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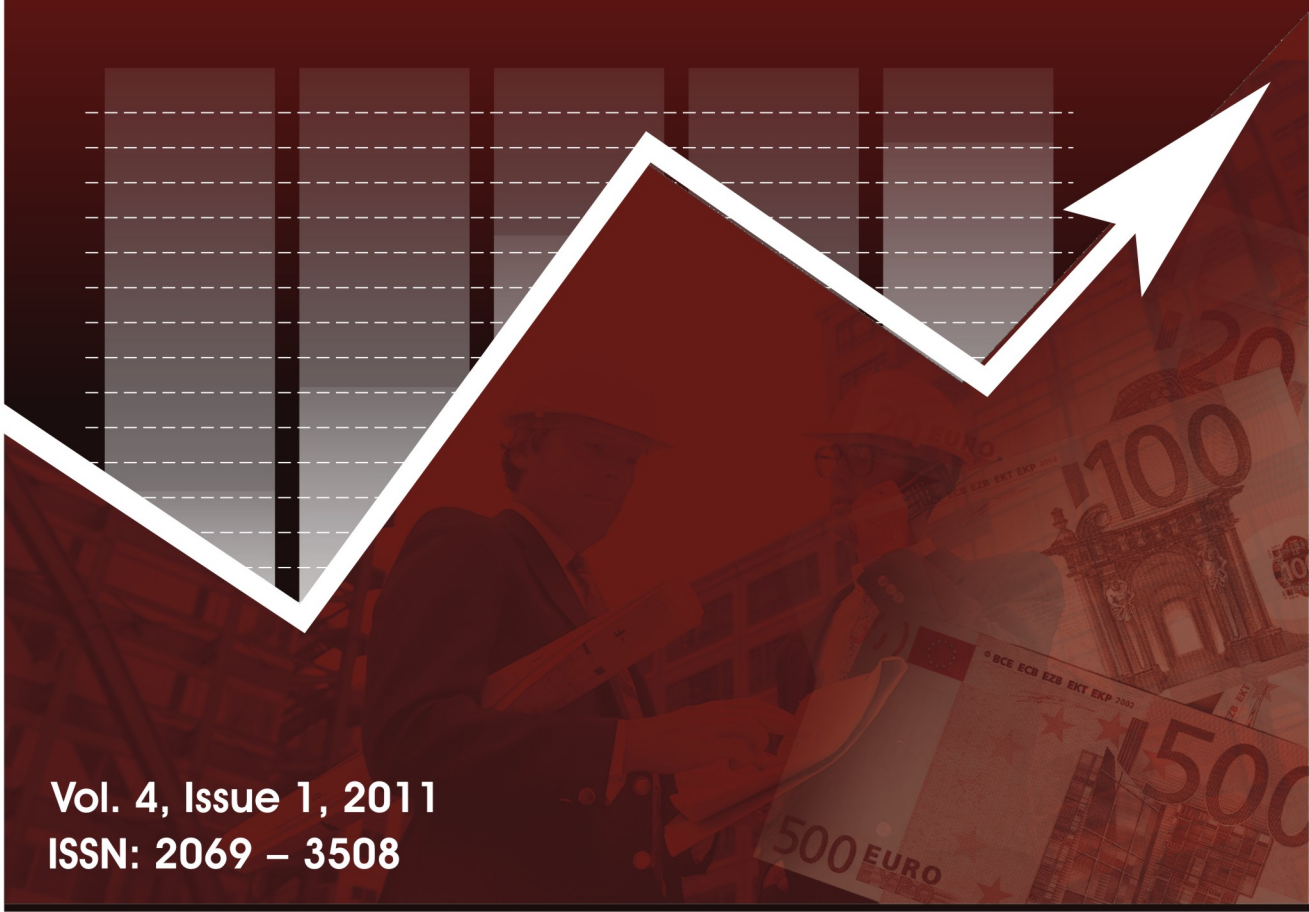

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GAUSSIAN AND NON-GAUSSIAN MODELS FOR FINANCIAL BUBBLES VIA ECONOPHYSICS

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Abstract. *We develop a rational expectations model of financial bubbles and study how the risk-return interplay is incorporated into prices. We retain the interpretation of the leading Johansen-Ledoit-Sornette model: namely, that the price must raise prior to a crash in order to compensate a representative investor for the level of risk. This is accompanied, in our stochastic model, by an illusion of certainty as described by a decreasing volatility function. As the volatility function decreases crashes can be explicitly seen to represent a phase transition from stochastic to deterministic behaviour in prices. Our approach is first illustrated by a benchmark Gaussian model, which we subsequently extend to a heavy-tailed model based on the Normal Inverse Gaussian distribution in order to provide a better fit to empirical financial data. Our model is illustrated by an empirical application to the London Stock Exchange. Results suggest that the aftermath of the Bank of England's process of quantitative easing has coincided with a bubble in the FTSE 100.*

Keywords: *financial crashes, super-exponential growth, illusion of certainty, heavy tails, bubbles.*

1. Introduction

Rational expectations models were introduced with the work of Blanchard and Watson to account for the possibility that prices may deviate from fundamental levels [1]. We take as our main starting point the somewhat controversial subject of log-periodic precursors to financial crashes [2-11], with a fundamental aim of our approach being relatively easy calibration of our model to empirical data. Additional background on log-periodicity and complex exponents can be found in [12]. A first-order approach in [3] and subsequent extensions in [13] state that prior to a crash the price must exhibit a super-exponential growth in order to compensate a representative investor for the level of risk. However, this approach concentrates solely on the drift function and ignores the underlying

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volatility fluctuations which typically dominate financial time series [14]. We undertake a similar approach to that in [3] but extend the original method by deriving a second-order condition which incorporates volatility fluctuations and enables us to combine insights from a rational expectations model with a stochastic model [15-16].

Our model gives two important characterisations of bubbles in economics. Firstly, a rapid super-exponential growth in prices. Secondly, an illusion of certainty as described by a decreasing volatility function prior to the crash. As the volatility function goes to zero bubbles and crashes can be seen to represent a phase transition from stochastic to purely deterministic behaviour in prices. This clarifies the oft cited link in the literature between phase transitions in critical phenomena and financial crashes. Further, this recreates the phenomenology of the Sornette-Johansen paradigm: namely that prices resemble a deterministic function prior to a crash. We explore a number of different applications of our model and the potential relevance to recent events is striking.

The layout of this paper is as follows. In Section 2 we introduce a benchmark Gaussian model. In Section 3 we extend the basic model to a heavy-tailed setting in order to account for leptokurtosis in financial returns. Section 4 gives an empirical application. Section 5 is a conclusion. A probability Appendix, included for the reader's convenience, can be found at the end of the paper.

2. Motivation: a simple Gaussian model

In this section we derive and solve a Gaussian model for financial bubbles, our approach later serving to motivate a non-Gaussian model in Section 3. An alternative formulation of the model in [3] leads naturally to a stochastic generalisation of the original model as follows. Let $P(t)$ denote the price of an asset at time t. Our starting point is the equation:

$$P(t) = P_1(t)(1-\kappa)^{j(t)}, \tag{1}$$

where $P_1(t)$ satisfies:

$$dP_1(t) = \mu(t)P_1(t)\mathrm{d}t + \sigma(t)P_1(t)\mathrm{d}W_t, \tag{2}$$

where W_t is a Wiener process and $j(t)$ is a jump process satisfying the condition $j(t) = 0$ before a crash and the condition $j(t) =1$ afterwards. When a crash occurs κ % is automatically wiped off the value of the asset. Prior to a crash $P(t)=P_1(t)$ and $X_t= \log(P(t))$ satisfies:

$$dX_t = \tilde{\mu}(t)\mathrm{d}t + \sigma(t)\mathrm{d}W_t + \ln[1-\kappa]\mathrm{d}j(t), \tag{3}$$

where $\tilde{\mu}(t) = \mu(t) - \sigma^2(t)/2$. If a crash has not occurred by time *t*, we have that:

$$E[\,j(t+\mathrm{d}t) - j(t)] = h(t)\mathrm{d}t + o(\mathrm{d}t), \tag{4}$$

and

$$Var[\,j(t+\mathrm{d}t) - j(t)] = h(t)\mathrm{d}t + o(\mathrm{d}t), \tag{5}$$

where $h(t)$ is the hazard rate. We compare (3) with the prototypical Black-Scholes model for an asset price:

$$dX_t = \tilde{\mu}\mathrm{d}t + \sigma\mathrm{d}W_t, \tag{6}$$

where $\tilde{\mu}(t) = \mu - \sigma^2/2$, and use (6) as our model for "fundamental" or purely stochastic behaviour in prices.

The first-order condition, see e.g. [1], [3], suggests that $\tilde{\mu}(t)$ in (3) grows in order to compensate a representative investor for the risk associated with a crash. The instantaneous drift associated with (3) is:

$$\tilde{\mu}(t) + \ln[1-\kappa]h(t). \tag{7}$$

For (6) the instantaneous drift is $\tilde{\mu}$. Setting (7) equal to $\tilde{\mu}$, it follows that in order for bubbles and non-bubbles to co-exist:

$$\tilde{\mu}(t) = \tilde{\mu} + vh(t), \tag{8}$$

where $v = -\ln[1-\kappa]$ with $v > 0$. Thus we see from (8) that the bubble results in a temporary increase in the rate of return. If we ignore volatility fluctuations by setting $\sigma(t) = \sigma$, then our pre-crash model for an asset price becomes:

$$\mathrm{d}X_t = (\tilde{\mu} + vh(t))\mathrm{d}t + \sigma\mathrm{d}W_t. \tag{9}$$

However, this is actually a rather poor empirical model [18], failing to adequately account for the volatility fluctuations in (3). Under a Markowitz interpretation, means represent returns and variances/standard deviations represent risk. Suppose that in (3) $\sigma(t)$ adapts in an analogous way to $\mu(t)$ so as to compensate a representative investor for bearing additional levels of risk. The instantaneous variance associated with (3) is:

$$\sigma^2(t) + v^2h(t). \tag{10}$$

For (6) the instantaneous variance is σ^2. Setting (10) equal to σ^2, the second-order condition for the co-existence of bubbles and non-bubbles becomes:

$$\sigma^2(t) = \sigma^2 - v^2h(t). \tag{11}$$

(11) illustrates an *illusion of certainty* – a decrease in the volatility function – which arises as part of the bubble process. Intuitively, in order for a bubble to occur not only must returns increase but the volatility must also decrease. If this does not happen (6) with an instantaneous variance of σ^2 would represent a more attractive and less risky investment than a market described by (9) and bubbles could not occur. Moreover, as (11) goes to zero, a crash is explicitly tied to a phase transition from random to deterministic behaviour in prices. We use (6) as a model of a `fundamental' or purely stochastic regime, as in Black-Scholes theory. From (11), our model for prices under a bubble regime becomes:

$$\mathrm{d}X_t = [\tilde{\mu} + vh(t)]\mathrm{d}t + \sqrt{\sigma^2 - v^2 h(t)}\mathrm{d}W_t. \tag{12}$$

