different modes of transport also partly reflects differences in sector composition.

In the case of grains, more than 80% of the volume is transported by truck. In the 1940s the main transport mode was the railroad specially for grain cargo but in the 1960s the railway gradually began to lose weight. The change in transport mode reacted in part to the expansion of the network (between 1940 and 1950 doubled the amount of km paved), the expansion of the automotive industry, the stagnation of grain harvest volumes and the gradual decline of the state-owned railway. Since privatization during the 1990s, levels have recovered to stabilize by the end of the decade.

Since most of the trucking is done through family business or self-employed, the degree of specialization of transport units is low (except for the trucks to transport grains): vehicles are used for general cargo and price competition prevails. However, this market fragmentation rather than leading to convergence in rates shows a significant dispersion in the pricing system (fares are based on weight, volume, amount of goods transported, distance traveled, etc.). Also, the absence of controls allows the circulation of old and overloaded units (especially in transport of grain).

As a sector with free entry -and traditionally with self-employed- automotive transportation does not face supply constraints. By contrast, the few detailed studies available point out oversizing (although this finding can not be supported with figures due to lack of information). That fact lowers the price (about $ 0.03 per ton-km in the case of bulk). However, the low estimated rate is explained by maintenance tasks performed mainly by car owners (especially of small size) and a high degree of informality (Müller, 1994).

2.2. Stock and density of cargo transportation infrastructure in Argentina

Coverage levels of transport infrastructure are strongly correlated with country income level. However, a more detailed analysis is required to assess the available infrastructure for each transport mode.

- Road Infrastructure

The road infrastructure offers a network of 231000 km of national and provincial roads and must be added about 400000 km of municipal roads, almost exclusively used for primary agricultural production. Table Nº 20 gives an overview of the sector based on the latest available data on coverage of infrastructure for countries with different income levels. Overall observations are following:

Table Nº 20: Road network density in selected countries. 1985-1990 *

Country	Population Millons	GDP per cap	Surface 1000 km2	Paved roads %	Paved roads km/000000 population	Paved roads km/ 000 km2	Paved roads in good condition km/ 000 000 population	Paved roads in good condition km/000 km2
Argentina	30.1	2230	2767	s/d	899	9.8	315	3.4
Brazil	132.6	1720	8512	s/d	763	11.9	229	3.6
Chile	11.8	1700	757	29.5	813	12.7	342	5.3
Colombia	28.4	1390	1139	37.6	339	8.4	142	3.5
México	76.8	2040	1958	s/d	843	33.1	716	28.1
Uruguay	3.1	2470	177	69.4	2079	36.4	541	9.5
Australia	16.5	12340	7700	49.8	25745	55.2	21883	46.9
Portugal	10.2	1970	92	s/d	1755	194.6	877	97.3
England	57.1	12810	244	s/d	6170	1443.8	5244	1227.2
Italy	57.4	13330	301	s/d	5259	1002.8	4470	852.4
France	55.9	16090	552	s/d	14402	1458.5	12242	1239.7
Japan	122.6	21020	378	66.1	6008	1948.6	5107	1656.3
USA	246.3	19840	9373	56.0	14172	372.4	12047	316.6

Source: Authors' calculations based on Queiroz and Gautam, 1992: 30-37

* Since the source is not indicated, judging by data from Argentina, we infer all infrastructure figures refer to national roads.

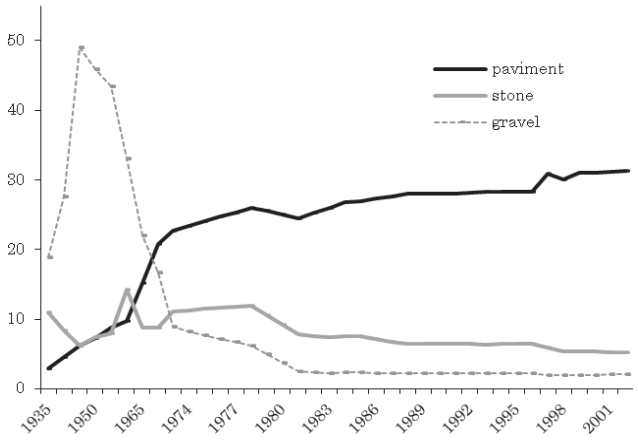
i) Access is extremely low in less developed countries. Developing countries with lower per capita income have about one third of road density than their higher per capita income economies, as they reach the sixth level of the DCs. One way to verify the weight of TC is to compare the extent of country roads and railways per unit area. For example, compared to U.S., households and firms in Argentina are 38 times more isolated (372.4/9.8).

ii) Infrastructure gaps by income level are higher in quality rather than length terms.

iii) On the other hand, for a given income level, the network grows relatively less than surface. Regions with lower absolute area naturally face fewer obstacles to achieve satisfactory levels of coverage.

iv) There are few disposable quality measures; a mile road of simple gauge has same weight than a mile of 12-lane highway.

Figure Nº 27: Evolution of the national road network by type of roadway



We point out that i) road network has expanded significantly in absolute terms until 1950 and then stabilized around 40.000 km. ii) since the mid 50's, DNV reduced its role in infrastructure policy, transferring nearly 40% of the total network -especially gravel and ground- to the provinces; iii) since the availability of routes has not changed substantially in stock, but in composition of the bearing surface, in particular the decade 1960-1970 was the largest expansion of the paved area, improving relative transitability.

Moreover, road traffic supply differs substantially by jurisdiction. In the poorest provinces (Chubut, Formosa, Jujuy, Río Negro, Salta, Santa Cruz, Tierra del Fuego) the percentage of paved national network falls to about 2/3 of the total area. The gap between regions is even greater when considering the condition of the provincial network.

The degree of development of the road network can be evaluated by its density (measured in km/km2). The provinces of the Pampas and Mesopotamia have higher densities (about 0.13 km/km2) while in Patagonia, part of North-West and North-East network density represents only half of that threlhold. Similarly, it can be posed here a positive association between density of road, transport infrastructure and per capita output.

About a third of the stock is currently paved, although the picture differs between regions. Table Nº 21 shows the composition by jurisdiction and type of roadway. While national roads have a high percentage of pavement, the provinces have approximately 20% of the paved network, more than half of provincial roads are now of ground. Moreover, almost all of the routes have two trails, the development of multilane roads is still small (0.7% of the total area contrasted to almost 4% in the U.S.) due to insufficient levels of traffic.

Table N º 21: Road network by 2000 bearing surface (in km)

	National	Provincial	Total	%
Paved	31081	38537	69618	30.1
Gravel	5382	44019	49401	21.4
Ground	1945	110055	112000	48.5
Total	**38408**	**192611**	**231019**	**100.0**
% paved	80.9	20.0		100.0

Source: DNV

While the national route network currently exceeds 38000 km and more than 80% of its length is paved, around half of its extent registers poor condition by scarce maintenance, congestion in some urban access and nearby port areas. This is because about 75% of vehicles transit on paved roads, increasing the burden on this type of roadway and pressing maintenance costs (Delgado, 1998). In fact, several reports agree that the main restriction of the routes is not the existence or not of pavement -which at the national level reaches satisfactory levels - but insufficient maintenance.

The various transport networks are managed by the national state and the provinces. In the case of the national network, almost 8900 km are managed by private pool of construction companies financed by tolls and subsidies. In this case, most of the work involves the replacement and maintenance of capacity. The rest of the network is maintained by various mechanisms, among which the Rehabilitation and Maintenance Contracts System (CREMA), through which government orders jointly capacity replacement and periodic maintenance for five years. This mechanism currently covers around 11800 km. of paved network.

Toll system has generated large revenues, which in turn led to improving network status. In 1999, 54% of funds allocated to national roads came from tolls (Müller, 2001). As a result, the state of the national paved network improved over the decade of 1990. While earlier around 53% of it qualified as regular or bad, this proportion had dropped to 46% in 1999. Anyway, considering the extension of the pieces that still need improvement the budgetary funds allocated for this purpose are permanently insufficient. On average, DNV has invested between 1994-1999 around $360 million annually, while a tentative estimate of capital requirement to maintain the serviceability of the network yields values of the order of $450 million. This is one of the most critical aspects of the sector, despite the implementation of the toll system, which reflects the fiscal constraints.

In addition, concession toll network seems to generate revenues in excess of maintenance and replacement needs, the net income per km of paved was 2.5 times higher than the budget implementation of the DNV in the period 1995-1999. The problem worsens when capacity expansion requirements are incorporated into the calculation; near 800 km. of national network of two paths register transit levels over 6000 vehicles per day, indicating the need to assess the desirability of increasing the number of lanes. The implementation of toll collection is feasible only in high traffic routes for two reasons. First, as a portion of the operating costs of the service road (personal assigned to cash collection, repairing tasks, etc.) is independent of traffic volume, a rate that covering these costs would be prohibitive in roads with low traffic. The weakness of the toll as a system of funding (both for its failure to generate the total resources required to deliver the service road as its inequality) has led several authors to point out the need to analyze new sources of funding for the sector (Müller and Queipo, 1999).

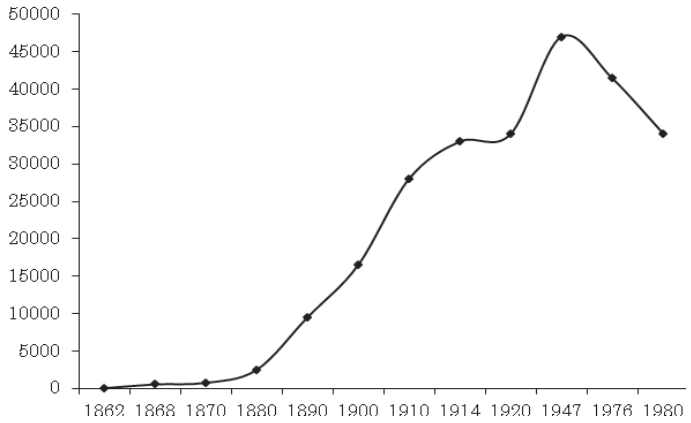
Moreover, the experience of deregulatory measures in the sector shows that the fate of the toll rates are not exclusively focused on the extension, repairing or maintenance of the network, but in the pursuit of profit for dealers which implies that enlargement, improvement and

maintenance of public infrastructure inevitably face high costs for the public sector, regardless of which management model (private / public) is adopted.

- Rail

In Argentina, most of the railway line was conducted between 1870 and 1914, converging with the development phase based on exports of primary products. The rail network suffered a gradual but steady decline since mid-twentieth century. Thus, from almost 47.000 km. achieved in the late 50's, by late 1980s only about 74% of that stock (34 thousand km) were active. The current network is a bit smaller.

Figure Nº 28: Railway network 1862-1980 (km)



Source: CNRT

The demand for rail services gradually diminished since the postwar, with the emergence of competitors, mainly automotive transportation (and to much lesser extent, pipelines). The low population density of the national territory and scarcity of bulky products, highly spatially concentrated and transport demanding did not make possible to determine clearly the role that could correspond to railways. This lack of focus was reflected in pendulous public management, traditionally pressed by rising investment and operating deficits, which resulted in growing losses[161]. The performance gradually deteriorated during the 1980s as a result of growing divestment (stemming from general fiscal restrictions), leading to this segment to a virtual collapse in the late 1980s (Müller, 1994).

On the other hand, rail transport was one of the activities that better reflect main effects of institutional reforms implemented during the 1990s. For the most part, privatization involved the transference of infrastructure and equipment to private operators under a concession regime based either on payment of a fee or leasing. Although there are some limits to the rates operators can charge, in practice services are totally unregulated (ie, non reinforcing public service obligations), the only requirements to meet relate to investment plans and the maintenance of minimum levels of service. Such requirements, in fact, have been met only partially.

From a single public operator, who managed the whole system, emerged 19 operators (including private and public, in the case of provincial governments). In the cargo sector, 6 companies exploit different lines of the national grid. Simultaneously a considerable reduction in the number of employees in the sector, from 90000 to about 17000, took place.

[161] The period of better quality can be placed into the late 1960s (Müller, 2001)

Table Nº 22: Rail network by operator. 2000

Operator	Km
Belgrano Cargas	7352
Buenos Aires al Pacífico	5254
Ferroexpreso Pampeano	5094
Nuevo Central Argentino	4512
Ferrosur	3342
Redes Provinciales	3434
Ferrocarriles metropolitanos	841
Total	**32568**

Source: CNRT

In Argentina, the rail concentrates its regular operations in a set of "classical" goods (Müller, 2001), which consist in a close variety of bulk materials (grain, oil, fuels, petrochemicals, etc.). In the 1990s, following the growing trend toward the use of containers in international transport, lead to an increase of the participation of this transport mode, but its total share remains modest.

Table Nº 23: Cargo carried by rail (million ton)

1930	1960	1980	1992
42,5	25,9	16,3	8,6

Source: Cristini *et al* (2002)

The train shows a declining trend in traffic levels during the 1980s, temporarily suspended in the decade following privatization. The temporary recovery of traffic is explained by the introduction of containers in foreign trade operations. This greatly increased the incentive to introduce management innovations (command train radio or satellite, etc.). Yet train lost market share since total demand for transport services increased in net terms. Since 1998 the evolution of transport volume shows unfavorable figures, at least in the transport of grain, which constitutes the bulk of the goods freighted. The contraction is both absolute and relative, from 8 million tons carried during the 1980s to 5 million in 1998-2002, indicating a reduction of almost 40% of volume. The smaller share of rail in the volume of goods freighted occurred even though the absolute reduction in unit cost (per ton-km) and the relative improvement for the transport vehicle, during which period the rail fare levels remained on average 25% below the truck (Müller, 2001). This shows that the dominance of the truck over the train is explained by other factors as coverage, delivery time, etc. and not exclusively by price advantages.