The simplest $h(t)$ considered in [3] is:

$$h(t) = B(t_c - t)^{-\alpha}, \tag{13}$$

where it is assumed that $\alpha \in (0,1)$ and t_c is a critical time when the hazard function becomes singular by analogy with phase transitions in statistical mechanical systems [19]. Here, we choose on purely statistical grounds:

$$h(t) = \frac{\beta t^{\beta-1}}{\alpha^\beta + t^\beta}. \tag{14}$$

This hazard function corresponds to a log-logistic distribution and is intended to capture the essence of the previous approach as the hazard function has both a relatively simple form and, for $\beta > 1$, has a non-trivial mode at $t = \alpha(\beta-1)^{1/\beta}$, with modal point $(\beta-1)^{1-1/\beta}/\alpha$. For these reasons, the log-logistic distribution is commonly used in statistics [20]. The log-logistic distribution has probability density:

$$f(x) = \frac{\beta\alpha^\beta x^{\beta-1}}{(\alpha^\beta + x^\beta)^2}, \tag{15}$$

on the positive half-line. The cumulative distribution function is:

$$F(x) = 1 - \frac{\alpha^\beta}{\alpha^\beta + x^\beta}. \tag{16}$$

The model (12) with $h(t)$ given by (14) has the solution:

$$X_t = X_0 + \tilde{\mu}t + v\ln\left(1 + \frac{t^\beta}{\alpha^\beta}\right) + \int_0^t \sqrt{\sigma^2 - v^2\frac{\beta t^{\beta-1}}{\alpha^\beta + t^\beta}}\mathrm{d}W_u\,. \tag{17}$$

From (17) the conditional densities can be written as:

$$X_t \mid X_s \sim N(\mu_{t|s}, \sigma^2_{t|s}), \tag{18}$$

where

$$\mu_{t|s} = X_s + \tilde{\mu}(t-s) + v \ln\left(\frac{\alpha^\beta + t^\beta}{\alpha^\beta + s^\beta}\right), \tag{19}$$

and

$$\sigma^2_{t|s} = \sigma^2(t-s) - v^2 \ln\left(\frac{\alpha^\beta + t^\beta}{\alpha^\beta + s^\beta}\right). \tag{20}$$

Under the fundamental equation (6) these expressions are simply $\mu_{t|s} = X_s + \tilde{\mu}(t-s)$ and $\sigma^2_{t|s} = \sigma^2(t-s)$. Thus, we see that under the bubble model the incremental distributions demonstrate a richer behaviour over time.

The fundamental or purely stochastic non-bubble model (6) corresponds to the case that $\kappa = 0$, or equivalently that $v = 0$. We can test for bubbles by testing the null hypothesis $v = 0$ (no bubble) against the alternative hypothesis $v > 0$ (bubble). This can be simply done using a (one-sided) *t*-test since maximum likelihood estimates, and estimated standard errors, can be easily calculated numerically from (19). A range of further implications of our bubble model can be derived as we describe below.

Crash-size distribution. Suppose that prices are observed up to and including time *t* and that a crash has not occurred by time *t*. The crash-size distribution resists an analytical description but a Monte Carlo algorithm to simulate the crash-size *C* is straightforward and reads as follows:

1. Generate *u* from *U* ~Log-logistic (α, β) with the constraint $u \geq t$.

2. $C \sim \kappa e^Z$,

where:

$$Z \sim N\left(X_t + \mu(u-t) + v \ln\left(\frac{\alpha^\beta + u^\beta}{\alpha^\beta + t^\beta}\right), \sigma^2(u-t) - v^2 \ln\left(\frac{\alpha^\beta + u^\beta}{\alpha^\beta + t^\beta}\right)\right). \tag{21}$$

We note that simulating *u* from the log-logistic distribution is straight-forward and from (16) possible via inversion using:

$$F^{-1}(x) = \alpha\left(\frac{x}{1-x}\right)^{\frac{1}{\beta}} \text{ or } F^{-1}(x) = \left(\frac{\alpha^\beta + t^\beta}{1-x} - \alpha^\beta\right)^{\frac{1}{\beta}} \text{ with constraint } u \geq t.$$

Post-crash increase in volatility. Before a crash equation (17) applies and the volatility is given by:

$$\sigma^2(t) = \sigma^2 - \frac{v^2 \beta t^{\beta-1}}{\alpha^\beta + t^\beta}. \tag{22}$$

After a crash, the volatility reverts to its fundamental level σ^2. Equation (22) thus predicts a post-crash increase in volatility according to:

$$\sigma^2(t) \propto \frac{v^2 \beta t^{\beta-1}}{\alpha^\beta + t^\beta}. \tag{23}$$

For $\beta = 1$ (23) corresponds to the model of post-crash volatility decay in [21].

Fundamental values. The above model suggests a simple approach to estimate fundamental value. Under the fundamental dynamics (6):

$$P_F(t) := E(P(t)) = P(0)e^{\mu t}, \tag{24}$$

and we use (24) to estimate fundamental value in our empirical application in Section 3. This approach recreates the widespread phenomenology of approximate exponential growth in economic time series (see e.g. Chapter 7 in [22]).

Estimated bubble component. Define:

$$H(t) = \int_0^t h(u)\mathrm{d}u = \ln\left(1 + \frac{t^\beta}{\alpha^\beta}\right). \tag{25}$$

Under the fundamental model $E(P(t))$ is given by (24). Under the bubble model, since $X_t = \log(P(t))$ satisfies:

$$X_t \sim N(X_0 + \tilde{\mu}t + vH(t), \sigma^2 t - v^2 H(t)), \tag{26}$$

it follows that:

$$P_B(t) := E(P(t)) = P(0)e^{\mu t + \left(v - \frac{v^2}{2}\right)H(t)}. \tag{27}$$

Thus we can estimate the proportion of observed prices which can be attributed to a speculative bubble as the weighted average:

$$\frac{1}{T}\int_0^T \frac{P_B(t) - P_F(t)}{P_B(t)}\mathrm{d}t = 1 - \frac{1}{T}\int_0^T \left(1 + \frac{t^\beta}{\alpha^\beta}\right)^{-(v - v^2/2)} \mathrm{d}t. \tag{28}$$

3. Heavy-tailed models via the NIG distribution

In this section we improve the model in Section 2 by moving the underlying assumptions of the model closer to observed properties of empirical financial asset returns. Distributional aspects of financial asset returns depend critically on the frequency over which returns are calculated. Approximately Gaussian behaviour is a reasonable assumption for returns calculated over periods of about 16 trading days or longer, e.g. monthly returns [23]. The Gaussian model of Section 2 was successfully used to model bubbles in low-frequency monthly data in [24]. For daily returns distributions such as the Normal Inverse Gaussian (NIG) distribution provide a better fit to empirical data [23]. The NIG distribution has also been successfully used to model intra-daily data [25].

We thus seek to build a more flexible model for financial bubbles using the Gaussian model in Section 2 as a stepping stone. More realistic distributional assumptions should lead to a more sensitive text for bubbles once the model is applied to empirical financial data [18]. The layout of this section is as follows. In Section 3.1 we introduce a revised model for purely random or fundamental behaviour in prices. Sections 3.2-3.3 present our revised model for financial bubbles.

3.1. Purely stochastic or fundamental model

As a model for fundamental or purely stochastic behaviour in prices we choose the equation

$$\mathrm{d}P(t) = \mu P(t)\mathrm{d}t + \sigma\sqrt{U}P(t)\mathrm{d}W_t, \tag{29}$$

where U is an unobserved random variable with an IG(1,1/K) distribution (see the Appendix), which has mean 1 and is independent of the Wiener process W_t. This formulation retains the tractability of Gaussian stochastic calculus [26] but enables one to generate heavy-tailed non-Gaussian behaviour inline with stylized empirical facts of financial-return data [14], Chapter 7. Related ways of generating financial models with heavy tails are discussed in [14], Chapters 4 and 5. The models in this section are based around the Normal Inverse Gaussian (NIG) distribution [27-28]. See the Appendix for the definition and for some additional facts about this probability distribution.

From (29) it follows that the log-price X_t evolves according to:

$$\mathrm{d}X_t = \left[\mu - \frac{\sigma^2 U}{2}\right]\mathrm{d}t + \sigma\sqrt{U}\mathrm{d}W_t. \tag{30}$$

From Result 1 in the Appendix it follows that:

$$X_t \sim NIG\left(\mu = X_0 + \mu t, \alpha = \sqrt{\frac{1}{\sigma^2 tK} + \frac{1}{4}}, \beta = -\frac{1}{2}, \delta = \frac{\sigma\sqrt{t}}{\sqrt{K}}\right). \quad (31)$$

Similarly, the incremental distributions are given by:

$$X_{t+\Delta} - X_t \sim NIG\left(\mu = \mu\Delta, \alpha = \sqrt{\frac{1}{\sigma^2 \Delta K} + \frac{1}{4}}, \beta = -\frac{1}{2}, \delta = \frac{\sigma\sqrt{\Delta}}{\sqrt{K}}\right). \quad (32)$$

We have that:

$$E[X_{t+\Delta} - X_t] = \mu + \frac{\delta\beta}{\gamma} = \mu\Delta + \sigma\sqrt{\frac{\Delta}{K}}\left(-\frac{1}{2}\right)\sqrt{\sigma^2\Delta K} = \Delta\left(\mu - \frac{\sigma^2}{2}\right), \quad (33)$$

and

$$\text{var}[X_{t+\Delta} - X_t] = \frac{\delta\alpha^2}{\gamma^3} = \sigma\sqrt{\frac{\Delta}{K}}(\sigma^2\Delta K)^{\frac{3}{2}}\left(\frac{1}{\sigma^2\Delta K} + \frac{1}{4}\right) =$$

$$= \sigma^4\Delta^2 K\left(\frac{1}{\sigma^2\Delta K} + \frac{1}{4}\right) = \sigma^2\Delta + o(\Delta). \quad (34)$$

Hence from (33-34) it follows, as in the Gaussian case, that under the fundamental or purely stochastic regime X_t has instantaneous mean or drift given by $\mu - \sigma^2/2$ and instantaneous variance given by σ^2.

As was the case with the Gaussian model in Section 2 this simple NIG model also suggests a simple approach to estimating fundamental value. It follows from (31) and Result 2 in the Appendix that:

$$P_F(t) := E(P(t)) = e^{X_0 + \mu t} = P(0)e^{\mu t}. \quad (35)$$

3.2.Leptokurtic bubble model

We formulate a heavy-tailed extension of the Gaussian bubble model in Section 2 as follows. We retain (1) but replace the relationship (2) with the equation:

$$dP_1(t) = \mu(t)P_1(t)dt + \sigma(t)\sqrt{U}P_1(t)dW_t. \quad (36)$$

As before, we have that prior to a crash $P(t)=P_1(t)$ and from (36) that $X_t = \log(P_1(t))$ satisfies:

$$dX_t = \left(\mu - \frac{\sigma^2(t)U}{2}\right)dt + \sigma(t)UdW_t + \ln|1 - \kappa\, \bar{d}j(t)|. \quad (37)$$

Under the bubble model (37) we have that:

$$E\left[X_{t+\Delta} - X_t \mid U\right] = \Delta\left[\mu(t) - \frac{\sigma^2(t)}{2}U\right] + \Delta \ln\left[1-\kappa\right] h(t) + o(\Delta). \qquad (38)$$

Therefore:

$$E\left[X_{t+\Delta} - X_t\right] = E\left[\Delta\left[\mu(t) - \frac{\sigma^2(t)}{2}U\right]\right] + \Delta \ln[1-\kappa]\, h(t) + o(\Delta),$$

$$E\left[X_{t+\Delta} - X_t\right] = \Delta\left[\mu(t) - \frac{\sigma^2(t)}{2} + \ln[1-\kappa]\, h(t) + o(\Delta)\right]. \qquad (39)$$

Similarly, we see that:

$$Var\left[X_{t+\Delta} - X_t\right] = E\left[\text{var}\left[X_{t+\Delta} - X_t \mid U\right]\right] + \text{var}\left[E\left[X_{t+\Delta} - X_t \mid U\right]\right],$$

$$Var\left[X_{t+\Delta} - X_t\right] = \Delta E\left[\sigma^2(t)U + v^2 h(t)\right] + \Delta^2 \text{var}\left(\mu - \frac{\sigma^2 U}{2}\right) + o(\Delta),$$

$$Var\left[X_{t+\Delta} - X_t\right] = \Delta\left[\sigma^2(t) + v^2 h(t)\right] + o(\Delta). \qquad (40)$$

Hence, it follows that under the bubble model the instantaneous mean is $\mu(t) - \sigma^2(t)/2 + vh(t)$ and the instantaneous variance is $\sigma^2(t) + v^2 h(t)$. The mean-variance conditions for the co-existence of bubbles and non-bubbles become:

$$\sigma^2 = \sigma^2(t) + v^2 h(t), \quad \sigma^2 - v^2 h(t), \qquad (41)$$

and

$$\mu - \frac{\sigma^2}{2} = \mu(t) - \frac{\sigma^2(t)}{2} - vh(t), \quad \mu(t) = \mu + \left(v - \frac{v^2}{2}\right)h(t). \qquad (42)$$

3.3. Statistical properties of the bubble model

The bubble model in (36) has the following construction:

$$U \sim IG\left(1, \frac{1}{\kappa}\right),$$

$$X_t \mid U \sim N\left(X_0 + \mu t + \left(v - \frac{v^2}{2}\right)H(t) - \frac{(\sigma^2 t - v^2 H(t))U}{2}, [\sigma^2 t - v^2 H(t)]\, U\right). \qquad (43)$$

It follows from (44) and Result 1 in the Appendix that X_t is NIG distributed with parameters:

$$\mu = X_0 + \mu t + \left(v - \frac{v^2}{2}\right)H(t), \alpha = \sqrt{\frac{1}{(\sigma^2 t - v^2 H(t))K} + \frac{1}{4}},$$

$$\beta = -\frac{1}{2}, \delta = \frac{\sqrt{\sigma^2 t - v^2 H(t)}}{\sqrt{K}}, \tag{44}$$

where $H(t)$ is given by (25). Similar reasoning shows that the conditional distribution of X_u given X_t $(u > t)$ is also NIG distributed with parameters given by:

$$\mu = X_t + \mu(u-t) + \left(v - \frac{v^2}{2}\right)\ln\left(\frac{\alpha^\beta + u^\beta}{\alpha^\beta + t^\beta}\right),$$

$$\alpha = \sqrt{\frac{1}{\left(\sigma^2(t-s) - v^2 \ln\left(\frac{\alpha^\beta + u^\beta}{\alpha^\beta + t^\beta}\right)\right)K} + \frac{1}{4}},$$

$$\beta = -\frac{1}{2}, \delta = \frac{\sqrt{\sigma^2(t-s) - v^2 \ln\left(\frac{\alpha^\beta + u^\beta}{\alpha^\beta + t^\beta}\right)}}{\sqrt{K}}. \tag{45}$$

Crash-size distribution. Suppose that prices are observed up to and including time t and that a crash has not occurred by time t. The crash-size distribution resists an analytical description but a Monte Carlo algorithm to simulate the crash-size C is straightforward and reads as follows:

1. Generate u from U~Log-logistic (α, β) with the constraint $u \geq t$.

2. $C \sim \kappa e^Z$, where Z is NIG distributed with parameters given by (45).

Estimated bubble component. Under the fundamental model $E(P(t))$ is given by (35). Under the bubble model it follows from (45) and Result 2 in the Appendix that:

$$P_B(t) := E(P(t)) = P(0)\mathrm{e}^{\mu t + \left(v - \frac{v^2}{2}\right)H(t)}. \tag{46}$$

Continuing, we see that the estimated bubble component can be formulated in exactly the same way as in equation (28).

4. Empirical application

As an empirical application we look at daily prices of the FTSE 100 from March 2nd 2009 to October 29th 2010 to try and determine whether or not the Bank of England's policy of quantitative easing has coincided with, and possibly led to, a speculative bubble in the London Stock Exchange. As shown in Figure 1, even with such a relatively short data set, there appears to be some merit in using a heavy-tailed non-Gaussian model with the asymmetric NIG model offering a better fit than the normal distribution to the right tail of the empirical distribution of the log-returns.

Testing the null hypothesis of no bubble is a test of the hypothesis $v = 0$. This can be tested using a one-sided t-test – dividing the estimate $\hat{v}$ by its estimated standard error and comparing to a normal distribution. For this data set we obtain a t-statistic of 3.332 and a p-value of 0.000, giving strong evidence of a bubble. A plot of observed prices compared to estimated fundamental values is shown in Figure 2. Some degree of over-pricing is apparent although prices appear to have moved closer to estimates of fundamental value over the second half of 2010. In contrast, however, calculating the estimated bubble component in equation (28) is only estimated to be 0.006, suggesting that the speculative bubble component accounts for a relatively trivial amount, roughly 0.6%, of the observed prices.

In summary, the statistical test and the plot shown in Figure 2 give enough evidence to point to a bubble and to some level of over-pricing in the FTSE 100. However, the level of over-pricing does not seem particularly large and prices appear to have moved closer to estimated fundamental values over the second half of 2010. The level of over-pricing also seems much less than the recent UK housing bubble where a similar approach suggested that the speculative bubble component accounted for around 20% of the observed prices [24].

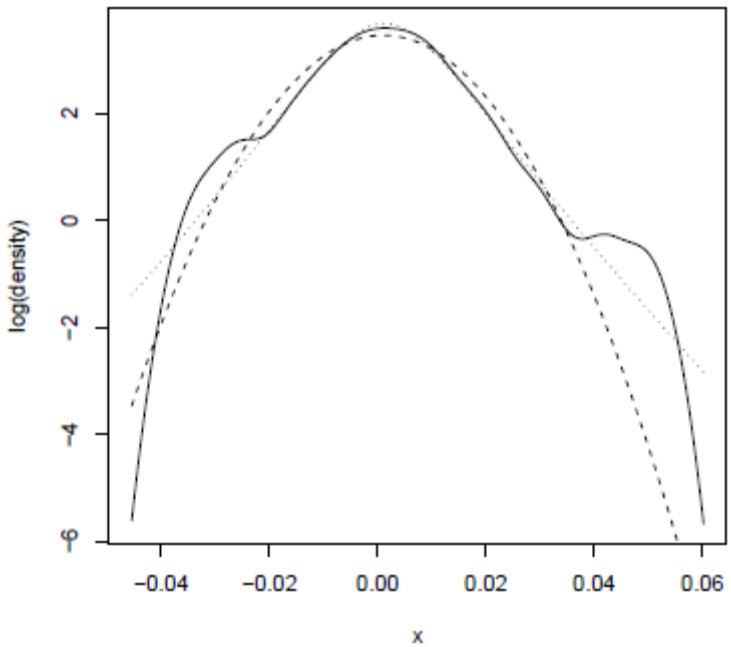

Figure 1. Distribution of log-returns. Plot of log kernel density estimate (solid line) together with best fits from a normal distribution (dashed line). And asymmetric NID distribution with $\beta = 1/2$ (dots).

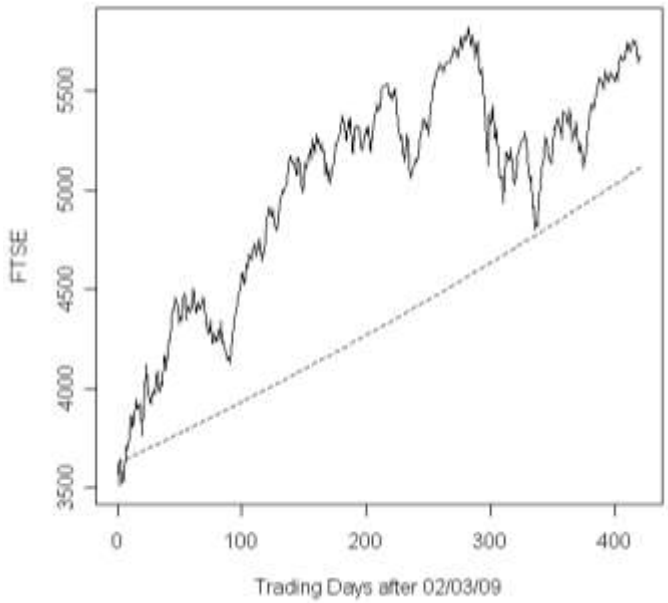

Figure 2. Plot of observed prices (solid line) together with estimated fundamental value (dashed line).

5. Conclusions

This paper builds on the now well-established analogy between financial crashes and phase transitions in critical phenomena. In a stochastic version of the original model of [3] crashes are seen to represent a phase transition from random to deterministic behaviour in prices. Crash precursors are a super-exponential growth accompanied by an "illusion of certainty", characterised by a decrease in the volatility function prior to the crash. A Gaussian model is introduced and then further extended to incorporate a heavy-tailed version of the model based around the NIG distribution. Under both settings a range of potential applications to economics were discussed. These include statistical tests for bubbles, crash-size distributions, predictions of a post-crash increase in volatility – related to Omori-style power laws in complex systems – and simple estimates of fundamental-value and speculative-bubble components. As an empirical application we test for whether a bubble is present in the FTSE 100 following the introduction of the Bank of England's policy of quantitative easing. Some evidence of a bubble and subsequent over-pricing is found. However, the level of over-pricing does not appear very large – particularly in comparison to the recent UK housing bubble – and prices appear to have converged towards estimated fundamental values during the latter half of 2010.

Probability Appendix

Definition 1. *The inverse Gamma distribution* $IG(\mu,\lambda)$ *is the probability distribution on* $[0, \infty)$ *with parameters* μ *and* λ *and probability density function given by*

$$f(x)=\sqrt{\frac{\lambda}{2\pi x^3}}e^{-\frac{\lambda(x-\mu)^2}{2\mu^2 x}} \quad . \tag{47}$$

The mean is equal to μ and the variance is equal to μ^3/λ.