According to the CNRT in 2002, more than half of rail loads belonged to grain and byproducts. In turn, 76% of total grain transported by rail is attended by 2 of the 5 companies currently operating in the rail freight market. The performance of those enterprises is generally poor (with one exception). The operating cost is not fully covered by revenues and there is no scope for investments in capacity expansion. This is reflected by the fact that fees and rental payments for the use of franchised materials are considerably lower than reasonable estimates of rental value, giving place to hidden subsidies. Muller (2001) estimates the current value of assets in the privatized segment (attributing residual value to locomotives, wagon and railway) and compares it with the fees charged by the government to operators. This calculation suggests that there would be a hidden subsidy of $ 0.013 per ton-km, whose coverage would require a rate increase of approximately 50%, displacing at least a part of the volume transported.

- Air transport

The total market share of air cargo is minimal (both coastal and foreign trade operations) and is limited to the category of goods of very high value per unit weight or volume, especially

perishables. Its behavior during the 1990s shows erratic fluctuations without a definite trend. The industry is not actually regulated; neither vault reservations nor limitations in pricing policy exist. Its feature is provided mainly for passenger transport companies, for which important part used in the same fleet.

- River-sea transportation

Transport by water (river and maritime segments) is still currently the most economical transport of loads, particularly in the case of low value bulk. In a country of large coastal areas and navigable rivers, while bulk producer of different kinds, it is inevitable that this medium-range transport quantitative importance.

Table Nº 24: Consumption, minimum capacity and facilities by transport mode

	Truck	**Rail**	**Ship**
Fuel consumption, km/ liter (for 1 ton-km)	15	120	500
Load per unit, tons	25	40	1500
Necessary equipment for 24 thousand Ton cargo	960	800	16

Source: Adapted from Agrolimentos Argentinos: Infraestructura y Transporte Vial

However, the relatively low density of the corridors and the particular location of main flows (more perpendicular than parallel to river/sea pathways) limit its use to specific segments. Therefore, this mode is concentrated in the transit of exports and imports, beyond the scope of our analysis.

3. Freight transportation impact on manufacturing activities

Road transport represents a relevant sector in manufacturing activities, especially in developing countries, where it plays an essential role for distribution of agricultural products and provides access to inputs and services (over 80% of internal trade is carried by truck). In Argentina, according to the latest data from Input-Output Matrix (dating from 1997), total transportation spending represented 5.2% of purchases of intermediate inputs of domestic origin. In terms of GDP, this expenditure stood for about 4% (Cristini et al, 2002). In particular, land freight transport accounted for between 3.3% and 3.9% of intermediate demand (at basic prices and purchasers' prices, respectively). In terms of Gross Product Value or Gross Added Value, land freight transport contributed 2.1% of national figures.

The goods flow estimates of Cristini et al (op cit) shows that most of the distribution by road and rail is concentrated in major urban centers. Taking into account the transit of goods destined to foreign markets, the map slightly decentralizes to urban ports (Bahia Blanca) or to borders (Zapala, Mendoza, Paso de los Libres). This reveals that the regions located outside export corridors, with fewer infrastructures, face higher transport costs. These authors also note that the expansion of large retail formats introduced technological changes in supply chain (cooling tunnel, distribution centers, etc.), which in turn increased the tradability of certain products (fresh and perishable). However, the weight of large-area stores is negligible in some activities.

In manufacturing sector, land freight transport represents 5.7% of total purchases, although the sector is marked by diversity, for most activities road transportation costs do not exceed 5% of total purchases. Naturally, in the activities offering bulky products and/or with higher degree of perishability, the weight of freight costs exceed 10% (cement, sugar, milling, dairy, pulp editions), to nearly 24% of purchases total inputs.

Table Nº 25: Manufactures tradability and freight trucking

	Intermediate purchases, %	Standard deviation
Non-tradables	6.23	4.81
Other activities	5.48	3.85

Source: Authors' calculations based on data from the Input Output (INDEC, 1997)

4. Evolution of transportation costs

It is a fairly widespread belief that TC has substantially been falling in recent years and therefore they now play virtually no role in production activities. Rietveld and Vickerman (2004) confront this belief with some global data. One of their main conclusions is that freight rates have actually decreased, but this decline has occurred over an extended period of time and was not particularly concentrated in recent years. For example, global maritime cargo freight rates fell 83% in real terms between 1750 and 1990 (Craft and Venables, 2001). The drop was particularly high during 1830-1910 and diminished more slowly since then.

Paradoxically, ocean transport rates did not decrease after the 1960s with the appearance of the container, which allowed large-scale transportation of goods. In addition, Hummels (2001) examines statistics based on actual trade flows pointing out that traveling time has greater impact on inventory costs than merely transfer cost. This suggests it may be plausible a greater willingness to pay more than expected in order to get a reduction in delivery delays. Apparently, the introduction of large-scale container freight rather than seeking cheaper freight accelerated the process, allowing a drop in overall costs (incorporating the cost reduction of stocks).

However, compared to air transport, the ocean mode is still slow explaining the global replacement of sea by air freight. According to Dollar (2005), air transport costs fell 75% between 1940 and 1980. Bairoch (1990) and Craft and Venables (2001) agree a similar figure for land transport rates: declining even faster between 1800 and 1910, especially due to infrastructure improvements (canal systems, extensive construction of railway lines). The emergence of automobile mass production and highways during the XX century led to further drops in cargo TC (about 80% in cost per ton-km in international road transport according to studies cited by Rietveld and Vickerman, 2004). This disparity in trends shows that the initial cost advantage of shipping compared to road transport has declined.

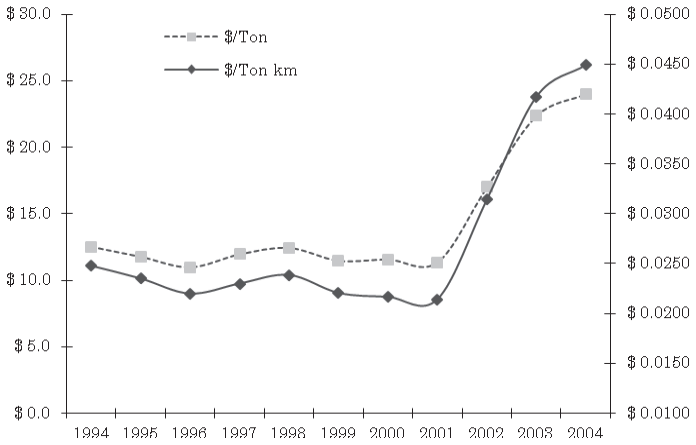
In Argentina, changes in technology (through introduction of modern transport equipment) and infrastructure expansion seem to be stagnant for at least the last 20 years. It follows that the evolution of internal TC not necessarily followed the same path as that observed in international grounds. Considering the fleet, records do not show a favorable and sustained trend; during the 1980s investment in transport equipment stagnated and consequently unit's age increased. In the 1990s cargo vehicle fleet experienced a partial renovation. However, according to figures compiled by Cristini et al (2002), the average age of equipment of larger size is greater than the total fleet, indicating a restructuring tendency towards small units, which tend to have higher average costs than larger ones.

On the side of the infrastructure, net has been stalled for over 50 years. While the proportion on paved roads increased, repairing and maintenance costs are still under satisfactory levels, resulting in network early aging (Muller, 2001). Considering rail, the largest expansion occurred during late XIX century and since the 1930s has lost relative share in the transport of general merchandise. Since train offers lower rates (per ton/km) than truck, it follows that the decline in rail freight traffic has hampered the fall of freight weigh in total cost of goods.

Table Nº 26 shows a decline in train rates relative to truck, explained by a more marked decline in train fares and a gradual increase in truck rates. However, Cristini et al (2002) show that in

1990s the total volume of grain transported has increased substantially, favoring that railroad recovered its historical market share (9-10%) achieving also high capacity utilization figures (70-80%). Something similar happened in the segment of auto transportation, where cargo bulk shifted the general one.

Figure Nº 29



Source: CNRT

Table Nº 26: Average grain transport rates ($/ton.-km*)

	1992	1993	1994	1995	1996	1997	1998	1999
Truck	0.0430	0.0423	0.0490	0.0540	0.0557	0.0623	0.0680	0.0617
Train	0.0314	0.0251	0.0258	0.0262	0.0239	0.0285	0.0334	0.0297
Gap, %	37	69	90	106	133	118	104	107

* An average distance of 300 km is considered, threshold at which the difference between transport rates is significant.

Source: Cristini et al (2002)

In addition, changes in TC were not homogeneous across sectors and regions. This could be a reason explaining why non-tradable activities still survive (though with increasing threat).

5. Transport impact on location pattern, market structure and trade

The TC has been an important element in explaining the observed spatial distribution in selected industries and their respective market areas. In the literature, central references are Weber (1909), Lösch (1944) and Hoover (1948), linked to traditional theories of industrial location. The classical theorists were concerned in location issues in order to identify the ideal (optimal) distribution of firms in space. This approach identifies a number of factors involved in location decisions, as the cost of transporting raw materials, finished products or the existence of close competitors.

It is possible to distinguish two approaches based on TC that vary their emphasis on the elements involved in firm location decision. Both approaches are part of "mainstream" location

theory, which emphasizes the pursuit of the highest possible profit when choosing the production unit location. The first approach raises the central corporate goal as one based on cost minimization. The costs analyzed are divided, in turn, into processing costs (hereafter PC), and transfer costs (TC). The pioneering location approaches assumed locations with identical PC, so the decision to site the facility is determined primarily by differences in TC, in turn dependent on the weighted distance between inputs and customers.

Some other models emphasize the role of demand in search of advantages over rivals: the essential idea is that the need to avoid competition gives place to a spatial distribution of firms based on demand location. The difference is, then, the emphasis placed on cost or, alternatively, revenue.

It should be clear that TC do not completely determine the location of productive activity. Alternative approaches to mainstream have indicated that environmental characteristics also affect the geographic distribution of economic activity promoting (externally) the operating conditions and competition environment for companies located in a particular place (Scott and Storper, 1986; Glaeser, 1992; Henderson, 1997). However, this line could be integrated into the previous theoretical body posing agglomeration externalities as explaining spatial variations of PC, an element that would help to relax one assumption of traditional models. Anyway, as we are focused on TC, that task largely exceeds the scope of this chapter.

TC promotes not only spatial spreading of activities but entrepreneurial also. If firms locate in a given place in order to serve the nearby market, this reduces their relative size compared to those seeking to serve broader market areas. This could result in a greater proportion of small establishments in those branches where TCs have not a negligible portion in firms cost structure (distribution and/or supply). So the existence of TC of some magnitude protecting firms from foreign competitors, relaxes the role of scale, allowing survival in the market with sub-optimal scales.

In terms of the relationship between TC and size distribution of firms, the existence of transaction costs (measurable or not) of considerable size encourages a bipolar distribution of sizes of companies. On the one hand, transaction cost theory posits that in presence of coordination and transaction costs of considerable magnitude, is more convenient for the firm to internalize operations that, in a context of low TC, could be outsourced. In other words, there is incentive for vertical integration (Williamson, 1981) and therefore a tendency toward relatively larger organizations emerges. On the other hand, high transaction costs, especially those involved in transactions mediated by geographic distance, also lead in limiting firm size to local market capacity, anticipating obstacles while attending remote customers or and restricting to small volumes operations (known as “small numbers bargaining”; Alchian and Woodward, 1988).

An additional impact of transport costs on market structure is related with the pace of technical innovation; high TC narrow geographic markets, reducing competition among firms. This lower potential competition alleviates, ceteris paribus the sector, the pressure to innovate at the same timing than that occurring in more dynamic markets. It happens that the existence of significant TC, by giving an advantage to local suppliers over foreign ones, allows a greater influence of personal factors in business organization that, otherwise, should discipline themselves to an environment with less room to relax about PC.

In addition, regions facing higher TC will exhibit a market structure with higher weight of small firms and fewer incentives to adopt improved technologies. As a result, it is possible that the high proportion of local manufacturers in low tradability branches observed in several provinces in Argentina is linked to the existence of high TC (Table Nº 27).

Table Nº 27: Transportation costs and tradability of regional manufacturing
(Dependent variable: Establishments in non-tradable branches) (%)

Regressors	**Coefficients**		
Average distance, km	0.157 3.67*		
Average travel time, log		0.167 3.78*	
Non paved roads, %			0.003 3.02*
Per capita GDP, 1993 log	-0.111 -3.07*	-0.226 -2.92*	-0.095 -2.26**
Constant	-0.436 1-39	0.489 5.67*	0.579 8.66*
R^2	0.477	0.481	0.396
Mean Squared Error	0.105	0.105	0.113

Source: own. Estimated with Stata 10.0

Type I errors: * 1%, ** 5%

Econometric estimates show that all proxies for TC are significant at 1% in the explanation of the manufacturing establishments operating in low tradability branches in provincial figures.

6. Transport and internal Trade

The higher the TC of a commodity between 2 regions, the lower the traffic of that good in that corridor. However, due to difficulties in collecting reliable and comparable information on TC height (even in the DCs), it is not possible to estimate the impact of a given increase in TC on the volume of goods traded between regions. The availability of data on trade between regions is more abundant. Therefore, the research in this area has taken a particular path:

- Resigning measuring the impact of TC on the transit of goods
- Comparing expected and actual transactions between regions

The gap between these flows is interpreted as a sign of high CT. An alternative to the former, which dispenses trading information between regions, is based on comparing prices of similar goods between regions.

The dissuation to trade generated by travel costs is known as "home market bias" or border effect. The central hypothesis of this approach is that TC generate a bias against foreign trade not explained by conventional barriers (tariffs). Crozet and Trionfetti (2008) and Disdier and Head (2008) provide an overview of the theoretical foundations of this body. Based on the evidence that internal trade flows are usually between 5 and 20 times higher than the external trade flows by period and country, empirical applications of this approach point to determine which proportion of this difference is explained by tariffs and which one is due to TC (home bias).

Another equal check for the border effect is estimating elasticity of substitution between imports considering both conventional barriers and TC. Due to fairly widespread lack of freight rates, in econometric regressions TC are proxied by bilateral distance between territories (Hummels, 1999). Such work suggests that the magnitude and nature of the impact of a free trade agreement depends crucially on the transaction costs associated with a particular location in territory, often fixed regardless of the size of producers and differing depending on the type of commodity.