Definition 2. *The normal inverse Gaussian distribution is the probability density on* $(-\infty, \infty)$ *with parameters* μ,α,β,δ *with* $|\beta|<\alpha$. *Define* $\gamma=\sqrt{\alpha^2-\beta^2}$. *The NIG distribution has probability density function given by:*

$$f(x)=\frac{\alpha\delta K_1(\alpha\sqrt{\delta^2+(x-\mu)^2})}{\pi\sqrt{\delta^2+(x-\mu)^2}}e^{\delta\gamma+\beta(x-\mu)}. \tag{48}$$

where K_1 denotes the modified Bessel function of the second kind with the integral representation:

$$K_v(z) = \frac{e^{-z}}{\Gamma(v+1/2)}\sqrt{\frac{\pi}{2z}}\int_0^\infty e^{-t}t^{v-1/2}\left(1+\frac{t}{2z}\right)^{v-1/2}\mathrm{d}t. \tag{49}$$

The mean of the NIG distribution given by (48) is:

$$\mu + \frac{\delta\beta}{\gamma}, \tag{50}$$

and the variance is:

$$\frac{\delta\alpha^2}{\gamma^3}. \tag{51}$$

Further, from (48), the moment generating function of the NIG distribution, $M_X(t)$: $=E[\exp\{tX\}]$, is given by:

$$M_X(t) = e^{\mu t + \delta(\gamma - (\beta+t)^2)}. \tag{52}$$

Result 1 [Mixture representation of the NIG distribution]. *Suppose that X and U are random variables obeying the following construction:*

$$U \sim IG\left(1, \frac{1}{K}\right), \tag{53}$$

$$X \mid U \sim N\left(\mu - \frac{\sigma^2 U}{2}, \sigma^2 U\right). \tag{54}$$

Then the marginal distribution of X is $NIG(\mu, \alpha, \beta, \delta)$ where:

$$\mu = \mu, \alpha = \sqrt{\frac{1}{\sigma^2 K} + \frac{1}{4}},\ \beta = -\frac{1}{2},\ \delta = \frac{\sigma}{\sqrt{K}}. \tag{55}$$

Proof: Write the probability distribution $f_X(x)$ of X as:

$$f_X(x) = \int_0^\infty f_{X|U=u}(x)\, f_U(u)\mathrm{d}u: \tag{56}$$

It follows that:

$$f_X(x) = \int_0^\infty \frac{1}{\sqrt{2\pi}\sigma\sqrt{u}} e^{-\frac{(x-\mu)^2}{2\sigma^2 u}} \sqrt{\frac{1}{2\pi K u^3}} e^{-\frac{(u-1)^2}{2Ku}}\mathrm{d}u. \tag{57}$$

The full result follows from the identity, see e.g. the appendix in [14]:

$$\int_0^\infty e^{-\frac{\alpha^2 t}{2}-\frac{\beta^2}{2t}} t^{-1-\nu} \mathrm{d}t = 2\left(\frac{\alpha}{\beta}\right)^{\nu} K_\nu(\alpha\beta). \tag{58}$$

Result 2. Suppose that X is *NIG* distributed with parameters given by (55). Then it follows that:

$$E(e^X) = e^{\mu}. \tag{59}$$

Proof: It follows from (53) that:

$$E(e^X) = e^{\mu+\delta(\gamma-\sqrt{\alpha^2-(-1/2+1)^2})} = e^{\mu+\delta(\gamma-\sqrt{\alpha^2-1/4})} = e^{\mu+\delta(\gamma-\gamma)} = e^{\mu}. \tag{60}$$

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MEASURING THE GROWTH AND THE STRUCTURAL CHANGE OF A MULTI-SECTOR ECONOMY

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Abstract. *The production process of an n-sector economy is described by a vector-function analogously as the motion of an ideal particle. The annual aggregate Gross Value Added and the annual speed in production value are shown to be two norms of the same velocity vector of accumulated sectoral production values, and thus they measure the same matter. Structural change in production is analyzed in this framework too. The structure of production changes when the shares of sectoral productions change. Our first measure for structural change is constructed in this way. Another measure for structural change is constructed from the shape of the space curve an economy leaves in the production space. Empirical measures corresponding to the theoretical ones are calculated by Finnish data.*

Keywords: *Disaggregate macroeconomics, particle motion, economic growth, structural change. JEL: C02, E01, O11.*

1. Introduction

We define helpful concepts for analyzing the growth and the structural change process of an economy. Our approach is analogous to kinematics in physics: *Kinematics is the study of the geometry of motion; it deals with the mathematical description of motion in terms of position, velocity, and acceleration. Kinematics serves as a prelude to dynamics, which studies force as the cause of changes in motion* ([1] p. 25).

A change in production in an *n*-sector economy consists of *n* simultaneous one-dimensional changes. We describe this process by a vector-function illustrating the motion of an ideal particle − a body with no size and no internal structure. This ideal particle is represented by a point in the *n*-space of accumulated sectoral productions; the point illustrates the

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position of the economy at a particular moment of time. Mathematically, the movement of a point with time in an *n*-dimensional space can be analyzed by a vector-function, see [2], pp. 21-27 and [3], pp. 517-550. The motion of an economy with time, illustrated by a change in the value of a vector-function, leaves a space curve in the *n*-space of accumulated sectoral productions. The moving economic object could as well be a multi-product firm or one industry with several producers, but here we study the disaggregated production process at economy level.

The advantage of modelling accumulated production, rather than annual flows of production, is that the production process becomes continuous. This allows us to measure the position, velocity, and acceleration of production in a fixed coordinate system. With these kinematic concepts we can study whether the assumption in the neo-classical theory − that firms produce at their profit maximizing equilibrium flows of production − is true. It appears that in every 3 main sectors in Finland statistically significant non-zero acceleration in production is observed, see Section 6.

The value and volume of production and their growth are measured by the speed and the change of speed (not acceleration which is a vector quantity) of accumulated value and volume of production of an economy in *n*-dimensional space. The speed of production of an economy is one norm, and the Gross Value Added (*VA*) is another norm of the same velocity vector of accumulated production. Thus the speed of production of an economy and its change measure the aggregate flow of production and its growth, which analogy is often made in newspapers.

The advantage of analyzing growth in disaggregated framework − as compared with standard aggregated framework − is that changes in production structure can be analyzed in this framework too. Modelling accumulated sectoral productions separately, and combining these to model the aggregate *VA* rather than modelling the single time series of aggregate *VA*, hopefully gives us better forecasts. We introduce here the principle for this kind of analysis.

In a growing economy, the structure of production changes so that the share of primary production decreases and that of services increases see e.g. [4]. This result among other things from Engel's law which postulates that a rise in living standard changes the consumption structure so that necessary goods are crowded out by luxury ones, see [5]. According to [6], the structural change in employment occurs due to changes in technology and demand while [7]-[8] stress the role of technologically leading industries in economic growth and structural change. Thus we have

evidence that in a growing economy different sectors expand at varying rates, and this effect is concealed in aggregated analysis.

However, the concepts of structure and structural change in economic analysis have been understood in at least nine different ways, see [9]. Thus it is not clear what we mean by these concepts. In classical works, e.g. [10] and [11], it is clearly understood that the structure of an economy changes with its development. Formal approaches for this have been developed by Wassily Leontief, Luigi Pasinetti, and Richard Goodwin among others. These authors stress the difference between "horizontal" and "vertical" representation of economic structure. The former describes the circular structure of an economic system while the latter stresses the unidirectional process where individual agents cluster into a smaller number of classes, see [12].

In the last 20 years emerged a literature called evolutionary or "neo-Schumpeterian" economics, see e.g. [13] or [14]. This framework stresses disharmony in the growth process and the role of micro and industrial level changes on macro dynamics because technological innovations spread in economies at different sectoral speeds, see [15]. Our framework, too, belongs in evolutionary economics. However, we do not study the reasons for structural change in an economy. We only measure the process by two different ways that give similar results. We treat structural change as a continuous process and show that during 1975-2002 Finland faced one exceptional period in this process at depression years 1990-92.

The only reference we found that analyzes structural change by using vector space methods like we is [16]. The measures for structural change introduced in [16] are based on the angle between two vectors, while our measures are based on a change of a vector-function. The coordinates of the vector in [16] are sectoral productions while we use the shares of sectoral productions of total production. Thus our measures are not directly comparable.

Other ways to measure structural changes have been concentrated on testing the stability of parameters in regression models; see e.g. [17]-[19]. These tests, no doubt, document changes in the production structure, but they do not inform about the causes of these changes. The advantage of our framework, as compared with e.g. [17], is that our measures can be used as endogenous variables in models that explain the structural change process.

This study is organized as follows. The data is described in Section 2. In Section 3 the production process of a n-sector economy is studied by the motion of an ideal particle in the n-space of accumulated sectoral productions. The framework introduced in Section 3 is applied in Sections

4 and 5 in measuring the structural change in production in an economy. The acceleration of sectoral productions is measured in Section 6, empirical results from structural change are given in Section 7, and Section 8 is a summary.

2. The data used in the study

We use annual sectoral production values at current prices and at year 2000 prices from Finnish economy. The latter are used to represent production volumes. The data contains the following 9 main sectors at 1975-2002 ([20]): 1 = A (Agriculture, forestry and hunting) + B (Fishing), 2 = C (Mining and quarrying) + D (Manufacturing) + E (Electricity, gas, and water supply), 3 = F (Construction), 4 = G (Trade, repair of motor vehicles and household goods) + H (Hotels and restaurants), 5 = I (Transport, storage and communication), 6 = J (Financial intermediation and insurance), 7 = K (Real estate and business activities), 8 = L (Administration, compulsory social security) + M (Education), 9 = N (Health and social work) + O (Other community, social and personal services) + P (Household service activities) – Financial intermediation services indirectly measured (FISIM). These 9 sectors cover the total production in Finland. In some of the graphical demonstrations, the 9 main sectors are aggregated to 3 as follows: X_1 (primary production) = A+B, X_2 (secondary production) = C+D+E, and X_3 (private and public services) = F+G+H+I+J+K+L+M+N+O+P - FISIM.

In Finland, manufacturing is divided in 13 sectors: DA: Food products, beverages and tobacco, DB+DC: Textiles, textile products, leather and leather products, DD: Wood and wood products, DE: Pulp, paper and paper products, publishing and printing, DF: Refined petroleum products, coke and nuclear fuel, DG: Chemicals and chemical products, DH: Rubber and plastic products, DI: Other non-metallic mineral products, DJ: Basic metals and fabricated metal products, DK: Machinery and equipment, DL: Electrical and optical equipment, DM: Transport equipment, DN: Other manufacturing and recycling. These sectors cover the whole Finnish manufacturing and we have annual data of these from years 1975-2008.

3. Production according to particle motion

We describe the production in an n-sector economy by a vector-function in a coordinate system. "*A coordinate grid, together with a set of*

synchronized clocks at every point in space, is called a reference frame", [1] p. 5. Let time unit (t_0, t_1), where $t_0 < t_1$ are two time moments, be partitioned in intervals Δs. The accumulated value of production at sector *k* during (t_0, t_1) is then

$$X_k(t_0, t_1) = \sum_{s=t_0}^{t_1} Q_k(s)\,\Delta s$$

and letting $\Delta s \to 0$ we get:

$$X_k(t_0, t_1) = \lim_{\Delta s \to 0} \sum_{s=t_0}^{t_1} Q_K(s)\,\Delta s = \int_{t_0}^{t_2} Q_k(s)\,\mathrm{d}s.$$

Now, $\int_{t_0}^{t_1} Q_k(s)\,\mathrm{d}s$ with unit € measures the accumulated value of production at sector *k* during (t_0, t_1). This is analogous as in physics. If, for instance, Q_k is the velocity of a body with unit *km/hour*, $\int_{t_0}^{t_1} Q_k(s)\,\mathrm{d}s$ with unit *km* measures the movement of the body during time $t_1 - t_0$.

With cumulative sectoral production values as the coordinate axes, our reference frame is:

$$X_1 = \int Q_1(s)\,\mathrm{d}s,\ \ldots,\ X_n = \int Q_n(s)\,\mathrm{d}s. \qquad (1)$$

Cumulative sectoral production values in the coordinate axes make the measurement units of speed €/*y* and acceleration €/y^2 of accumulated value of production similar to those found in mechanics; *y* is a time unit like a year or a month. In this coordinate system, the point describing the position of the economy moves away from the origin all the time, and it does not change its direction of motion toward the origin. In particle motion in physics, analogously, a coordinate axis measures the length the particle has moved in the direction in a time unit. An analogous coordinate system for (1) is devised for production volumes too. Annual value of production at sector *k* at year t is denoted as:

$$Q_k(t)\,(€/y),\ Q_k(t) = p_k(t)\,q_k(t) \text{ where } p_k(€/unit)$$

is the price and $q_k(unit/y)$ the annual volume of production. The empirical correspondence for annual volume of production at year t is

$Q_{kr}(t)$, $Q_{kr}(t) = p_k(t_0)\, q_k(t)$, where t_0 is fixed (in our case, year 2000). In empirical analysis, $Q_k'(t)$ is approximated by $\Delta Q_k / \Delta t$ with:

$$\Delta t = 1(year).$$

Designating the initial time moment as 0, the position of the economy in the *n*-space of accumulated production values at time moment *t* can be denoted by the following vector-function:

$$X(t) = (X_1(t), \ldots, X_n(t)) = \left(\int_0^t Q_1(s)\mathrm{ds}, \ldots, \int_0^t Q_n(s)\, \mathrm{ds} \right). \qquad (2)$$

In time $(0, t)$, Function (2) can be graphed as a space curve in coordinate system (1). In figures 1 and 2 are three-dimensional realizations of Function (2) of the Finnish economy at 1975-2002 with accumulated values and volumes of sectors $X_1, X_2,$ and X_3 as the coordinate functions, see Section 2. Every observation represents the position of the Finnish economy at the corresponding year. In figure 2, the observed points are modeled by a second order time polynomial (the continuous graph). The graph is constructed from the models for the Sectors $X_1, X_2,$ and X_3 shown in figures 3-5; see Section 6. Figures 1 and 2 show how the Finnish economy "moves" along the curve with time, which establishes our analogy to particle motion.

The average velocity vector of the economy along space curve (2) is

$$\frac{\Delta X(t)}{\Delta t} = \left(\frac{\Delta X_1(t)}{\Delta t}, \ldots, \frac{\Delta X_n(t)}{\Delta t} \right), \qquad (3)$$

and the instantaneous velocity vector of the economy at point $X(t)$ is:

$$X'(t) = (X_1'(t), \ldots, X_n'(t)) = (Q_1(t), \ldots, Q_n(t)). \qquad (4)$$

Geometrically, $X'(t)$ is the tangent vector of the space curve (2) at point $X(t)$. Instantaneous acceleration vector of accumulated value of production in the economy is defined analogously:

$$X''(t) = (Q_1'(t), \ldots, Q_n'(t)).$$

In Newtonian mechanics, the three-dimensional real physical world is approximated by the three-dimensional Euclidean space. Assuming that the

above-described production space is approximately Euclidean, we can calculate the Euclidean norm of vector $X'(t)$ in the *n*-space as:

$$Speed(t) = \|X'(t)\| = (Q_1^2(t) + \cdots + Q_n^2(t))^{1/2}. \quad (5)$$

Scalar *Speed* with unit $€/y$ measures the instantaneous velocity of accumulated value of production in the economy in reference frame (1) at point $X(t)$. An example of calculating the *Speed* of accumulated value of production in two-dimensional case is given in figure 6, where X_i is the accumulated value of production at sector $i, i = 1, 2$. The length of vector AB is $\|\Delta X\|$, where $\|\Delta X\| = X(t_1) - X(t_0)$ and $X(t_j) = (X_1(t_j), X_2(t_j))$, j = 0, 1. Applying Pythagorean Theorem we get

$$\|\Delta X\|^2 = (\Delta X_1)^2 + (\Delta X_2)^2 \Rightarrow \|\Delta X\| = \sqrt{(\Delta X_1)^2 + (\Delta X_2)^2}\,. \quad (6)$$

Now, during time $\Delta t = t_1 - t_0$ the economy has moved from point $(X_1(t_0), X_2(t_0))$ to point $(X_1(t_1), X_2(t_1))$. The speed of accumulated value of production at sector i (the speed of movement in direction X_i) is then $\Delta X_i / \Delta t,\ i, i = 1, 2$. However, the total "length" the point has moved in the space of accumulated production values during Δt is $\|\Delta X\|$. The average speed of the *"point representing the accumulated value of production in the economy"* during Δt is then

$$\frac{\|\Delta X\|}{\Delta t} = \sqrt{\left(\frac{\Delta X_1}{\Delta t}\right)^2 + \left(\frac{\Delta X_2}{\Delta t}\right)^2}. \quad (7)$$

Taking the limit $\Delta t \to 0$ we get the instantaneous speed of the accumulated value of production at t_0 as

$$\|X'(t_0)\| = \sqrt{(X_1'(t_0))^2 + (X_2'(t_0))^2}, \quad (8)$$

which corresponds to (5) with n = 2.

Acceleration of accumulated value of production has unit $€/y^2$. This is seen as:

$$Q_k'(t) = \lim_{\Delta t \to 0} \frac{\Delta Q_k}{\Delta t} = \lim_{t-(t-y) \to 0} \frac{Q_k(t) - Q_k(t-y)}{t-(t-y)} = \lim_{y \to 0} \frac{Q_k(t) - Q_k(t-y)}{y}$$

where $Q_k(t) - Q_k(t-y),\ k = 1, \ldots, n,$ are measured in units $€/y$.

Economy level nominal *VA* with unit $€/y$ is calculated by adding the sectoral value additions Q_k. In coordinates (1), *VA*-measure is the absolute value norm $\| X'(t) \|_1 = \sum_{k=1}^{n} |Q_k(t)|$ of vector (4) because the components of (4) are non-negative. Thus the Euclidean norm (5) of vector (4) measures the same quantity as the *VA*-measure because they are two norms of the same vector.

Using *VA* we get a measure for growth in the aggregate value in production as:

$$\Delta VA(t) = VA(t) - VA(t-y) = \sum_{k=1}^{n} Q_k(t) - \sum_{k=1}^{n} Q_k(t-y) = \sum_{k=1}^{n} \Delta Q_k(t).$$

Using *Speed* we get another measure for growth in the aggregate value flow of production:

$$\Delta Speed(t) = Speed(t) - Speed(t-y) = \left(\sum_{k=1}^{n} Q_k^2(t) \right)^{1/2} - \left(\sum_{k=1}^{n} Q_k^2(t-y) \right)^{1/2}.$$

Now, *VA* and *Speed* both measure the movement of a point in coordinates (1), and the reason for defining *Speed* is that it shows the connection to the theory of particle motion that is applied here as the general framework. The empirical values for *VA* and *Speed*, and those for ΔVA and $\Delta Speed$ are highly correlated, see Section 7. This shows that the two measures for the aggregate flow of accumulated production quantify the same matter. Using value data these measures are diagrammed in figures 7 and 8, and using volume data, in Figures 9 and 10.

4. Measurement of structural change

The production structure of an economy stays constant if the *VA* – share of every sector stays constant. If one sector increases or decreases its share during time unit *y,* a distance exists between the sectoral share vectors at time moments $t-y$ and *t*. According to the previous section, at time moment *t* the production structure of an economy is described by Vector-Function **V**,

$$\mathbf{V}(t) = (V_1(t), \ldots, V_n(t)) = \left(\frac{Q_1(t)}{\sum_{k=1}^{n} Q_k(t)}, \ldots, \frac{Q_n(t)}{\sum_{k=1}^{n} Q_k(t)} \right), \qquad (9)$$

where the coordinate functions are sectoral shares of the total value of production. Structural change is measured by the change of function (9) with time. The derivative vector of (9) is:

$$V'(t) = (V_1'(t), \ldots, V_n'(t)) =$$

$$= \left(\frac{Q_1'(t)\left(\sum_{k=1}^{n} Q_k(t)\right) - Q_1(t)\left(\sum_{k=1}^{n} Q_k'(t)\right)}{\left(\sum_{k=1}^{n} Q_k(t)\right)^2}, \ldots \right.$$

$$\left. \ldots, \frac{Q_n'(t)\left(\sum_{k=1}^{n} Q_k(t)\right) - Q_n(t)\left(\sum_{k=1}^{n} Q_k'(t)\right)}{\left(\sum_{k=1}^{n} Q_k(t)\right)^2} \right), \qquad (10)$$

and its Euclidean norm is

$$v_n(t) = \| V'(t) \| = (V_1'^2(t) + \ldots + V_n'^2(t))^{1/2}. \qquad (11)$$

Measure v_n calculated from the 9 main sectors of the Finnish economy is displayed in figure 11. We can notice that v_n gives a positive value for structural change also when the structure reverts to what it has previously been. Cyclical behavior may thus cause v_n to overestimate the long-term structural change. To eliminate this problem, the corresponding long-term measure can be calculated e.g. from five-year averages of annual production values.

Eq. (10) implies that the structural change of an economy depends on sectoral price and volume changes, and on the "sizes" of the sectors. If we write $Q_j(t) = p_j(t)\, q_j(t)$, we get:

$$V_j'(t) = \frac{p_j(t)\, q_j}{\sum_{k=1}^{n} p_k(t)\, q_k(t)} + \frac{p_j(t)\, q_j'(t)}{\sum_{k=1}^{n} p_k(t)\, q_k(t)} - \frac{p_j(t)\, q_j(t) \sum_{k=1}^{n} p_k'(t) q_k(t)}{\left(\sum_{k=1}^{n} p_k(t)\, q_k(t)\right)^2} -$$

$$- \frac{p_j(t)\, q_j(t) \sum_{k=1}^{n} p_k(t) q_k'(t)}{\left(\sum_{k=1}^{n} p_k(t)\, q_k(t)\right)^2}. \qquad (12)$$

Thus the share of sector j increases if its price and flow of production increase, and decreases if prices and flows of production increase at other sectors.