Several empirical studies try measuring the magnitude of this effect. Hertel and others (2003) econometrically estimated substitution elasticities between imports from different origins between two given countries including Argentina, Brazil, Chile, Paraguay, US, Uruguay and New Zealand through a gravity model. They find that the elasticities are substantially higher when only tariffs are considered, indicating that TC significantly affect trade flows between countries. In turn, manufactured products exhibit higher elasticities than primary products. The magnitude of the elasticity is explained by intrinsic product characteristics (weight/value, perishability). Thus, the boundary effects (ie, larger volume traded between regions with lowest TC) tend to be ceteris paribus the more significant for products with lower value/volume ratios and greater perishability. Similar results were obtained by Head and Mayer (2002) and Chen (2004).

In recent years, empirical evidence has accumulated indicating the existence of significant border effects at subnational levels, suggesting that internal TC and even other transaction costs could be very relevant (Kjollerstrom, 2004). Wolf (2000, 1997), who initiated this line of research, register this effect for the U.S.; Ceglowski (2000) and Helliwell and Verdier (2001) for Canada, Nitsch (2002) for Germany and Combes et al (2003) for France. The contribution of this series of work reinforces the idea that border effects do not emerge primarily from crossing political boundaries associated with observable costs such as tariffs but from spatial barriers, among which include freight and other transactional costs.

Table Nº 28: Manufactured imports elasticity, by commodity

Product	Elasticity
Beef	7.7
Other meat products	8.8
Vegetable oil and fat	6.6
Dairy products	7.3
Rice (processed)	5.2
Sugar	5.4
Other foods	4.0
Tobacco and beverage	2.3
Fabrics	7.5
Clothes	7.4
Shoes	8.1
Wood Products	6.8
Paper and Publishing products	5.9
Petroleum and coke	4.2
Chemicals and plastic goods	6.6
Other minerals	5.8
Ferrous materials	5.9
Other metals	8.4
Metal products	7.5
Vehicles and their parts	5.6
Other transport equipment	8.6
Electrical equipment	8.8
Other machinery and equipment	8.1
Other manufactures	7.5

Source: Hertel et al, 2003

7. Conclusion

Just as articulation between spatial and transport economics has been increasing, the fall in long-term TC appears to have reduced the role of space in modern economies. Recent technological and organizational innovations in the sphere of circulation and distribution of commodities (new logistics, large retail chains, just in time practices, etc.) have diluted locational advantages

for many firms based on market geographic segmentation and therefore have reduced internal trade barriers. It is then considered that technological change may eventually mitigate the friction imposed by physical distance, triggering thus a process of relocation to low-cost areas or, alternatively, with the greatest potential to benefit from scale economies.

However, a more careful analysis of the evidence shows that prediction is far from widespread. Transport costs should be interpreted as a package including not only costs of physical movement of commodities, but also trade transaction costs based on distance (eg time, effort and search cost, specification of product attributes and/or service agreement, terms of payment, delivery and maintenance guidelines, technical assistance, etc.). In this sense, although the fall in freight rates and the significant increase in traffic of information have eroded much of local firms competitive position, based on the natural protection based in TC from more distant rivals, certain trade costs continue to give rise to proximity advantages (especially those where the transaction involves personal supplier-customer contact type).

Despite the lack of information, in Argentina the evidence shows a deficit of transport infrastructure that can be summarized as follows:

- Low density routes. The most populated areas exhibit some articulation in the transport system that contrast to the isolation of backward regions. In relatively richer provinces road density is almost 4 times higher than that observed in poorest jurisdictions.
- The percentage of paved roads exhibited an increasing trend in national highways but does not reach a third of total length taking into account provincial and municipal roads. The low level of paved roads, overloads on paved roads pressing thus maintenance costs.
- Suboptimal levels of investment in road network maintenance. This causes premature aging of the network lowering transit capacity.
- The high share of truck freight transportation (especially in general cargo, which includes manufactures) leads to pose that the incidence of freight in commodities final price is probably greater than elsewhere. Figures for specific periods show that the truck rates relative to railway fares increased without leading to substitution between both modes. This is due to the lack of adequate rail infrastructure between certain destinations causing demand trucking rather inelastic.
- Road transport fleet oversized and old. On the one hand, the surplus stock puts pressure downward on freight but age increases operating costs (higher repairing costs, travel time, etc.). There are corridors where the transport services supply is adequate and varied and others where there is virtually no systematic service.
- As opposed to the fairly widespread belief that TC have substantially diminished in recent years and that therefore TC do play virtually no role in location of productive activity, empirical studies show that TC has not decreased uniformly in all modes and nor have reached the same magnitude in all regions. Some modes of transport have reached marginal decreases in cost while other have experienced more significant cost reduction. The largest decreases were recorded in international freight transport (more in time and cost terms and especially in ship transport after the introduction of motorized transport containers and incorporation of larger size units).
- There is poor evidence on the evolution of inland freight. Judging by the stock of roads and trucking operation in Argentina, the reduction of TC within the country, if operated, occurred slowly and unevenly in space. While fleet restructuring towards more advanced units is active, the pace is slow and it's strongly dependent on macroeconomic conditions. Overall, it was found that each advance in transportation methods tends to favor certain routes and these routes form a very limited network. The impact on production activity is then mixed according to industry and region.

- Regarding the impact of TC on locational pattern, production structure and domestic trade our findings can be summarized as:

  ⇒ Distance acts as a differentiation factor in certain types of activities in regional economies, classified as a low range (maximum distance that buyer is willing to go to get the product) and low threshold (minimum market ensuring firm survival), typical of small urban centers. The existence of TC of certain magnitude creates conditions for the emergence of production structures scattered around various urban markets.

  ⇒ High TC pressure final goods manufacturing firms to produce closer to customers and also push early processing stages near the sources of supply. Up to some consumer dispersion and raw materials sources spreading, TC ceteris paribus stimulate the spatial spread of establishments. Thus, the exploitation of scale economies by spatially concentrated production is hampered by the need to control TC. In the extreme case, if TC are prohibitively high, production should be held in each market and employment in manufacturing would be proportional to local demand. When TC are not null but moderate most of producers located in larger markets and export to smaller ones. If TC are null location is independent of TC (Krugman, 1991).

  ⇒ Trade barriers vary from one sector to another and even within the same sector. They tend to be low if the incidence of TC in total expenditure is negligible or high if the product could be altered during transport to market (eg perishable goods). In general, there is strong negative correlation between the height of trade barriers and the existence of scale economies in a given activity. For this reason, sectors with high trade barriers tend to be dominated by SMEs. Moreover, as TC raise a barrier to commodity entry from other regions; it diminishes the pressure on PC for local establishments discouraging thus the adoption of innovations.

So far, there are ways to demonstrate that high TC lead to spatial segmentation (recall that TC also includes transaction costs, operationally complex to quantify). Therefore, indirect approaches are only supported on its consequences, ie, spatial dispersion of production. It should be noted that while a scattered spatial distribution is not necessarily indicative of internal trade barriers in countries like Argentina, with strong agglomeration population figures in few points, the existence of activities relatively less spatially concentrated supports the hypothesis of the existence of internal trade barriers.

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Chapter 12
Ecological Orientation in Measurement of Transport Intensity in Economy

Izabela Dembińska

1. Introduction

Analysis of the place and the role of the transport in economy function, including the stimulation and the reaction into changes occurring in it, are obliging to look at the economy through the prism of the intricate and dynamic structure. It is possible in this case to consider the complexity of the economy above all from a point of view of two structures: sector and spatial, remaining with each other in the arrangement which indeed influence the transport. However dynamics of the economy are space-time expressing its state and structure, according to the assumption that the economy is in a sustained development, since its components are undergoing constant changes.

The problem of transport intensity in economy already has its place in the area of theoretical deliberations about the transport. There is, therefore, some new field of research. However, changes in the environment have forced transport intensified in recent years, an attempt to reinterpret the concept. The aim is to develop recall some of the discussions about a new approach to the scope of the concept of semantic transport intensity in economy against the background of its current understanding.

2. Transport and economy: power and scope of the interdependence

It is undisputed that transport plays a vital role in the economy. It is an integral part. Fully complementary role in relation to other sectors of the economy, but also you can look further and see transport as a carrier system for the economy, highlighting the role of its conditioning to any other activity. This statement gives a clear to understand, first, that the functioning of the economy without transport is not possible, and secondly - the operation of transport without the economy would not be justified.

The economy isn't a monolith. Its branches form a structure that exhibit relevant differences generated transport needs in terms of their distribution in space and time and qualitative characteristics. It isn't impossible to exchange all differences in detail, nonetheless it is possible to point for most important, as:

- Material or immaterial character of the production
- Type of produced goods (semi-finished products, consumer, industrial final goods etc.)
- Transport, manual and stock susceptibility of goods
- Relation (and the relation degree) from raw material of the production
- Specificity of supply bases, production and markets
- Production cycle
- Cooperation degree of production
- Specificity of delivery channels
- Specificity of factors marking supply policy in the sphere of delivery, production and distribution
- Size and specificity of the demand’s spatial structure

- Disintegration of the demand in time (continuity, seasonal character, susceptibility to hesitations etc.)
- Participation in the international exchange
- Degrees and areas dependent on the use of personal transport, namely the possibility that the market for transport services

Transportation needs can vary in size and structure within the various sectors of the economy. It is therefore necessary to analyze the behavior of those making up the sector in a dynamic, bearing in mind that this behavior is determined by the structure of the market. The size and structure of the transport needs can therefore be seen as a function of market structure and behavior of transport users.

An important role in shaping the particular size of the transport needs of the life cycle of the sector to play the national economy. Rate of growth for individual sectors is, in fact diverse. It can be assumed that the growth sectors will report increased demand for transport, in the case of declining industries will need to gradually decrease. Furthermore, changes in transportation needs caused by changes in the sector structure of the economy and changes in the activity of the individual sectors have an effect on:

- Directions of the quantitative transformation of the industrial structure of the transport system,
- Directions of qualitative changes in the level of services provided by various modes of transport.

This means that the sector structure of the economy and activity of various sectors of the economy determines the suitability of each of the branch in meeting transportation needs.

Transport is both an element and the subject of economic development. Economic development usually associated with an increase in transport activity. Occurs, therefore, not only in the role of pacemaker, but the directions of economic development have also been a guideline for the development directions of transport. On the other hand, the transport may affect the development of stimulating the economy when its growth and potential is fully harmonized with the needs of the economy, and constraining, when its development and potential do not correspond to some extent needs to notify the economy.

3. Transport intensity in Economy: "old" interpretation of a problem

According to this, as stated previously, the functioning of the economy, and more precisely, its various departments, is possible due to transport activities. The economy is therefore characterized by certain degree of transport intensity. In the literature, the subject of transport intensity (transport intensity of national economy) mainly as the state of involving the transport activity in the operations of other departments of economy[162] are being defined what it is possible differently to express the business activity as the ratio of the demand for transports to the scale and to write in the following manner[163]:

$$WT_{gosp} = \frac{V}{A_{gosp}}$$

[162] Transport w procesie integracji gospodarki. Red. M. Ciesielski, Wydawnictwo Akademii Ekonomicznej w Poznaniu, Poznań 1996, p. 80 in.: T. Szempliński, K. Zaborska: Transportochłonność gospodarki narodowej. „Przegląd Komunikacyjny" 1978, Nº 2; Transportochłonność gospodarki narodowej. Red. R. Kuziemkowski, Wydawnictwo Komunikacji i Łączności, Warszawa 1981, s. 48-49; Transport. Red. W. Rydzkowski i K. Wojewódzka-Król. PWN, Warszawa 1997, p. 22 in.

[163] M. Madeyski, E. Lisowska: Badania analityczne transportu samochodowego. Wydawnictwo Komunikacji i Łączności, Warszawa 1981. Za: B. Liberadzki: Transport: popyt, podaż, równowaga. Wyższa Szkoła Ekonomiczno-Informatyczna w Warszawie, Warszawa 1998, p. 35.

where:

WT_{gosp} : ratio of transport intensity in economy

V : demand on transport

A_{gosp} : scale of economic activity

One should here understand the state of employing the transport activity as employing the work and objectified at the transport service of all departments of the economy, inclusive with the service of individual needs of the population.

It is clear that each of the sectors of the economy is characterized by only the appropriate level of transport intensity. And if so, the relationship described above will take the form[164]:

$$\begin{pmatrix} WT_1 \\ WT_2 \\ . \\ . \\ WT_n \end{pmatrix} = \frac{\begin{pmatrix} V_1 \\ V_2 \\ . \\ . \\ V_n \end{pmatrix}}{\begin{pmatrix} A_1 \\ A_2 \\ . \\ . \\ A_n \end{pmatrix}}$$

where:

$WT_{1,2...n}$: ratio of transport intensity in economy branches

$V_{1,2,,,n}$: demand on transport reported by individual economy branches

$A_{1,2...n}$: scale of economic activity in individual economy branches

n : economy branches

Partition and the industrial structure of the national economy are characterized by certain level of transport intensity, as it implicates[165]:

- Balance between the production of means of production and consumption,
- Balance between the extraction of raw materials and industrial processing,
- Balance between industries representing low and high degree of processing,
- Spatial distance between the centers of demand-and supply centers,
- Share of international trade in aggregate economic activity.

As noted, the structure is an overriding factor in determining transport intensity in economy. However, the significant role it should also be attributed to the historically shaped the organization of the economic sphere, more precisely the factors that determine it. They have been presented in previous discussions, the opportunity to discuss sources of transport needs (level of specialization in production, the level of cooperation, the degree of concentration of production, location of production facilities and logistics, organization and distribution of supplies, etc.).

Both the structure and the organization of economic activities in different sectors change over time. This process is continuous and inevitable. These changes, their content and strength, are directly reflected in their level of transport intensity (Table Nº 29). You can also adjust the level

[164] B. Liberadzki: Transport: popyt …op.cit., p. 35
[165] Ibidem, p. 82

of conscious transport intensity. This is possible through the deliberate impact on the various factors determine the economic structure and organization of economic life.