If we calculate (11) from sectoral shares of total volume flow of production, we get a measure for structural change in production volumes. This measure v_r from the 9 main sectors of the Finnish economy is displayed in figure 13. Measures v_n, v_r are calculated for Finnish manufacturing too with data 1975-2008. In this case Vector-Function (9) displays the shares of the 13 manufacturing sectors of total manufacturing production, and measures v_{nm}, v_{rm} are constructed analogously. These measures are presented in figures 17 and 19.

5. Non-linearities in production path

Here we study the production structure in another way by measuring whether the movement of the economy in the space of accumulated sectoral productions has been linear or not, that is, whether the structure has remained constant. To illustrate this framework, see figures 1 and 2. The non-linearity of these space curves reveals a change in the production structure. We calculate the instantaneous curvature of the curve corresponding to Function (2). If this space curve is linear, the structure of the economy stays constant or changes in a linear way. We use the extent of non-linearity of Function (2) in measuring the change in the production structure.

The extent of non-linearity of a curve can be measured by its curvature. In our case,

$$k_n(t) = \frac{\| T'(t) \|}{\| X'(t) \|} \tag{13}$$

is the formula for curvature, and the velocity vector is

$$X'(t) = (X_1'(t), \ldots, X_n'(t)) = Q_n(t)),$$

and

$$T(t) = \frac{X'(t)}{\| X'(t) \|} = \left(\frac{X_1'(t)}{\| X'(t) \|}, \ldots, \frac{X_n'(t)}{\| X'(t) \|} \right) \tag{14}$$

is the unit tangent vector of the curve when $\| X'(t) \|$ is nonzero. Then

$$T'(t) = \left(\frac{X_1''(t) \| X'(t) \| - X_1'(t) \frac{X'(t) \cdot X''(t)}{\| X'(t) \|}}{\| X'(t) \|^2}, \ldots \right.$$

$$\left. \ldots, \frac{X_n''(t) \| X'(t) \| - X_n'(t) \frac{X'(t) \cdot X''(t)}{\| X'(t) \|}}{\| X'(t) \|^2} \right),$$

where. · is the dot product of two vectors. The curvature of a curve is non-negative, and a linear curve has zero curvature, see [3] p. 537.

The instantaneous curvature of Function (2) measures change in the production structure. Measure k_n calculated from the value data of 9 main sectors is displayed in figure 12, and measure k_r from the volume data of 9 main sectors in figure 14. The corresponding measures for manufacturing, k_{nm}, k_{rm}, are in figures 18 and 20. The difference in these measures can be seen by writing k_n in an expanded form

$$k_n(t) = \left(\left(\frac{Q_1'(t) \left(\sum_{k=1}^{n} Q_k^2(t) \right) - Q_1(t) \sum_{k=1}^{n} Q_k(t) Q_k'(t)}{\left(\sum_{k=1}^{n} Q_k^2(t) \right)^2} \right)^2 + \right.$$

$$\left. + \left(\frac{Q_n'(t) \left(\sum_{k=1}^{n} Q_k^2(t) \right) - Q_n(t) \sum_{k=1}^{n} Q_k(t) Q_k'(t)}{\left(\sum_{k=1}^{n} Q_k^2(t) \right)^2} \right)^2 \right)^{1/2}.$$

Although v_n and k_n scaled at equal level in figures 15 and 16 look similar, they measure different things; v_n has unit 1/*y* while k_n has 1/€, and the values of k_n are much smaller.

6. Modelling the production process

We estimate the following model for accumulated volume of production at sector k, $X_{kr}(unit)$,

$$X_{kr}(t) = \int_0^t q_k(s)\,\mathrm{d}s = a_k + b_k t + \frac{c_k}{2}t^2,\ \ k = 1, 2, \ldots, \qquad (15)$$

where t is time with unit y, $q_k(unit/y)$ the flow of volume of production at sector (industry) k, and a_k, b_k and c_k are constants with units: *unit*, *unit/y*, and $unit/y^2$, respectively; $y = year$. These constants can be interpreted as: $q_k(t) = b_k + c_k t$ and $q_k'(t) = c_k$; thus c_k measures acceleration of the accumulated volume of production at sector k, see Section 3.

The estimation results for model (15) for primary X_{1r} and secondary production X_{2r} and private and public services X_{3r} are in Table 1; D-W is the Durbin-Watson statistic.

Table 1

Estimated models for accumulated production volumes at sectors X_1, X_2 and X_3

Sector	Constant (T-stat.)	Time (T-stat.)	Time^2 (T-stat.)	R^2	D–W
X_{1r}	-6.9×10^7 (–6.9)	65065.0 (6.5)	−15.3 (−6.1)	0.999	0.28
X_{2r}	1.2×10^9 (20.4)	-1.3×10^6 (−20.8)	322.7 (21.3)	0.999	0.25
X_{3r}	2.4×10^9 (21.9)	-2.5×10^6 (−22.4)	640.8 (22.9)	0.999	0.22

Table 1 show that the acceleration of production volume has been statistically significantly negative in Sector X_1, and significantly positive in other sectors. The assumption in the neo-classical framework, that firms produce an equilibrium amount in a time unit, is thus rejected in every case. The DW-statistic shows that the models have a positive autocorrelation problem in residuals, which implies that a cyclical term is missing. However, we did not get rid of the problem by adding cyclical terms in the model, and so we report the results as such. The estimated models are displayed in figures 3-5 and they are combined to model the accumulated aggregate production in figure 2.

7. Empirical results for the structural change measures

Measures *VA* and *Speed* displayed in figures 7 and 9 in nominal and real terms show a clear similarity. The correlations between the production and growth measures are in Tables 2 and 3. The correlation between the nominal flow of production measures is 0.999, and that between the real measures is 0.997. The correlations between ΔVA and $\Delta Speed$ in nominal and real terms are 0.950 and 0.978, respectively. Thus both measures contain the same information.

Table 2

Correlations between the "flow of production value and volume" measures

	VA_n	$Speed_n$	VA_r	$Speed_r$
VA_n	1.000			
$Speed_n$	0.999	1.000		
VA_r	0.985	0.986	1.000	
$Speed_r$	0.987	0.999	0.997	1.000

Figures 11-14 reveal the change in the production structure in Finland in nominal and real terms. The highest peak in the figures can be explained by the Finnish depression at years 1990-92 (see Figures 7-10), which was caused by the rapid liberalization of the Finnish financial markets and the collapse of the Soviet Union. Soviet Union covered roughly 25% of Finnish exports, and this share decreased close to zero during these years. Figures 11-14 imply that the structural change process has been slightly decreasing during the period excluding the depression years.

Table 3

Correlations between the "growth of production value and volume" measures

	ΔVA_n	$\Delta Speed_n$	ΔVA_r	$\Delta Speed_r$
ΔVA_n	1.000			
$\Delta Speed_n$	0.950	1.000		
ΔVA_r	0.852	0.833	1.000	
$\Delta Speed_r$	0.852	0.871	0.978	1.000

Figures 15 and 16 shows a remarkable similarity between measures v and k when scaled at equal levels. The correlation matrix of all variables measuring structural change is in Table 7. Correlation 0.898 between v_r and k_r shows strong dependency. However, measured from values this dependency is weaker; the correlation between v_n and k_n is only 0.494.

Table 4

Correlations between the structural change measures

	v_n	k_n	v_r	k_r
v_n	1.000			
k_n	0.494	1.000		
v_r	0.767	0.446	1.000	
k_r	0.628	0.699	0.898	1.000

The structural change in Finnish manufacturing does not seem to have been as great during the depression years 1990-92 as in the whole economy, see Figures 17-20. The change in the composition of volume flows in manufacturing at 1990-92 is seen as a peak in the structural change process, but even a greater peak occurred at other depression years 1999-2001, and also at 2005. On the other hand, in value flows in manufacturing no such peak is seen at 1990-92.

8. Conclusions

We used the theory of particle motion and kinematics in classical mechanics in measuring production and its growth, and the structural change in production in a multi-sector economy. The speed of production and the aggregate Value Added were shown to be two norms of the same velocity vector of accumulated production. When the flow of production of the Finnish economy was measured by means of these two concepts, their correlation was roughly 0.99. Thus both measures were shown to quantify the same matter. A vector of sectoral production shares was used to describe the production structure of an economy, and the change of this vector-function was used as a measure for structural change. The curvature of the space curve describing the motion of an economy in the coordinate system of accumulated sectoral productions was used as another measure for structural change. These measures were calculated using Finnish data.

Appendix

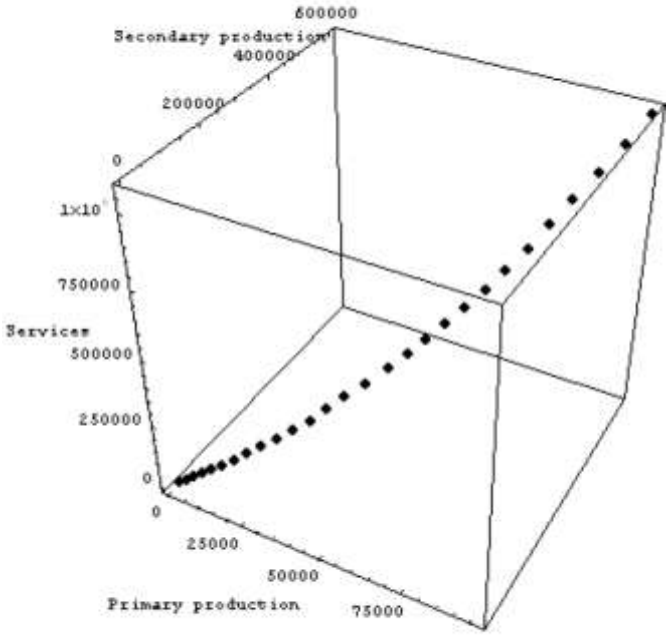

Figure 1. Accumulated production values in Finland at 1975-2002.

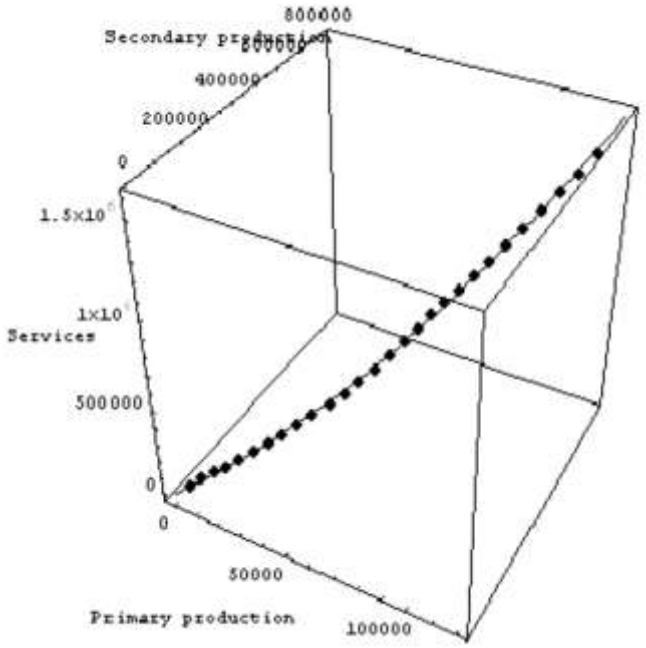

Figure 2. Accumulated and fitted production volumes in Finland at 1975-2002.