Its reasoning finds precision calculations and analysis by setting transport intensity for the various modes of transport. In the case of freight carried by road transport, for example, J. Brunel[166], founded in their study that the narrow definition of industry involvement in the service economy can be measured as follows:

$$RFI_i = \frac{road\_TK_i}{GDP_i}$$

where:

$road\_TK_i$: "tkm" quantity made by motor transport in "i" country

GDP_i : PKB of "i" country

Table Nº 29: Models of macroeconomic situation and its impact on the level of transport intensity

Macroeconomic situation	Consequences	Charakter of economy
Assumptions: A – economic activity, WT – level of transport intensity, V – demand on transport, i – set of economic branches		
$\Delta A_i \geq 0$, $\Delta V \geq 0$ i depends on the growth of production in *i*	$\Delta WT \geq 0$	Transport intensity in economy
$\Delta A_i \geq 0$, $\Delta V > 0$	$\Delta WT > 0$	Transport intensity in economy
$\Delta A_i < 0$, ΔV depends on the proportion of changes in the economy	$\Delta WT \geq 0$ lub $\Delta WT \leq 0$	Transport intensity in economy or Transport saving economy
$\Delta A_i > 0$, $\Delta V < 0$	$\Delta WT < 0$	Transport saling economy
$\Delta A_i < 0$, $\Delta V \leq 0$	$\Delta WT \leq 0$	Neutral economy or transport saving economy

Source: own studies

In broader terms, the indicator is presented as follows:

$$RFI_i = \frac{road\_TK_i}{TK_i} \times \frac{TK_i}{T_i} \times \frac{T_i}{IND_i} \times \frac{IND_i}{GDP_i},$$

where:

TK_i : "tkm" quantity made by all transport branches in "i" county

T_i : number of tons of cargo transported

IND_i : industrial production in "I" country

This means that considering the cargo, the involvement of motor transport in the service economy is the product: the participation of freight transportation by road in total freight transport (implemented by all branches), the average distance journeys, and the average weight of indus-

[166] J. Brunel: Freight transport and economic growth: an empirical explanation of the coupling in the EU using panel data. Laboratoire d'économie des transports - CNRS: UMR5593, Université Lumière, Lyon II, Ecole Nationale des Travaux Publics de l'Etat, Lyon 2005, p. 6 i n.

trial production value of 1 $, the share of industrial production GDP. Of course this is just an example; the methodology can be, depending on the needs, modified.

The main premises of transport intensity analysis for the various modes of transport are characterized by diversity of these outlays and the diversity of involvement in various service sectors. Moreover, the trend for aggregate transport intensity is not appropriate for transport intensity designated for each branch. This study showed for the German economy, which showed decrease aggregate transport intensity, whiles the increase of road transport[167].

Transport intensity can also be recognized as the sum, material-, energy-and labor-intensive, while specifying it as the ratio of expenditures incurred on the transport activity to the effects achieved in the economy, in its various branches, supported by transport, namely:

$$WT_{gosp} = \sum_{i=1}^{n} \frac{M_T + E_T + P_T}{Ef_G} = \left(\frac{M_{T_1} + E_{T_1} + P_{T_1}}{Ef_1} \right) + \left(\frac{M_{T_2} + E_{T_2} + P_{T_2}}{Ef_2} \right) + \ldots + \left(\frac{M_{T_n} + E_{T_n} + P_{T_n}}{Ef_n} \right)$$

where:

WT_{gosp} : ratio of transport intensity in economy

M_T : material intensity of transport

M_{Tn} : material intensity of transport serving n-branch of economy

E_T : energy intensity of transport

E_{Tn} : energy intensity of transport serving n-branch of economy

P_T : labor intensity of transport

P_{Tn} : labor intensity of transport serving n-branch of economy

Ef_G : effects gained in economy

Ef_n : effects gained in n-branch of economy

i : amount of economic branches

Therefore, the expenditures incurred in the transport activity can be expressed in three ways, firstly by the volume of traffic in tones, and secondly by the size of transport performance in tone-kilometers, and finally by the value of transportation in gold. In the first two cases are used in meters, natural, and more recently - a measure of value. National income and product are the effects of global economic activity. It should be noted that the use of only natural metrics, which is fairly standard practice, research, leads to obtain information about the transport intensity in an indirect and imprecise, and sometimes even incorrect. Increase in transport performance does not have to testify because of the increased transportation costs, and thus - as measured by the increased consumption of material resources, energy and labor. In addition, a special cognitive value, especially from the perspective of sustainable development is to calculate and analyze the transport of intensity in terms of material-, energy -and labor-intensive for its various sectors of the economy separately, because each of them characterized by different levels of expenditures incurred on transport activity, shaped by specific factors.

[167] H. Baum: Decoupling transport intensity form economic growth. W: ECMT, Key issues for transport beyond 2000. 15th International Symposium on Theory and Practice in Transport Economics. Paris: OECD 2000, pp. 231-260; H. Baum, J. Kurte: Transport and economic development. W: ECMT, Transport and economic development. 17th International Symposium on Theory and Practice in Transport Economics. Paris: OECD 2002, pp. 5-49

The aim of transport intensity measurement as W Rydzkowski and K. Wojewódzka-Król[168] noticed, determine sizes of the transport activity per unit of reference, but - like stress - there is no official statistical records, which would allow for precise, detailed measures of transport intensity particularly of subject character. Meters are the exception relating to the economy when you can use the following options[169]:

- tons of transported charges taken back to the individual of the value of the national income and of the national product,
- tons and kilometers of the transit work taken back to the individual of the value of the national income and of the national product,
- Value of transports and other core activities of the transport values taken back to the individual of national income and national product.

4. Transport intensity in Economy: "new" interpretation of a problem

Relations between the structure and functioning of the economy are the current and important subject of the research invariably for many authors. Of course climbs and motives for these examinations are changing. In foreign literature from two last decades clearly two directions of analyses related to this are became scratched:

- Examinations of developing the relation between the rise in the economy and transport intensity in a long stretch, in it particularly with respect to power and the scope of the effect of the factor of the fluctuation
- Examinations, what strength of the influence of the rise in the economy on the rise in transports is (coupling), which means that what step the rise in the economy and the rise in transports are dependent on oneself in, as well as whether the disappearance of this influence is possible, it is dividing the rise in the economy and the rise in transports (decoupling).

In macroeconomic analysis can be clearly demarcated areas of interactions in long and short term. The modeling of the general demand for transport of long-term use is now entered into the current so-called "new econometrics, co integration theory[170], which allows examining relationships of variables over long periods and seeking their long-term sustainability. Co integration because, simply speaking, the existence of dynamic relationships between variables. 70-80 to the end of the twentieth century assumed stationary time series[171]. The fundamental discovery was made by C.W.J. Granger[172], who noted that the time series properties are not generally met, and that economic processes are characterized by non-stationary. According to this, C.W.J. Granger and R.F. Engel[173] formulated property of co integration time series that can be inferred from the growth of the economy by transport intensity; needs to know the property that say about their distribution during the past time. However, it is assumed that the time series describing the growth of the economy and transport intensity move in a non-stationary manner, but similar to it, and more - share similar growing trends. And if so, relationship, what unites them is respect for stationary signs. Recognizing, however, the transition from assumptions of linearity and symmetry depending on long-term adaptation to long-term equilibrium position toward the non-linearity, in studies of the effect of the economy on the demand for transport use is now

[168] Transport … op.cit., p. 24
[169] Transportochłonność gospodarki … op.cit., p. 60
[170] Co integration theory was introduced to econometrics in the mid-eighties of the twentieth century. For its founder is considered C.W.J. Granger, who introduced her as the first established in 1981. Later the concept was developed by cwj Granger and R.F. Engel, who in 2003 for achievements in this area received the Prize. Nobel Prize in economics. Cointegration Theory widely described in W.W. Charemza, D. F. Deadman: New econometrics. PWE, Warszawa 1997; A. Welfe: Econometrics. PWE, Warsaw, 2003
[171] Stationery time series means that the parameters such as average and variance, do not change over time.
[172] More, see C.W.J. Granger: Some Properties of Time Series Data and their Use in Econometric Model Specification. "Journal of Econometrics" 1981, Vol. 16, pp. 121-130
[173] R.F. Engle, C.W.J. Granger: Co-integration and Error Correction. Representation, Estimation and Testing. "Econometrica" 1987, Vol. 55, pp. 251-276

co integration nonlinear analysis, often using the model correction through error[174]. In addition, the use of models allows the determination of co integration more reliable predictions of the general level of transport intensity in the long run, because they may reflect the importance of cyclical fluctuations[175], which may manifest itself in greater or lesser degree, but are an important determinant. Can be seen here:

- Cyclical fluctuations observed in the economy and their impact on the level of transport intensity,
- Cyclical fluctuations observed in the transport and their impact on the economy,
- Relationship between cyclical fluctuations in the economy and the cyclical fluctuations in transport.

Generally, therefore we can conclude concluded the need to develop research and improve methods of forecasting long-term transport due to its significant role to other areas of the national economy. It is also the implication of the extended time horizon for planning its development as set out by:

- High capital-, material-, time-, effort-, and land intensity of transport investments
- The need to synchronize the development of transport systems with the overall land development, while respecting the environmental conditions
- Making the development of transport systems from long-term trends of their development
- Changes in transport's technical and organizational structures

The second stream of research and analysis of the relationship between the economy and transport, focusing on the strength depending on transport growth from growth in the economy, and more precisely - on the possibility of separation of economic growth from growth in transport, i.e. to achieve decoupling, is a response to the growing importance to sustainable development. Can be observed in this case, the emphasis of the following problems:

- What are the levels of the relation between the economy rise and the rise in transports (coupling levels)?
- How to measure levels of dividing the relation between the economy growth and the growth in the transport (decoupling levels)?
- How the energy consumption of the transport looks in the context of the economy service and how to measure it up?
- How the carbon dioxide emission looks through the transport in the context of the economy service and how to measure it up?

[174] Here you can specify the following examples of researches on transport intensity in economy: 1) H. Meersman and E. Van de Voorde studied in the late nineties of the twentieth century the relationship between the growth of industrial production and transport intensity in Belgium (See H. Meersman, Van de Voorde E: Is Freight Transport Growth Inevitable? In: Which changes for transport in the next century? 14th International Symposium of Theory and Practice. ECMT, Paris: OECD, 1999, p. 23-51), 2) C. Gabella-Latreille examined in his doctoral thesis how it will present the relationship between the growth of industrial production in France and transport intensity to 2015 and will run as the growth of industrial production cycles and how they will shape the relationship (See C. Gabella-Latreille La Quinquin fret models, un modèle de simulation à l; horizon 2015 des flux de transport de marchandises. Tome 1: La Models Quinquin fret, un instrument d' aide à la décision. Thèse de Ph.D. de sciencess économiques. Lyon: Lumiére Université Lyon 2, 1997), 3) M. Kulshreshtha team examined the relationship between the growth of Indian economy and the demand for cargo transportation by rail (M. Kulshreshtha, B. Mage, M. Kulshreshtha: A Multivariate cointegrating vector auto regressive model of freight transport demand: evidence from Indian railways. Transportation Research 2001, 35 (A) 1, p. 1-72), 4) VW Yao, using the Granger test, examined the relationship between the evolution of production and inventory stocks in manufacturing companies and transport intensity (VW Yao: The causal linkages between freight transport and economic fluctuations.; International Journal of Transport Economics 2005, Vol 32, No . 2, pp. 143-159), 5) VW Yao and K. Lahiri analyzed correlation between cycles in the economy (designated by the method of the National Bureau of Economic Research) and the cycles of transport on the example of the United States (VW Yao, K. Lahiri, Economic indicators for the U.S. transportation sector. Transportation Research 2006, 40 (A) 1, pp. 872-887)

[175] Pioneering, wide attempt to show the complexity of the business cycles in the transport of Polish literature in the area of transport shows D. Rucińska: D. Rucińska: Cykle gospodarcze w transporcie. Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk 1992

- How to measure transport intensity of economy in the aspect of the dematerialization and transmaterialization (immaterialization) of transport?

P. Tapio[176] suggests that the separation of transport growth from economy growth, so called decoupling, put in the category of flexibility in the growth of GDP measured in terms of freight volume measured in tkm for freight or pkm passenger transport to value below 1. Because it reflects on the carriage of cargo, the pattern of this dependence, based on a P. Tapio proposal, is as follows:

$$e_{PKB/tkm} = \frac{\%\Delta PKB}{\%\Delta tkm}$$

where:

$e_{PKB/tkm}$: Flexibility in terms of economy growth in terms of increase in cargo transportation

$\%\Delta PKB$: Percentage change in economy growth measured by GDP

$\%\Delta tkm$: Percentage change in growth of cargo transport measured in tkm

P. Tapio points out that in this way you can measure the level of decoupling, not only for transport in terms of aggregate, but also for each branch separately. Also indicate that in addition to the average distance transport of 1 ton of cargo in km, changing freight growth, depending on the context analysis can be expressed as the number of kilometers driven by a single vehicle.

Tapio suggests that measuring levels of decoupling economic growth and increase in freight to make, respecting the fact that transport is a significant contributor to CO_2 emissions. Hence suggests that the measure decoupling of CO_2 emissions from the transport of freight volume in the following manner:

$$e_{tkm/T_{CO_2}} = \frac{\%\Delta tkm}{\%\Delta T_{CO_2}}$$

where:

$e_{tkm/T_{CO_2}}$: Elasticity of growth in CO_2 emission caused by transport in terms of growth in transports of cargoes

$\%\Delta tkm$: Percentage change of growth in transports of cargoes measured in tkm

$\%\Delta T_{CO_2}$: Percentage change of CO_2 emission caused by transport

Continuing the deliberation line of P.Tapio, taking into account the elasticity of growth in CO_2 emission caused by transport in terms of growth in transports of cargoes let us measure the level of the decoupling expressed with elasticity of growth in economy on the account of CO_2 emission caused by transport, which can be written down as:

$$e_{PKB/T_{CO_2}} = \frac{\%\Delta PKB}{\%\Delta T_{CO_2}}$$

[176] P. Tapio: Decoupling has begun in Finland. Economic growth, traffic volume growth and the CO_2 policy of EU15 and Finland 1970-2001. TUTU Publication 5/2003, Turku School of Economics and Business Administration, Finland Futures Research Centre, Turku 2003, p. 6

where:

$e_{PKB/T_{CO_2}}$: Elasticity of growth in economy in terms of growth in CO_2 emission caused by transport

$\%\Delta PKB$: Percentage change in the growth in economy measured by GDP

$\%\Delta T_{CO_2}$: Percentage change of CO_2 emission caused by transport

Indicator of economic growth in terms of elasticity of growth in CO_2 emissions caused by transport therefore indicates to what extent the economy service by transport, dependant on the growth of the economy, entails CO_2 emissions. P. Tapio believes that if this indicator shows decoupling achievement, it is possible to speak of the entrance to the levels of dematerialization of transport. Examining in turn the rate of growth elasticity of growth of cargo transportation, reaching decoupling in this case would be tantamount to the entry levels transport immaterialization. Dematerialization of transport is, therefore, a manifestation of reducing CO_2 emissions in transport, e.g. through technical innovations in transport, organic fuels, substitution by more environmentally friendly modes of transport[177], and immaterialization is a reduction of the level of transport intensity in economy, for example, through changes in the structure of the economy.

In addition to dematerialization and immaterialization, P. Tapio lists another form of decoupling that can be related to the engagement of transportation into economy service. He indicates decarbonization, which measures changes in the level of CO_2 emissions caused by transport with respect to CO_2 emissions throughout the economy[178], that is, by all other departments / sectors of the economy (Table Nº 30).

Table Nº 30: Decoupling forms of economic growth and transport growth (of cargos)

Decoupling forms	Measure
Immaterialization	tkm/GDP_{PPS}^{*}
Dematerialization	Transport CO_2/tkm
Decarbonization	TransportCO_2/GDP_{PPS}

PPS (Purchasing Power Standard) - applied in the EU conventional monetary unit by which economic units are compared in each country, taking into account the purchasing power of their currencies. In this way eliminates the influence of price differences on the size of these aggregates.

Source: own studies based on; P. Tapio, D. Banister, J. Luukkanen, J. Vehmas, R. Willamo: *Energy and transport in comaparison… op.cit,* p. 438

He adds that all these three forms of decoupling can take two options[179], either the relative separation, however, when the involvement of transport is increasing, but it is not proportional to the growth of the economy, only smaller, or absolute separation, when economic growth occurs when successive reduction of its transport intensity.

[177] M. Jänicke: Ökologische Modernisierung, Optionen und Restriktionen präventiver Umweltpolitik. In: Simonis, U.E. (ed.), Präventive Umweltpolitik. Campus, Frankfurt am Main 1988, p. 13-26; J. Kaivo-oja, J. Luukkanen: The European Union balancing between CO_2 reduction commitments and growth policies: decomposition analyses. "Energy Policy" 2004, Vol. 32, Nº 13, pp. 1511-1530

[178] P. Tapio, D. Banister, J. Luukkanen, J. Vehmas, R. Willamo: Energy and transport in comparison: Immaterialisation, dematerialisation and decarbonisation in the EU15 between 1970 and 2000. "Energy Policy" 2007, Vol. 35, p. 436. About decarbonization also wrote: N. Nakićenović: Decarbonization: doing more with less. „Technological Forecasting and Social Change" 1996, Vol. 51, Nº 1, pp. 1-17

[179] In addition to P. Tapio, at various levels also indicate decoupling J. Vehmas, P. Malaska, J. Luukkanene, J. Kaivo-oja, O. Hietanen, M. Vinnari J. Ilvonen: Europe in the global battle of sustainability: Rebound strikes back? Advanced Sustainability Analysis. Publications of the Turku School of Economics and Business Administration, Series Discussion and Working Papers 7, Turku, 2003; CI Wernick, R. Herman, S. Govind, J. Ausubel: materialization and Dematerialization: measures and trends. "Daedalus, 1996, Vol 125, Nº 3, pp. 171-198

To be valuable in this matter the reflections of D. Stead[180] should be considered, which presents different approaches to measuring transport intensity that are currently used in research, analysis and statistics by EUROSTAT, the World Bank and OECD, demonstrating the growing importance of sustainable development. Thus shows that look at transportation-management relationship have been extended. He looks up, not only the tasks and duties of transportation to the economy, but also that it brings with it consequences for the environment of their implementation.

When considering a new approach to transport intensity in economy, two issues emerge. Firstly, it should be noted that this new approach is based, in essence, two shots - the measurement of efficiency for the transport of energy, or energy intensity of transport, and for measuring the efficiency of handling the economy (Table Nº 31). It is also important that both approaches used the concept of net mass transport (NMM - net mass movement) and the gross weight of the carriage (GMM - gross mass movement), which moved from the energy sector in the area of transport S. Peake, believing that it is possible, by analogy, As with the analysis of energy efficiency in production and consumption (efficiency of energy intensity of production and consumption), to analyze the effectiveness of transport intensity in economy. Both the NMM and GMM capture the total passenger and cargo, where the rate of NMM is imputed as the sum of the ratio of total passenger carried and 11.11 (assuming that people and their luggage, they weigh on average 90 kg) and total tone-kilometers. As regards the rate of the GMM, it is imputed as NMM, in that it takes into account the additional weight means of transport used to transport people and cargo and empty driving modes, which relate to freight transport[181]. You can have, therefore, the conviction that operation of the economy by analyzing the transport efficiency of the prism is to show how the management of the environment necessary to support this could be done. Do you conform to the standards imposing the principles of sustainable development or not, or the extent to which they correspond.

Table Nº 31: Indicators of transport intensity area characteristics in modern statistics (for cargos)

Area of measurement	Measure of transport intensity
Energy intensity in transport	Energy consumption /tkm Energy consumption / cargo net mass
Effective service in economy	GDP_{PPS}/tkm GDP_{PPS}/cargo net mass GDP_{PPS}/ Energy consumption

Source: own studies based on; D. Stead: Transport intensity in Europe…op.cit, p. 30

The second issue concerns the GDP, which is used in the traditional measurement approach of transport intensity in economy. This approach still has its analytical value, but it is too narrow, if we consider that the functioning of the economy must conform to the objectives of sustainable development, creating conditions for sustainable prosperity. This means that the use of GDP in measuring transport intensity in economy with such a condition is insufficient. Thus reveals the weakness of GDP as an indicator of economic activity. Hence, D. Stead takes the view that among the many new alternatives to measures of GDP, which appear in recent years, in studies on transport intensity in economy functioning by principles of sustainable development can use the rate of sustainable economic prosperity ISEW (Index of Sustainable Economic Welfare)

[180] D. Stead: Transport intensity in Europe – indicators and trends. "Transport Policy" 2001, Vol. 8, No. 1, pp. 30-31

[181] Broader concept is described in S. Peake: Transportation in Transition. Earthscan, London 1994. Indicators NMM and GMM define and use in their studies include: D. Banister: Unsustainable Transport: The Transport Crisis. Spon Press, London-New York 2005, p. 49; D. Banister, D. Stead, P. Steen, J. Akerman, K. Dreborg, P. Nijkamp, R. Schleicher-Tappeser: European Transport Policy and Sustainable Mobility. Spon Press, London-New York 2000, p. 51; L. Michaelis, A. Davidson: GHG mitigation in the transport sector. "Energy Policy", 1996, Vol 24, Issue 10/11, pp. 969-984, D. Stead: Transport intensity in Europe…op.cit.

developed by H. Daly 's and J. Cobb Jr[182]. Simply speaking, the concept of ISEW is based on adoption as the basis for calculating public spending on final goods and, more specifically - the size of individual consumption that is being referred to as weighted by the increased or decreased, depending on whether additional consideration categories contribute to increasing the level of prosperity and may cause its decline[183]. Therefore, the contribution of transport will be analyzed in the creation and delivery of welfare, rather than in the growth of the economy, which does not necessarily mean well-being, something that was already under consideration. By analogy, therefore, as in the case of GDP transport intensity in economy can be measured as follows:

- ISEW / tkm
- ISEW / net mass of the transport
- ISEW / power consumption caused by the transport

Such attitude gives the possibility of more versatile measurement to the economy activity, as well as the wider look at the object of the transport service.

5. Conclusion

Summarizing the discussion above “old” and “new” interpretation of transport intensity in economy, transport intensity in economy, in the classic sense reflects the degree and strength of the relationship between transport and the economy. The new, broader interpretation shows how to shape the transport system that was tailored to the needs of the economy and have them meet without interference, while respecting the principle of rational management of the environment.

[182] ISEW for the first time has been used in H. Daly and J. Cobb, Jr..: For the Common Good: Redirecting the Economy towards Community, the Environment, and Sustainable Future. Green Print, London 1990

[183] The elements included in the calculations SIEW are: (+) value of the work in the household, (+) value of the services of consumer durables, (+) value of the services of roads and highways, (+) consumption related to education and health, (+) increase in net capital, (+) balance of investment abroad and foreign country (-) health care and education, (-) spending on advertising, (-) expenses associated with commuting, (-) cost of urbanization, (-) expenses associated with traffic accidents, (-) pollution, (-) spending on consumer durables, (-) loss of natural resources, wetlands and agricultural areas, (-) loss resulting from long-term changes in the environment (greenhouse effect, loss of layer layer), the difference (+/-) net capital (+/-) changing international position. ISEW is widely characterized in S. Gil, J. Sleszynski: Index of Sustainable Economic Welfare (ISEW). Economist2001, No. 1; P.A. Lawn: A theoretical foundation to support the Index of Sustainable Economic Welfare (ISEW), Genuine Progress Indicator (GPI), and other related indexes. Ecological Economics 2003, Vol 44, pp 105-118, E. Neumayer: On the methodology of ISEW, GPI and related measures: some constructive suggestions and some doubt on the; threshold hypothesis. Ecological Economics 2000, Vol 34, pp. 347-361

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Section Four
Case Studies

Chapter 13
City logistics and sustainable development

Blanka Tundys[184]

1. Introduction

Postindustrial phase of city development is featuring incessant increase of the number of towns and its inhabitants. Considering and analyzing ONZ[185] statistics a conclusion occurs that since 2009 over 50% of the population occupies the cities. It is predicted that in 2050 this percentage will increase up to 68,7%. In this case a constant increase of the social, economical and ecological problems is most likely in such developed administrative units. Movement on such areas becomes a larger case as well as the flow of logistics streams - supplying the cities with goods and services. These circumstances are forcing an interest in ideas of city logistics and ability to compensate the transportation issues between them through solutions from its area of expertise. It also has to be taken under consideration that the highest rate of growth of the population takes place in developing countries. In highly industrialized nations this rate is not such spectacular however other problems occur within them, which have to be solved systemically. The list of most burdensome inconveniences contains mainly those related to air pollution, noise or congestion, which are the result of economic activities, social and motorization development.

Implementing the principals of city logistics the focus should be concentrated on improving the flow of logistics streams on urbanized areas, simultaneously in compliance with sustainable development. The principals of green logistics, which are in similar in scope to sustainable development should reflect in ideas of City logistics.

Transportation burden in the cities and increasing number of logistics processes occurring on urbanized areas requires appliance of new means and solutions, which would provide improvement in the quality of life and encourages the settlement in urbanized centers.

2. City logistics: characteristics, objectives, areas

2.1. Etymology and development of theoretical aspects of urban logistics considering ecological aspects

From the beginning of the second half of XX century logistic ideas were developed constantly. That also included spreading the levels and areas of interest of systemic operations, which were improving the functioning of the entities (not only economical ones). In the nineties of XX century began the concern of the cities about ideas which would relieve them from the negative influences of transportation, lower and rationalize the number of vehicles (both passenger cars and trucks), also improve the flow of any streams within urbanized areas. It is relevant that certain analogies were found in implementing complex logistic solutions for urbanized areas, which share the characteristics of logistic system. The presence of the flow all logistic streams is noticeable, which means that the most of economical and social processes taking place within the cities, requires logistic support through creation of integrated ideas, which would support the transportation system functioning.

City logistics is one of the basic elements of urban economy, including municipal, residential, housing, public utility, and resources of urban areas economies. Logistics ideas regard the city as a socially urbanized area, within which trade takes place and which economical infrastructure should be wisely utilized[186]. Th. Wagner[187] presents a belief that city logistics considers logistic

[184] Blanka Tundys, PhD. University of Szczecin, Faculty of Management and Economics of Services
[185] 2009 Revision of World Urbanization Prospects, United Nations, 2009
[186] see, e.g. D. Aden, Zeit für Kooperation: City-Logistik und Warenzentren, w: R. Hossner (red.) Jahrbuch der Logistik 1995, Düsseldorf 1995, p. 61

difficulties in geographically defined and restricted urbanized area. It is a tool designed for solving those problems and to seek the synergic results, reducing the costs and presenting its orientation on the flows at the same time. Its development was possible only through a new logistic social movement. Due to that movement the logistic became an instrument of providing the citizens with best possible conditions of functioning and improving the quality of life.[188] The subjects of this matter are affecting all actions of the daily cycle of civic life as an economical, social and cultural space.[189] Therefore managing the city as a system must adopt its economical, ecological and cultural dimension. Such approach in the context of relevance of the sustainable development in the cities allows to conclude that the logistic solutions must be correlated with preservations of natural environment. Depending on the range the logistics can be defined in general or particular sense, accepting different conventions: classic, systemic and ecologic[190].

Table Nº 32: Characteristics of urban logistics depending on convention

Convention	Characteristics
Classic (location of street network)	Contains logic ordering of the flow in time and space, especially through the central areas of the city and agglomeration, various types and intensity of street network traffic: individual passengers, deliveries, disposals, transit and public transportation. It also considers forming principals for optimization of the city system by planning, steering and supervising all processes taking place in the system, in economic, ecologic, technical and social dimension.
Systemic	Contains logical configuration of urbanized economical area of human activity with compliance to the principals of minimization of logistic outlay. It determines functioning of the city infrastructural and suprastructural elements in cooperation with urbanized cultural environment. It defines logistic relations between those elements and theirs physical properties. It describes the metalogistic and macrologistic processes, considers strategic and operative management of the city as a system, with all its internal and external conditioning, which are leading to optimization of the outcomes of servicial logistics in city development and its interactive environment. It proves that the logistics is a stimulator of the dynamics and quality of the city development.
Ecologic	Contains logical configuration of the flows and transportation system functioning in compliance with principals of sustainable development. It considers stimulating and promoting actions which would help to reduce external costs. It promotes clean civic transportation.