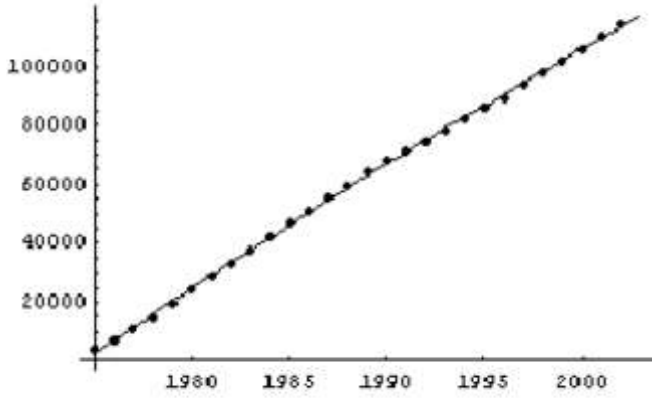

Figure 3. Accumulated and fitted volume of primary production.

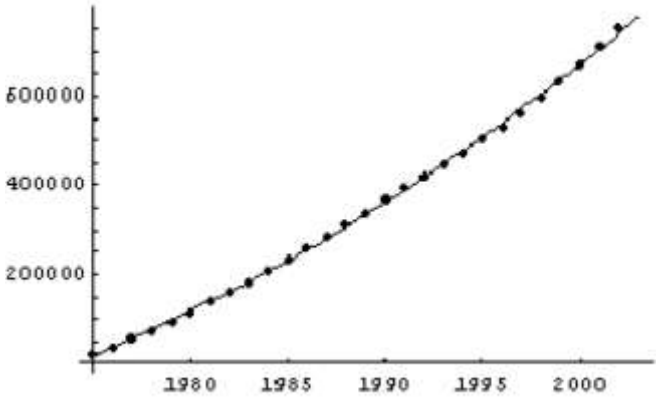

Figure 4. Accumulated and fitted volume of secondary production.

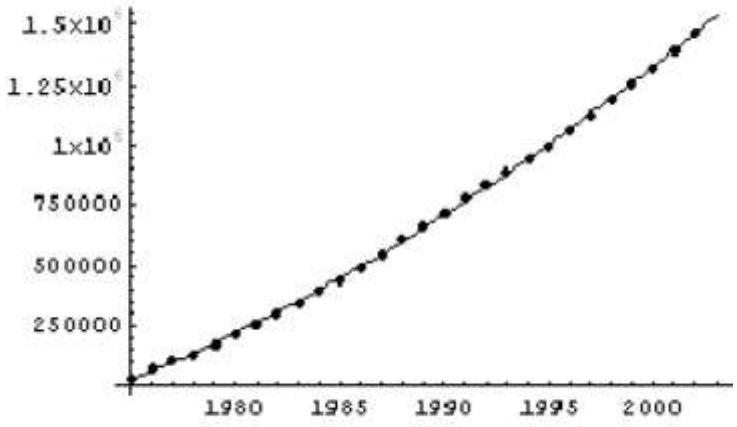

Figure 5. Accumulated and fitted volume of primary and public services.

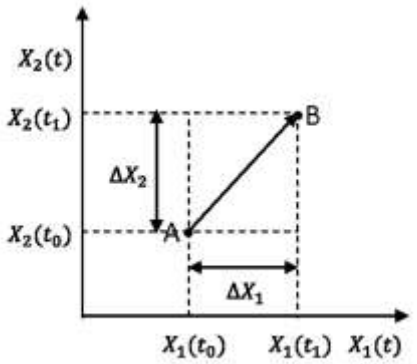

Figure 6. The speed of value of production in a two-good system.

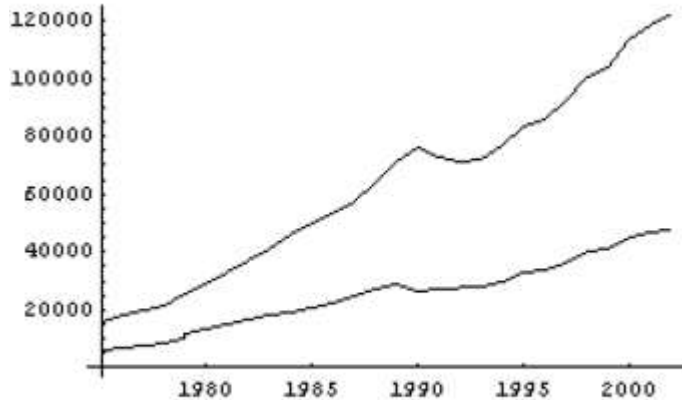

Figure 7. VA_n and $Speed_n$.

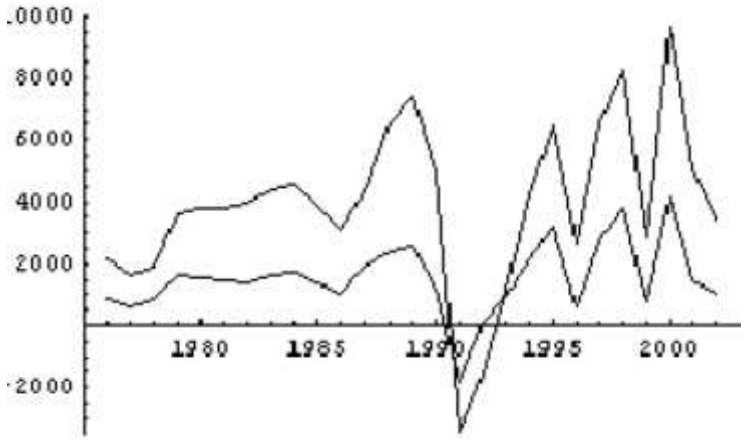

Figure 8. ΔVA_n and $\Delta Speed_n$.

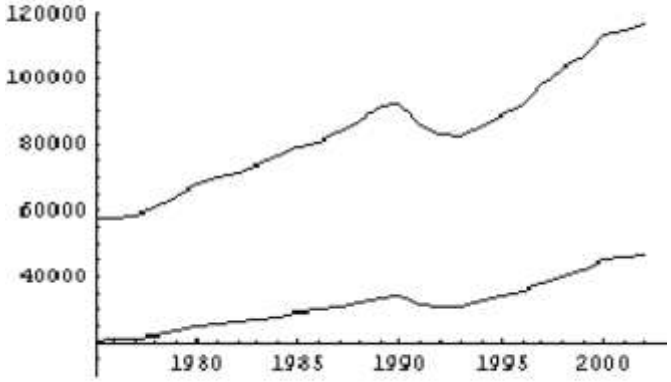

Figure 9. VA_r and $Speed_r$.

Figure 10. ΔVA_r and $\Delta Speed_r$.

Figure 11. Measure ν_n. .

Figure 12. Measure k_n.

Figure 13. Measure v_r.

Figure 14. Measure k_r.

Figure 15. Measures v_n and k_n scaled at equal level.

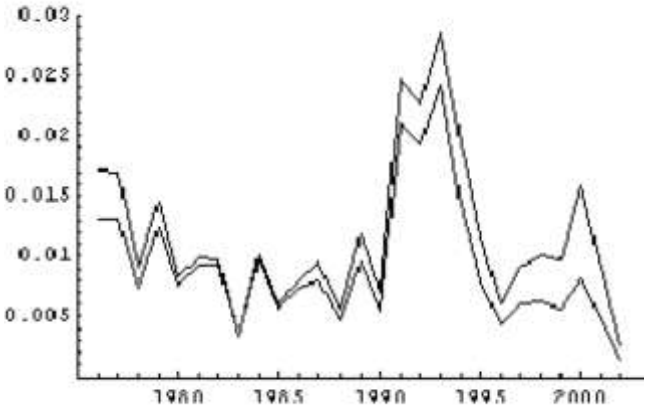

Figure 16. Measures v_r and k_r scaled at equal level.

Figure 17. Measure v_{nm} from Finnish manufacturing.

Figure 18. Measure k_{nm} from Finnish manufacturing.

Figure 19. Measure v_{rm} from Finnish manufacturing.

Figure 20. Measure k_{rm} from Finnish manufacturing.

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A CHAOTIC UNEMPLOYMENT RATE GROWTH MODEL

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Abstract. *Chaos theory, as a set of ideas, attempts to reveal structure in a periodic, unpredictable dynamic systems such as the fluctuation of unemployment rate. Chaos embodies three important principles: (i) extreme sensitivity to initial conditions; (ii) cause and effect are not proportional; and (iii) nonlinearity.*

The basic aim of this paper is to provide a relatively simple chaotic unemployment rate growth model that is capable of generating stable equilibria, cycles, or chaos depending on parmeter values.

A key hypothesis of this work is based on the idea that the coefficient $\pi = \gamma + 1$ *plays a crucial role in explaining local stability of the unemployment rate,* γ *– suitable parameter. The estimated chaotic unemployment rate growth model shows the monotonically increasing unemployment rate in the major advanced countries in the period 1980-2010 (www.imf.org).*

Keywords: *growth, model, unemployment rate, major advanced countries, chaos.*

1. Introduction

Chaos theory is used to prove that chaotic fluctuations can indeed arise in completely deterministic models. Chaos theory reveals structure in aperiodic, dynamic systems. Chaotic systems exhibit a sensitive dependence on initial conditions: seemingly insignificant changes in the initial conditions produce large differences in outcomes. This is very different from stable dynamic systems in which a small change in one variable produces a small and easily quantifiable systematic change.

Chaos theory started with Lorenz's (1963) discovery of complex dynamics arising from three nonlinear differential equations leading to turbulence in the weather system. Li and Yorke (1975) discovered that the

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simple logistic curve can exhibit very complex behaviour. Further, May (1976) described chaos in population biology. Chaos theory has been applied in economics by Benhabib and Day (1981, 1982), Day (1982, 1983, 1997), Grandmont (1985), Goodwin (1990), Medio (1993, 1996), Medio, A. and Lines, M. (2004), Lorenz (1993), Shone, R. (1999) among many others.

The basic aim of this paper is to provide a relatively simple unemployment rate growth model that is capable of generating stable equilibrium, cycles, or chaos depending on parameter values.

2. The chaotic unemployment rate growth model

Unemployment rate movement can be analyzed in formal framework of the chaotic growth model: The first step follows form the definition of the unemployment rate (u). The unemployment rate equals the ratio of unemployment (U) to the labour force (L), i.e.:

$$u = \frac{U}{L}. \tag{1}$$

Let U denote unemployment, and L the labour force.