Source: own elaboration based on: M. Antonowicz, H. Zielaskiewicz, *Możliwości wykorzystania transportu szynowego w logistyce miejskiej na przykładzie miasta Wrocławia,* in: Logistyka a infrastruktura miejska, I Science and Technology Conference, CL Consulting & Logistyka Publishing House, "Nasz dom i ogród" Publishing House, Wrocław 2004, pp. 11-12, B. Rzeczyński, *Logistyka miejska XXI wieku. Słowo odrębne z refleksją nad jej przeznaczeniem*, „Logistyka" Nº 3/2002 and B. Rzeczyński, *Racje i ogólne cele logistyki miejskiej,* "Logistyka" Nº 4/1999

Urban logistics is managing the logistic system of the city, which is its socioeconomic subsystem. It is influencing specific fractions through those subsystems (supply, production, distribution, transportation, warehousing, utilization). It also affects the needs of higher category (sustainable development, ecology, revitalization) creating logistic system of the city. Considering

[187] see, e.g. Th. Wagner, City-Logistik als Teil der Supply- Chain, Diss. Wissenschaft & Praxis, Sternenfels 2002, p. 29

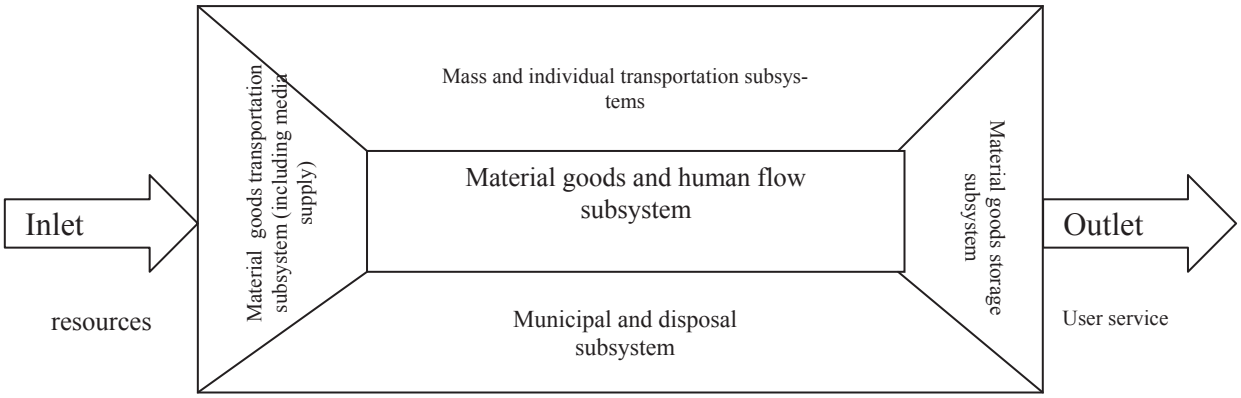
[188] M. Szymczak, O istocie i funkcjach logistyki miejskiej, w: Współczesne kierunki rozwoju logistyki red. nauk. E. Gołembska, PWE, Warszawa 2006, p. 73

[189] Id, p. 75

[190] Reflections quoted for M. Antonowicz, H. Zielaskiewicz, Możliwości wykorzystania transportu szynowego w logistyce miejskiej na przykładzie miasta Wrocławia, in: Logistyka a infrastruktura miejska, Science and Technology Conference, CL Consulting & Logistyka Publishing House, "Nasz dom i ogród" Publishing House, Wrocław 2004, p. 11-12 and B. Rzeczyński, Logistyka miejska XXI wieku … op. cit., and B. Rzeczyński, Racje i ogólne cele logistyki miejskiej, "Logistyka" Nº 4/1999

the functional demarcation of logistic systems presented by H. Ch. Pfohl[191] and classification presented by J. Szołtysek[192] it is possible to acknowledge the logistic subsystems of the city, which is related to ideas of urban logistics.

Figure Nº 30: Logistic system of the city as a subsystem of the socioeconomic system



Source: J. Szołtysek, Logistyczne aspekty zarządzania przepływami osób i ładunków wmiastach, Katowice University of Economics, Katowice 2005, p. 92

By presenting the urban logistics the most conventional way, also by restricting the study only to the area related to civic transportation, it is possible to display on what areas and which subsystems are the subjects of logistics contained.

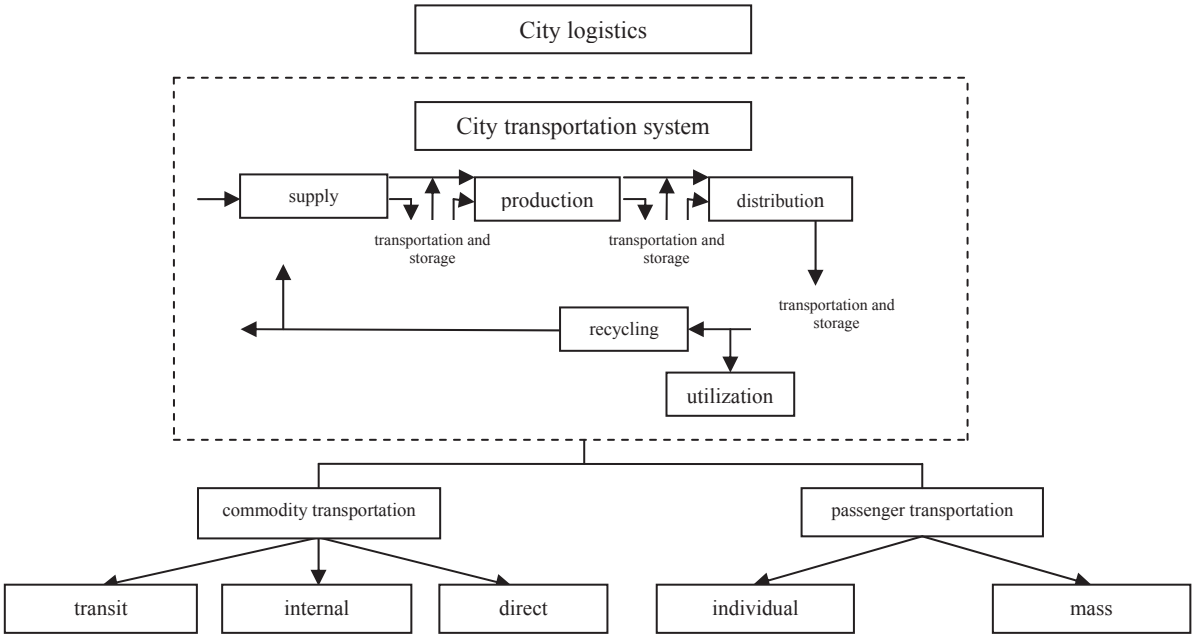
Complex definition in Polish literature is displayed by J. Szołtysek[193] who claims that urban logistics is an entirety of processes of managing the flow of person, cargo and information inside the logistic system of the city, according to needs and objectives of city development in harmony with natural environment. Considering the city as a social organization, its primary target should be to meet the needs of its inhabitants.

Examining the issues of urban logistics[194], the following should be taken under consideration:

- Subject of study which consists: flow of the products and humans with related information within the city logistic system,
- Objective of study, which constitutes the city logistic system with its processes and phenomena, which are of interest to urban logistics,
- External goals – meeting the social needs and development objectives of its inhabitants,
- Internal goals: efficient control of the flow of all resources within the city, between its subsystems.

[191] see, e.g.. H. Ch. Pfohl, Systemy logistyczne, Biblioteka Logistyka, Instytut Logistyki i Magazynowania, Poznań 1998, p. 20
[192] see, e.g.. J. Szołtysek, Logistyczne aspekty zarządzania przepływami osób i ładunków w miastach, Katowice University of Economics, Katowice 2005, p. 93
[193] Idem, p. 105
[194] J. Szołtysek, Logistyczne aspekty zarządzania przepływami osób i ładunków w miastach… op. cit., p. 104

Figure Nº 31: Urban Logistics



Source: B. Tundys, Logistyka miejska, koncepcje, systemy, rozwiązania, Difin 2008, p. 135

Such consideration is indicating that these are internal connections of transportation system within specific civic area, containing flows of cargo as well as person, which are set on efficient, optimal and ecological coordination of civic transportation, containing all kinds of components: infrastructural, organizational, info-technological and personal, considering economical, social and ecological aspects. The ideas that support functioning of logistic system of the city, relieving environment, traffic and intracivic areas are going to be regarded as projects supporting urban logistics.

2.2. Objectives, areas and functions of city logistics

City logistics has become one of many functional areas of city management. All logistic operations must focus on meeting needs of its users, competing between themselves on common areas. Functional and area partitioning of city logistics is depending on its range of interactions.

Specific infrastructure (social, technical, residential, logistical) is required for realizing objectives, functions and area division. Acquiring such infrastructure supports exploitation of human potential and points out investments directions. It is not possible for the city, economy and human potential to coexist without appliance of urban logistics and implementation of related projects. Functional and area partitioning of urban logistics presented by Th. Wagner[195] is displayed in Table Nº 33.

[195] Th. Wagner, City-Logistik als Teil … op. cit., p. 64

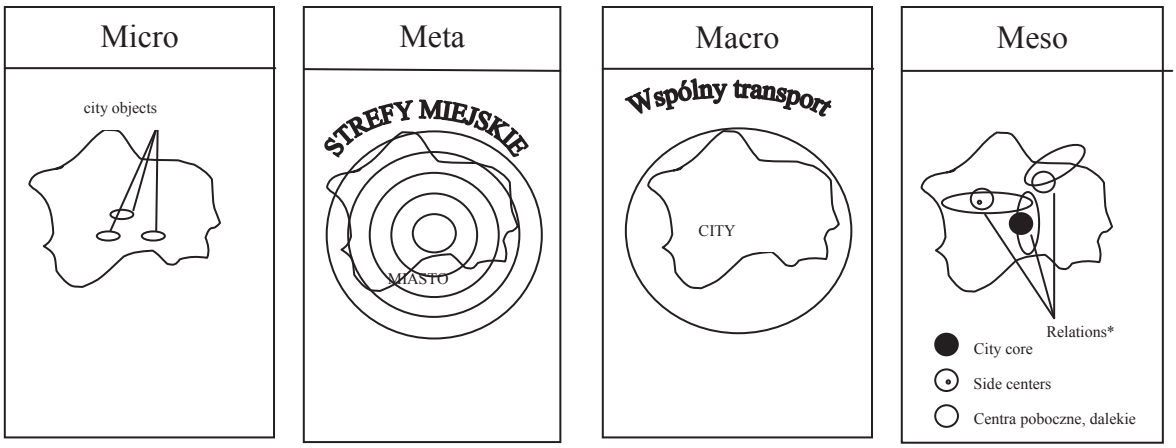
Table Nº 33: Functional and area partitioning of urban logistics

Area partitioning	Functional characteristics
Macro – urban logistics (urban logistics in macro approach)	It contains the study on transportation relations and flows between cities and regions and their influence on transportation relations in specific cities. Importance of this matter is accented on the level of general economic relations without separating them on trades, chains or channels. It examines economical relations and flows of logistic streams between different cities. Initiation of supply is carried out by locating logistic centers on the outskirts of the cities.
Micro – urban logistics (urban logistics in micro approach)	In this approach the levels of singular economic relations in the city are being considered. It is focused on objects like economic institutions, public utilities, enterprises and households. Distribution and means of its realization are strongly accented.
Meta – urban logistics (urban logistics in meta approach)	Main interest is put in horizontal economic relations between business entities in specific logistic chain. Systemic level of logistic structure is set within city area. Economic relations in specific chain are matched with appropriate economy levels. These are relations of lower importance, appointed to single economic area. It mainly regards special sort of service and such assortment (chemists, bookstores, retailers of luxury assortment)
Meso – urban logistics (urban logistics in meso approach)	It examines the flows in specific city areas and districts. Within this idea the city is being divided in specific zones of influence and deliveries. Connections between these zones are equalized on specific, homogenous economic area. These connections are related to vertical contacts in logistic channels. Those are in fact entities in the same trade in particular areas of the city.

Source: own elaboration based on: Th. Wagner, City-Logistik als Teil der Supply – Chain, Wissenschaft & Praxis Publishing House, Sternenfels 2002, p. 64

Graphic display of the partitioning is presented as follows:

Figure Nº 32: Spatial relations between specific levels of city logistic system



Network of transportation flow between specific business entities and city zones

Transport relations between individual business entities of the same or related trade in crossing point of particular parts of the city

Source: based on: Th. Wagner, City-Logistik als Teil des Supply-Chain: Entwicklung einer Konzeption vor dem Hintergrund infrastruktureller Veränderungen, Wissenschaft & Praxis Publishing House, Sternfels, 2002, p. 67

Accepting the city as a starting point of logistic operations, the subject of study on its territory will concern areas related to[196]:

- Cargo transportation: supply, transit, incoming and outgoing, also forming transport connections between agglomeration and logistic system of macro-region
- Preservation and stocking goods for benefit of the city
- Passenger mass and transit transportation
- City supply
- Disposal of waists
- Organizing the telecommunication network in the city.

Studying urban logistics three aspects has to be taken under consideration, which are strongly contributing to area partitioning and the range of implemented conceptions interactions. These areas are depending on specific approach (area, industrial and instrumental) towards urban logistics. Division and characteristics are presented in Table Nº 34.

If urban logistics is suppose to solve problems occurring in civic environment, a particular set of goals and objectives has to be created. All operations should be reflected on balanced strategies of the city development.[197] Basic objective is considered as providing the means of development for the civic areas in compliance with meeting social, economical and ecological needs of the agglomeration such as: quality of life, managing, economizing and sustainable development.

Table Nº 34: Division of urban logistics regarding its aspects

Aspect	Area	Interaction
Area	▪ city logistics ▪ center ▪ zones	▪ users cooperation ▪ revitalization ▪ commodity transportation ▪ supply optimization within strict city center ▪ optimization of distribution outgoing from city center ▪ optimization of all commoditive flows in the city which are suppose to relieve it
Industrial	▪ cooperation within transportation (from supplier to recipient)	▪ transport: transport companies, forwarding agencies, ▪ suppliers: industrial enterprises, trade chain, ▪ recipients: retailers
	▪ trade	▪ fresh and frozen products
	▪ services	▪ handling offices, institutions, schools, universities
	▪ waists	▪ disposal and utilization
	▪ construction yards	▪ means and materials for construction
	▪ final consumers	▪ mail-order trade, deliveries, teleshopping
Instrumental	▪ technical and organizational ▪ informational ▪ planar and regulative ▪ cooperative and communicational	▪ optimizing commodity transportation (both close and long-distance), transportation networks ▪ core functions (infrastructure, logistic centers, terminals) ▪ partnership between suppliers and recipients (flexibility in time and delivery points – creating ramps, sluices) ▪ telematics ▪ prospecting of the civic space

Source: B. Tundys, Logistyka miejska, koncepcje, systemy, rozwiązania, Difin, Warszawa 2008, p. 150

[196] M. Szymczak, O istocie i funkcjach logistyki miejskie, op. cit., p. 77-79 and Kompendium wiedzy o logistyce, op. cit., pp. 293-295

[197] Ł. Hadaś, Logistyka miejska w strategii rozwoju miasta, w: Logistyka a infrastruktura miejska, I Science and Technology Conference, CL Consulting & Logistyka Publishing House, "Nasz dom i ogród" Publishing House, Wrocław 2004, p. 26

Economical goal focuses on lowering the costs of logistic processes, realized as a service to the city, as well as the social costs of its inhabitants. It also regards improving those processes, which would reduce their negative influence on natural environment[198]. Social goal is related to meeting needs of the citizens and on improving their quality of life through efficient realization of the main functions of the city. Providing conditions for the city development in all three aspects should be the long-term objective.

Objectives[199] of urban logistics ought to be considered as something more than only gathering, merging and connecting the loads. Combining all that could help reducing driven distance within the city and increasing efficiency of transportation means. Following are considered as objectives: determining areas of coordination of logistic processes by various entities operating within the city, working out the methods of coming to agreements between the city and specific network entities in the area of planning and realization of logistic processes. Controlling the course of logistic processes is also very important, especially processes of flows within the city in compliance with commonly accepted principals and conditions, as well as determining operations which should be carried out by the city in benefit for infrastructure transformation and improvement of the flow control in the city areas. All kinds of modernization plans should be based on economic efficiency and financing ideas with regard for any available models and commercial sources. Applying of fiscal instruments and accenting the efficiency in infrastructure usage should be taken under consideration. Another objective of urban logistics might be strategic planning and development of the cities[200]. First in line are organizational and technical dimensions of logistic flows and an attempt to connect logistic and area needs of most interest groups. Core principal of the projects and their practical appliance is at least partial realization of objectives and expecting certain outcomes. The objective of the operations is proper distribution of the specific, regular but yet not coordinated transport flows[201]. Relieving the city must go head to head with increasing the cost-effectiveness[202] of processes on urbanized areas. General conception should form technical and organizational flows in cities and agglomerations.

2.3. Levels and types of concepts

The number of solutions, ideas and means of realization in urban logistics is extremely high. This section will be dedicated to present selected and applied solutions mostly identified with logistic support of the city. The area partitioning shows that specific ideas may contain: service for singular customers, delivery and service of pedestrians traffic areas, delivery and service of particular parts and districts, service of specific relations in internal transportation or whole areas of close transportation. Regarding conditions which may contribute to success of these ideas, following has to be considered[203]:

- Commodity transportation must disregard transport classical, individual delivery system, in return the cooperation between companies must exist, which will consider modern logistic strategies of commodity deliveries
- Trading and industrial companies should reconsider their commodity flows and start cooperating with transport, forwarding and logistic companies which makes the abandonment of individual deliver services necessary
- Exchange of experience between offices, authorities, business entities, industry and TSL companies must be intensified
- Solutions are highly dependent on logistic and transport infrastructure on specific area

[198] I. Dembińska-Cyran, Logistyka miasta, "Gospodarka Materiałowa i Logistyka" Nº 11/2001, p. 18
[199] S. Krawczyk, Logistyka w zarządzaniu miastem… op. cit., p. 47
[200] K. Lewandowski, Wykorzystanie towarowego transportu szynowego w logistyce miejskiej Wrocławia, in: Logistyka a infrastruktura miejska, I Science and Technology Conference, CL Consulting & Logistyka Publishing House, "Nasz dom i ogród" Publishing House, Wrocław 2004, p. 51
[201] see, e.g. S. Kruse, A. Marquardt-Kuron, U. Schaller, Ch. Schneider, U. Wienke, City-Logistik – Ein Leitfaden für die Praxis… op. cit., p. 21
[202] A. Ergenzinger, Kartellrechtliche Aspekte virtueller Unternehmen am Beispiel der City-Logistik..., op. cit. p. 19
[203] Id., p. 59 and 80-81

As infrastructural conceptions following solutions may be classified: serving entire agglomeration (logistic centers, logistic service centers, logistic production centers), decentralized solutions - reloading sites (city distribution centers), City-Terminals, concepts of road infrastructure upgrading.

In realization of these ideas, introducing city marketing as a medium of advertisement and information is an additional mean. Also very helpful are ideas of reducing pollution in natural environment by eliminating negative influences of transportation in the city, introducing telematics in transportation and promoting cycling and public transport instead of individual one.

There are conceptions that cannot go unmentioned which could strongly contribute to improvement of the quality of life of inhabitants of specific territorial units. Apart from the major city roads, the ideas of promotion of public transportation are also of great importance. Among many others, the express tram, usage of railroads and building subway ale the leading ones. Last one might be quite capital intensive and in many cases impossible to realize, but the first two could initiate the change in consumers way of thinking by availability and competitiveness, which could lead to abandonment of individual transportation for benefit of public means of traveling. Competitiveness is displayed in availability, convenience, quality of the service and in financial aspects. Until public transportation will offer only availability and the costs will still be relatively high it will not be competitive enough for individual transportation. This requires the authorities to cooperate and provide substantial direct grants. Another important matter considers appliance and improvement of already existing solutions, such as sharing civic areas and division of transportation objectives which rationally performed could reflect positively.

3. Analysis of capabilities of matching the sustainable development principles to concepts of urban logistics

3.1. Levels of sustainable development and urban logistics

Current trends in city development are indicating disproportions and increase in lack of balance especially considering communicational development. Such state is mostly affecting natural environment, but also the life and existence of human. Negative influence of transportation on natural environment is undeniable despite specific procedures which are ordering environmental compensations.[204] However they are not yet fully applied. Therefore it seems relevant to consider natural environment aspects in urban logistics solution in higher regard. Reflections considering urban logistics may be approached from different angles such as area, type of concept as well as its interactions. It is beyond doubt that regardless of applied method or idea solutions should be implemented with objectives of environmental protection. Validity of those objectives is consequence of substance of principles of most conceptions which are by definition suppose to relieve the city from negative influence of transportation and negate external costs caused by it. Therefore in attempt to implement those ideas following should be taken under consideration: state of ecological awareness (prominent entities, promoters, beneficiary units), analysis of implemented and realized environmental strategies including ISO certificates (ISO 14000 in Racibórz for example), attitudes of cooperatives and potential participants of ecological conceptions, actions taken before implementing new strategies on various areas, organizations and promotions of ecologic operations and instruments striving for achieving them, signifying possibilities of undertaking ecological initiatives and financing them, education.

Considering sustainable development in classical approach it may be accepted that urban logistics in any level of interest (ecological, economic and social) should be properly located. By its idea it is clear that these initiatives are addressed to the society (social aspect) and suppose to reduce functional costs of the cities as well as external costs of transportation (economical aspect) and implement solutions relieving environment, especially elimination of air pollution, noise or extensive traffic.

[204] T. Parteka, Konstruktywna i destruktywna rola transportu w kształtowaniu treści i formy miast, Architektura, Technical journal, Kraków University of Technology Publishing House, vol 1A-2010, p. 102

3.2. Transportation and natural environment-speculations in context of logistic solutions

Logistic solutions should contribute to the elimination of destructive influence of transportation on sustainable development of the cities through intensification of initiatives within solutions that already exist and better usage of civic areas.

Outcomes and influence of transportation on natural environment are often poorly considered in spatial planning. Modern approach to development planning, expansion or upgrades should regard that aspect significantly, especially considering particular functional, economical and social areas.

Influence of transportation on natural environment is mostly noticeable by highways or by civic main road arteries. Those influences reflect mostly in above average concentration of exhaust gases in the air. Such state is caused in most cases by trucks, vehicles with Diesel engines, special use devices, waists (wrecks, car parts, oil), general emission of pollution, congestion, climate changes, catastrophes, water pollution. High load of exhaust gases and noise emission in main roads areas are negatively influencing human health condition and local natural environment causing climate changes.

Protecting the air from pollution coming from vehicles has multiple aspects[205]. It should be considered on the phase of designing the road network by supporting transportation policies and implementing tools of logistic management, such as: promotion of public transportation, energy-efficient vehicles, new engine technologies (electric, hybrids), exacerbation of pollution emission regulations, development of communication means, alternative forms of employment (telework), modernizing vehicle space usage. Instruments of areal polices are also of great importance: cohesive infrastructure, promotion of public transportation and its development (entrance and parking zones, means of discouragement to entering the city centers in personal vehicles, priorities of public transportation, promotion of walking and cycling). On the other hand, it is possible in the phase of infrastructural exploitation to protect natural environment and most of all the quality of air. The most relevant tools of accomplishing that are as follows: duty of implementing new technologies regarding vehicles, promotion of new types of vehicles and controlling the quality on the fuel in modern systems of traffic management.

Various types of multi-component and coexisting systems are being used for control and management of quality of air on civic areas, such as:[206]

- Network of air pollution control
- Emission sources data bases, in case of mobile sources - specific informative models of its dynamics and location
- Air pollution spread models in compliance with input data models of pollution concentration,
- Air quality standards and norms (admissible pollution concentration),
- Spatial information systems for managing, sharing and visualizing the stored and processed data,
- Systems of communication with local communities,
- Expert modules (decision-making systems) for forming and interpreting strategies of alternative solutions.

One of the most relevant elements in the process of creating systems of air quality improvement is the integration of solutions with decision-making support systems. Means of monitoring, managing air quality and also affecting its improvement must be implemented with assistance of logistic solutions.

[205] M. Stańczak-Strząska Ochrona środowiska w transporcie. Wybrane zagadnienia. Kraków University of Technology Publishing House, Kraków 2007, p. 35

[206] L. Brzozowska, K. Brzozowski, Ł. Drąg, Transport drogowy a jakość powietrza atmosferycznego. Modelowanie komputerowe w mezoskali, Wydawnictwo Komunikacji i Łączności, Warszawa 2009, pp. 13-14

Practical managing the city should always consider logistic support and aim for protecting the natural environment and reducing the influence of pollution on its inhabitants life quality. To realize such goal appliance of specific systems of air quality management is recommended, which would consider the vehicle transportation as a emission source. In practice, many projects of monitoring and decision-making systems have been designed, projects regarding the evaluation of environmental interactions considering noise and exhaust gases emission. Those systems can constantly monitor the vehicle traffic, gather data and process them online, which would effect in long-term evaluations for conceptions of transportation management. There are also other elements supporting air quality management systems such as models of transportation network usage, which are relying on traffic intensiveness, types and sorts of roads and vehicle velocities on specific sections.

As the most important systems created for the need air quality control in the cities are considered as follows: SATURN (designed for creating, sustaining and applying integrated air quality control systems for civic areas) realized within EUROTRAC-2, HEAVEN (manages constant monitoring of vehicle traffic and its influence on air quality), SIMTRAP system, DYNEMO-mesoscopic model of vehicle traffic (model of street traffic dynamics, regarding velocities and traffic intensity), TREAMS (integrated with MapInfo spatial information system), AisGIS (air quality management and control model, applied in Denmark, integrated with geographical data bases), TEMMS (air quality modeling, considers various types of emission sources – engines as well as others, e.g. stationary ones) . Integration of those systems with traffic management systems may result in major relief of infrastructure and contribute to reducement of negative outcomes of transportation.

3.3. Urban logistics solutions review in compliance with principles of sustainable development

Besides models and systems of natural environment, modern conceptions in civic transports are considering applying other supportive tools, such as Carsharing[207] idea. This project promotes clean civic transportation and strives for reducing the number of vehicles in the cities. The idea is based on "renting" vehicles but not in the usual fashion[208]. Those vehicles are specially labeled and driven by environment friendly fuels. Parking lots and places are located in transport nodes (train stations), which in case of using the railway allows the bearer of a special card to benefit from discounts in CarSharing points in various cities. Rental could be short-term, even for few hours. Reservation is accomplished by the internet or telephone (text messages). Proper contract is being signed and small deposit paid. The settlement is done in monthly cycles and the user is obviously bearing the costs of the fuel. Keys to the vehicle are received from a special vault located on specific parking lot. Returning of the vehicle is performed in the similar way. In Germany, in the first year after the system was implemented following results were concluded: 2500 vehicles rented in 250 cities[209], estimated 4,5 million liters of fuel saved, which reduced the emission of carbon dioxide (CO_2) to atmosphere by 10 000 tones. The time that was saved due to reduced traffic is not yet estimated. The outcomes of this project may not be yet substantial in the scale of the country or specific cities, but it is another alternative solution, which promotes clean transportation and reduces number of unnecessary vehicles.

Sharing the vehicle - Car Pooling might be considered as the second solution regarding this matter. It promotes increase in space usage of the vehicles, which means sharing space in private vehicle or company car for other travelers. Sharing system may be based on using only one or several vehicles of different owners. This idea is successfully functioning in United States, Holland and Great Britain. Organization and selection of co-travelers may based on geographical, chronological or personal principals. In time of almost unlimited internet availability and

[207] http://www.bund-berlin.de/index.php?id=208&type=10 (01.2012), http://www.carsharing.de/seiten/start.html?/seiten/brandenburg_berlin_4.html [01.2012]

[208] According to studies the car is statistically used for 40 minutes per day, which means it is unused for almost 23 hours. The idea allows to use the vehicle for 1 hour, which increases efficiency and economicalness. It is recommended for those, who are using the car rarely, and drive less than ten thousand kilometers per year

[209] Berlin and Hamburg - Stattauto, Halle, Lipzig and Erfurt - teilAuto, Dortmund, Dresden - Stadtmobil, Frankfurt - book n driver, Hanover - Ökostadt

modern means of mass media, the access to information about car pooling or establishing contacts between the users is not problematic. According to various statistic sources, 80% of people is traveling alone[210], which suggest that the reduction of this figure might effect in decreasing the amount of emitted pollutions and increase the quality of air in the cities. For this idea to be efficiently applied, certain profits for the beneficiary units must be provided, such as: convenient access to transportation infrastructure, discounts, parking space available only for shared cars, zone entrance allowances and separate driving lanes.

Changes in communication citizens´ behavior models are another supportive element. Unfortunately this one would be the most difficult to implement, considering the personal car as a presently preferred transportation mean. The process of mental transformation is time taking and has to be supported with specific qualitative and quantitative solutions. Promotions of modern public transportation, its correlation with personal one (P&R solutions) and construction of bicycle lanes may firmly accelerate behavioral transformation of the citizens.

4. Conclusion

Solutions for urban logistics have to support principals of sustainable development. Considering the theory of viscous circle it needs to be signified that upgrading the infrastructure is always the cure-all for transportation issues and not always its influence on natural environment is considered as positive. Therefore it is crucial to search for innovative solutions, which will contribute to economical, ecological and social development of modern cities.

[210] J. Szołtysek, Car-pooling w koncepcji podróży pasażerskiej w miastach, Logistyka Nº 4/2008, p. 47

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Chapter 14

Green logistics: A case study of urban solid waste recycling

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1. Introduction

1.1. From Logistics to Green Logistics Concept

A. Efron (2009) says that the concept of collection and treatment of Urban Solid Waste (USW) has evolved from the field of conventional logistics to integrated logistics; then to reverse logistics, lean logistics and finally green logistics.

Logistics is the integrated management of all activities needed to move products along a supply chain in order to meet customer requirements with simultaneous maximization of the cost-benefit relationship. Thus, by conventional logistics, this management goes from the raw material to the consumption point of the product. Reverse logistics, however, manages the comeback of this product in the most efficient and inexpensive way (Efron, 2009) and lean logistics is oriented to reduce all logistic activities which do not add any value to the final products or services. Finally, the aim of green logistics is to reduce the environmental impact of the carbon waste coming from product movement along the supply chain. It includes activities from conventional and reverse logistics and also lean logistics needed to reduce the impact of shipment operations on the environment.

1.2. Management Categories in Reverse Logistics

Reverse logistics activities enclose the recovery and recycling of containers, packages and dangerous waste. Other activities such as the recovery of storage surplus, customer returns, old products and season stocks are included. Reverse logistics has several aims, increasing customer service and environment protection amongst them. The latter is called green logistics.

Many alternatives of reverse logistics presented at the Logistics and Supply Chain Management Conference (Zaragoza, 2007) can be considered as part of green logistics. Such is the case of the problem of electrical and electronic waste known as RAEE (Gonzáles, P. et all, 2007); new management conditions for credit contracts by returns (Ruiz and Muriel, 2007) and the analysis of different possibilities to manage the return of containers to distribution hubs (Hortal et all, 2007). Moreover, at the Forum of Reverse Logistics held in Sao Pablo (2011) important issues such as the need of legislation on solid waste, concrete cases of empty packages comeback and AEE (electric and electronic waste) consumption, the strategy of the European Union related to solid waste and reverse logistics trends in industry were considered.

All these examples, focusing on the problem from different angles, reflect the importance of this study area, not only as an improvement process but also as a new industry for economic and environmental development.

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2. Record Study

2. 1. Management of Urban Solid Waste (USW)

The increasing generation of waste and its negative environmental effects has been recognized by different authorities all over the world. Now there is heightened awareness and concern about the implementation of new alternatives for final disposal of both home and industrial waste.

Recycling is considered a new stage of waste management whose aim is the recovery of raw material and the minimization of the final disposal of waste. This is a new challenge for both private and public organizations. Policies shall aim to turn home and industrial waste from rubbish to goods to be recovered.

This work was done on the basis of field studies carried out in a USW treatment plant located in General Daniel Cerri, in the vicinity of Bahía Blanca city, Argentina. The goal of this USW plant is to reverse the negative effects of the final disposal of waste by reinserting material recoverede from waste into production cycles. The primary aim of this work is to analyze the significance of the operational and logistic activities carried out in the internal production process. Some other aims are:

- To describe a small-scale process of organic and inorganic USW disposal.
- To identify its more important characteristics and restrictions;
- To check up growing opportunities for operational improvement on the basis of waste classification at its source.

2. 2. Technology processing of USW

For years, urban waste has been taken to the so called open sky dump near the cities. The problem of pollution was unknown because cities were small and most waste was organic; it was then naturally degraded on the ground.

The development of cities and the changes in consumption patterns forwarded the problems associated with waste disposal. The new method of final disposal of waste was sanitary landfill. It places the waste in a small area, compacts it in order to reduce its bulkiness and finally covers it with a layer soil at the end of each day (De Val, 1993).

The application of this method requires the fulfillment of some conditions in order to avoid environmental pollution and to ensure environmental protection. There must be a drainage system for lixiviated fluids to avoid underground water pollution and also vent stacks for proper gas migration. Underground aquifers must be protected through the use of waterproof membranes to prevent leakage and artesian wells must be monitored to control water quality as a result of sanitary landfill

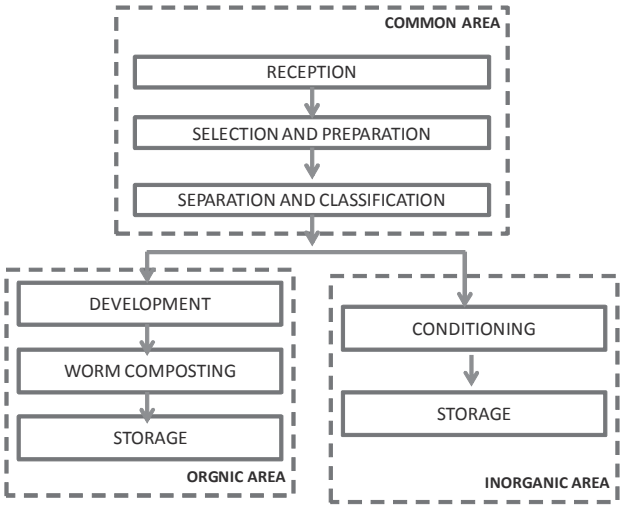
Presently, the most promising method of waste management is recycling, which comprises the processing of materials recovered from waste and their return to production cycles as useful raw material for new products. The materials most commonly recovered are glass, paper, plastic and metal, whose reuse means great environmental advantages.

Argentina has made some progress on waste disposal policies. However, new technologies should be applied to process solid waste in order to recover energy and materials.

3. Process Description

The Figure Nº 33, describes the process as scheme way**.** It is possible to identify the following stages: reception; selection and preparation; separation and classification. These three stages are common to both organic and inorganic treatment areas as well.

Figure Nº 33: Areas Schedule



The first treatment area deals with organic waste. Its process takes place in one specific section and comprises the following stages: development; worm composting and storage. Inorganic waste treatment includes conditioning and storage.

3. 1. Reception of raw material

Arriving trucks are weighed in order to know the daily average of waste. Afterwards they are unloaded in different sections according to waste nature (organic or inorganic). In case of some specific material coming from chemical industries, they are unloaded in the polyethylene or in the postindustrial sector for hand classification.

3. 2. Selection and preparation of raw material

Organic waste is hand placed on a transportation vertical band for its processing. The operator in charge must verify the waste bag does not include inorganic parts. If this is the case, the bag is isolated and sent to the inorganic manufacturing sector.

Afterwards, the bags on the vertical transportation band are hand opened by two operators standing on each side of the band. They remove bottles, flasks, tin cans, etc. which could be mixed with organic waste. Finally, a fourth operator takes out the previously opened bags for their final disposal.

3. 3 Separation and classification

After raw material preparation, six operators placed to the sides of the horizontal or secondary transportation band remove little inorganic parts (such as lids, boxes, wrappings etc.), in order to collect at the end of the band only organic material to build the composting piles.

The residue which has been moved along the transportation band and is not recoverable is sent in special compaction trucks to the sanitary landfill of Bahía Blanca city for its final disposal.

3. 4. Organic Sector

3. 4. 1. Development

The organic material produced is carried out to the composting piles placed on cement surfaces provided with drain pipes for liquid evacuation. These fluids coming from the waste composting process have a high organic residual load which cannot be drained as effluent without previous degradation.

A steady and valuable product is obtained after the composting process thanks to the action of microorganisms. In order to properly develop this process it is necessary to control temperature, air taking, acidity grade (PH) and humidity in each one of the composting piles. It is estimated that in two or three months the composting material reaches stability, that is to say, there are no more temperature changes. At this point the composting process is finished and the product obtained - the compost - is ready for the next stage.

3. 4. 2. Worm composting

The ripe material in the piles is sent to the composting bed before adding the earthworms to obtain worm compost or worm humus. The type of earthworm used is the so called *red californian worm* (*eisenia foétida*). It is estimated that earthworms stay between 45 and 60 days in each composting bed. Worm compost is the result of worm excretion and represents near 60% of what the worms eat. This compost is an organic fertilizer of high quality thanks to higher phyto-hormonal, nutritional and micro organic values.

In order to carry out this process properly it is necessary to perform periodical controls of humidity (near 40% thanks to a drip irrigation system in each earthworm composting bed); temperature (which must ambient) and acidity (a neutral PH=7). Factory data concludes that from the total volume of organic material entered it is obtained near 40% of worm humus.

3. 4. 3. Storage

The worm compost produced is sent to an open air place where it is sifted with the purpose of removing all types of impurities (Figure Nº 34). Worm humus can be stored for a long time without modifying its properties, but it is necessary to maintain the humidity level near 40%.

Figure Nº 34

3. 5. Inorganic Sector

3. 5. 1. Selection and preparation of raw material

Inorganic waste for processing is unloaded in a special section for its classification. The first operator dumps it gradually into a hopper towards a vertical transportation band (figure Nº 35).

Figure Nº 35

3. 5. 2. Separation and Classification

Waste is placed on the vertical transportation band as a second operator opens the bags and removes cardboard, which is the first material selected for recycling.

Afterwards, three operators remove the bags from the vertical transportation band and place them in baskets for their final disposal. The material moves towards a horizontal transportation band where people placed on both sides perform classification activities. The first operator on the line removes all types of non reclaimable Polyethylene pieces which could have gone through the previous transportation band and the following thirteen operators remove and classify different types of material for their disposal.

Each operator on the line is assigned to the classification of one type of material which is dumped into a basket and then taken outside. Ferrous (tin) and non ferrous pieces (aluminum) together with glass are taken to a container outside. The ferrous objects are classified by hand and the aluminum pieces are stored waiting to be sold.

Bottle caps are dropped in baskets and then they are hand classified outside the band according to their different colors (red, white, blue, green, etc.). Finally, all unusable inorganic waste reaches the end of the transportation band. It is carried outside through a tube towards a container and then sent together with all unusable organic waste to the sanitary landfill of Bahía Blanca city for its final disposal.

3. 5. 3. Conditioning

Material such as paper, cardboard, plastic and tin is compressed with a hydraulic press in order to form bundles of different weights: cardboard: 260 kg; plastic: 130 kg and tin: 40 kg. On the other hand, glass, bottle caps and aluminum are stored in bulk and then sent for commercialization.

3. 5. 4. Storage

Finally, cardboard, paper and polypropylene, which cannot stay outside, is sent indoors for storage in boxes.

4. Inbound Logistics

The factory has two main sources of raw material: waste collection and the industries. The first one is coming actually only from General Daniel Cerri, where the selection of waste has been made for over ten years. Waste collection is carried out with public trucks which collect urban waste classified in different bags: green for organic waste and white for inorganic waste.

The importance of the classification and separation of urban waste in its origin was preceded by an arduous work of consciousness-raising and periodic supervision of homes to explain the significance of urban waste differentiation to facilitate its treatment at the plant and route planning to minimize collection time. The truck used for refuse collection is specially equipped for this task and divided into two compartments (for organic and inorganic wastes).

Industrial refuse coming from different industries located around Bahía Blanca city is dropped into different bags or containers for its transportation to the plant.

Some districts of Bahía Blanca city are being incorporated to the differentiated refuse collection system as a pilot project since 2011 because the factory does not yet work at its full capacity. The collection of organic and inorganic materials is carried out on different days of the week.

5. Conclusion

- It is possible to conclude that USW recycling is a feasible activity, as it is evidenced from the operation of the ecological plant (Ecoplanta) located in General Daniel Cerri during the last 10 years.
- There is potential for growth due to the continuous production and growing generation of USW.
- Actually, recycling is operatively limited at the plant because of its internal process. In order to get over this problem it will be necessary to study two research paths: a) feasibility studies of alternative locations for recycling plants (Queiruga et. al., 2007) and/or b) different route maps for refuse collection (Maquera et. al., 2007)
- It will be necessary to analyze the enlargement of the working capacity of the plant, to develop new plants for urban waste recycling and to analyze alternatives of location.
- The organization of the USW collection before the inbound processing and the results of the pilot project in order to expand it in different districts of Bahía Blanca city require the collaboration of all the population. That means additional training work and community consciousness-raising.

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