We index u by t, i.e., write u_t to refer to the size at time steps $t = 0,1,2,3,...$ Now the growth rate is measured by the quantity already given corresponding to the expression:

$$\frac{u_{t+1} - u_t}{u_t}. \tag{2}$$

It is postulated that the growth rate at time t should be proportional to $1 - u_t$ (the fraction of the labour force that is not used up by the unemployment at time t). Assuming that the unemployment is restricted by the labour force, the growth of the unemployment rate should change according to the following equation, after introducing a suitable parameter γ:

$$\frac{u_{t+1} - u_t}{u_t} = \gamma\,(1 - u_t). \tag{3}$$

Solving the last equation yields the unemployment rate growth model, i.e.:

$$u_{t+1} = u_t + \gamma u_t (1 - u_t). \tag{4}$$

This model given by equation (4) is called the logistic model. For most choices of γ, there is no explicit solution for (4). Namely, knowing γ and measuring u_0 would not suffice to predict u_t for any point in time, as was previously possible. This is at the heart of the presence of chaos in deterministic feedback processes. Lorenz (1963) discovered this effect – the lack of predictability in deterministic systems. Sensitive dependence on initial conditions is one of the central ingredients of what is called deterministic chaos.

This kind of difference equation (4) can lead to very interesting dynamic behaviour, such as cycles that repeat themselves every two or more periods, and even chaos, in which there is no apparent regularity in the behaviour of u_t. This difference equation (4) will possess a chaotic region. Two properties of the chaotic solution are important: firstly, given a starting point u_0 the solution is highly sensitive to variations of the parameter γ; secondly, given the parameter γ, the solution is highly sensitive to variations of the initial point su_0. In both cases the two solutions are for the first few periods rather close to each other, but later on they behave in a chaotic manner.

3. Logistic equation

The logistic map is often cited as an example of how complex, chaotic behaviour can arise from very simple non-linear dynamical equations. The map was popularized in a seminal 1976 paper by the biologist Robert May. The logistic model was originally introduced as a demographic model by Pierre François Verhulst.

It is possible to show that iteration process for the logistic equation:

$$z_{t+1} = \pi_t (1 - z_t), \quad \pi \in [0,4], \quad z_t \in [0,1] \tag{5}$$

is equivalent to the iteration of growth model (4) when we use the identification:

$$z_t = \frac{\gamma}{\gamma + 1} u_t \quad \text{and} \quad \pi = \gamma + 1. \tag{6}$$

Using (6) and (4) we obtain:

$$z_{t+1} = \frac{\gamma}{\gamma + 1} u_{t+1} = \frac{\gamma}{\gamma + 1} [u_t + \gamma u_t (1 - u_t)] = \gamma u_t - \frac{\gamma^2}{\gamma + 1} u_t^2.$$

Using (5) and (6) we obtain:

$$z_{t+1} = \pi z_t (1 - z_t) = (\gamma + 1) \frac{\gamma}{\gamma + 1} u_t - \left(1 - \frac{\gamma}{\gamma + 1} u_t\right) =$$

$$= \gamma u_t - \frac{\gamma^2}{\gamma + 1} u_t^2.$$

Thus we have that iterating $u_{t+1} = u_t + \gamma u_t (1 - u_t)$ is really the same as iterating $z_{t+1} = \pi z_t(1 - z_t)$ using $z_t = \frac{\gamma}{\gamma + 1} u_t$ and $\pi = \gamma + 1$. It is important because the dynamic properties of the logistic equation (4) have been widely analyzed (Li and Yorke (1975), May (1976)).

It is obtained that:

(i) For parameter values $0 < \pi < 1$ all solutions will converge to $z = 0$;

(ii) For $1 < \pi < 3{,}57$ there exist fixed points the number of which depends on π;

(iii) For $1 < \pi < 2$ all solutions monotonically increase to $z = (\pi - 1) / \pi$;

(iv) For $2 < \pi < 3$ fluctuations will converge to $z = (\pi - 1) / \pi$;

(v) For $3 < \pi < 4$ all solutions will continuously fluctuate;

(vi) For $3.57 < \pi < 4$ the solution become "chaotic" which means that there exist totally a periodic solution or periodic solutions with a very large, complicated period. This means that the path of z_t fluctuates in an apparently random fashion over time, not settling down into any regular pattern whatsoever.

4. Empirical evidence

The main aim of this paper is to analyze the unemployment rate growth stability in the major advanced countries in the period 1980-2010. by using the presented non-linear, logistic growth model:

$$u_{t+1} = \alpha u_t - \beta u_t^2 \qquad (7)$$

where: *u* represents unemployment rate.

Firstly, we use data on unemployment rate [Source: www.imf.org]. Now, we estimate the model (7). The results are presented in Table 1 [Source: www.imf.org World Economic Outlook 2009].

The positive square root of the estimated variance, denoted by *R*, is usually referred to as the standard deviation of the regression or the

standard error of regression. *R* is a measure of the dispersion of the actual *u* – values about the regression line. *R*=.66964, and variance explained is 44.841 %.

Table 1
Results of Equation (7) on the unemployment rate,
major advanced countries: 1980-2010

Coefficient	α	β
Estimate	1.181830	2.457604
Std.Err.	0.164455	2.437589
t(28)	7.186362	1.008211
p-level	0.000000	0.321987

[Source: www.imf.org]

5. Conclusion

This paper suggests conclusion for the use of the chaotic unemployment rate growth model in predicting the fluctuations of the unemployment rate. The model (7) has to rely on specified parameter γ and initial value of the unemployment rate, u_0. But even slight deviations from the values of parameter γ and initial value of the population, u_0, show the difficulty of predicting a long-term unemployment rate movement.

A key hypothesis of this work is based on the idea that the coefficient $\pi = \gamma+1$ plays a crucial role in explaining local unemployment rate stability, where γ – the suitable parameter. An estimated values of the coefficient $\pi = \gamma + 1 = 1.181830$ in the major advanced countries is greater than 1 and smaller than 2 in the observed period. This result confirms stable but monotonically increasing movement of unemployment rate to 0.1538546 (or $z = (\pi - 1) / \pi$) in the observed period.

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AN EFFICIENT SOFT COMPUTING FOR A NEW SIMULATION APPROACH ON THREE MODELS OF OPTIMAL STOCK MANAGEMENT IN THE DETERMINISTIC CASE

Nicolae POPOVICIU*

Abstract. *The work is a generalization of three* ***Wilson's models*** *related with the stocks management in the deterministic case. A new variable r, called stock rate or* ***simulation rate****, appears* ***in all*** *these generalized models. This variable assures a better stock controlling by* ***deterministic simulation method****. For r= 1/2 we obtain all Wilson's results from the bibliography [4], [5]. For each economical model* ***the mathematical foundation*** *is given, together with several* ***numerical applications*** *and economical interpretations.*
The work contains: 3 economic models, 3 mathematical models, and 3 C++ programs.

Keywords: *Stock theory, optimal stock management, simulation rate, Wilson models, simulation models, C++ computer programs.*

1. Introduction

The work is a generalization of three **Wilson's models** related with stocks management in the deterministic case. A new variable *r*, called stock rate or **simulation rate**, appears **in all** these generalized models. This variable assures a better stock controlling by **deterministic simulation method**. For $r = 1/2$ we obtain all Wilson's results from the bibliography [4], [5]. For each economical model **the mathematical foundation** is given, together with several **numerical applications** and economical interpretations.

The work contains: 3 economic models
3 mathematical models
3 C++ programs
Each mathematical model generates **1) an informatics model** and **2) a C++ program**.

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So, the work contains three C++ valid programs:

a) source codification,

b) numerical output results and

c) print screen.

The C++ simulation programs have been validated by **supplementary techniques and independent computations**.

By simulation with various values of r a good manager has the possibility to choose **the best version** of his activity.

All models are based on **the same notations** with their specific meanings. So we used the following notations:

N = the total number of supplies.

h = the period length (the number of days, let us say) between two supplies; h is **constant**.

c_L = the launch cost for one demand of supply (the ordering cost per one order).

c_H = the holding cost (in warehouse) unit cost, per day.

c_P = the penalty cost per item, per day (when the stock s is less than the client's demand).

W = the production rate of the factory, on the unit time (the model 3).

D = the client's demand rate on the unit time (the model 3).

From time in time the manager has to stop the production activity, otherwise the whole quantity WT is too big, i.e. $WT >> Q$.

t_W = the working time (the production time) for the factory or industrial unit.

t_S = the stop time (the factory doesn't work).

t_{WP} = the working time and the penalty time for the factory because the client's demands are not satisfied.

t_P = the penalty time and stop time.

Remark: Generally there exists the inequalities $c_L >> c_P > c_H > 0$, where $a>>b$ means a is much greater than b. When the supply order of magnitude q was done, the stock is augmented quite instantaneous.

Remark: Between the described elements there are some important relations i.e.

$Q = Nq,\ T = Nh$

$C_r(q)$ = the total cost (composed of the ordering and holding cost) for interval $[0,T]$, in model 1.

$C_r(q,s)$ = the total cost (composed of the ordering, holding and penalty cost) for interval $[0,T]$, in model 2.

$C_r(t_S,t_P)$ = the total cost (composed of the production cost and ordering, holding and penalty cost) for the interval $[0,T]$, in model 3.

In the above description the elements T,Q,W,D,c_L,c_H,c_P and r are **input data**.

The elements $q,s,N,h,t_S,t_P,t_W,t_{WP}$ are **unknown data** (positive real numbers). They must be found by using the mathematical models for the maintenance stock problem.

MODEL 1. The absence of Ware in the Warehouse is not allowed.

MODEL 2. The absence of Ware in the Warehouse is allowed.

MODEL 3. Production, Holding, Stop Production and Satisfy Client's Demands .

The aim of the stock theory is to determine the best values q^* (model 1), q^*, s^* (model 2), t_S^*, t_P^* (model 3) which minimize **the total maintenance costs**, respectively:

$$C_r(q^*) = \min_{q\in(0,\infty)} C_r(q)$$

$$C_r(q^*,s^*) = \min_{q\in(0,\infty),\ s\in(0,\infty)} C_r(q,s)$$

$$C_r(t_S^*,t_P^*) = \min_{t_S\in(0,\infty),t_P\in(0,\infty)} C_r(t_S,t_P).$$

2. The Mathematical Model 1

For one period the cost is $c_L + rqc_Hh$ and for N periods of length h the total cost is:

$$C_r(q) = c_L\frac{Q}{q} + rc_HTq^2,\quad C_r'(q) = 0,\ q = \sqrt{\frac{c_LQ}{rTc_H}}\Bigg)$$

$$q^* = \sqrt{\frac{c_LQ}{rTc_H}},\ N^* = \frac{Q}{q^*},\ h^* = \frac{T}{N^*}\Bigg).$$

The total ordering and holding cost for interval $[0,T]$, in model 1 is:

$$C_r(q^*) = 2\sqrt{r\,c_Lc_HQT}.$$

Because $\frac{\partial C_r(q^*)}{\partial r} = \frac{\sqrt{c_L c_H QT}}{\sqrt{r}} > 0$ then the function $C_r(q^*)$ is increasing with *r*.

3. The Mathematical Model 2

For one period *h* (for one supply) the cost is $c_L + rsc_H h_1 + (1-r)(q-s)c_P h_2$ and for *N* periods of constant length *h* the total cost is $[c_L + rsc_H h_1 + (1-r)(q-s)c_P h_2]N$. We denote it by:

$$C_r(q,s) = [c_L + rsc_H h_1 + (1-r)(q-s)c_P h_2]N. \quad (8)$$

If we take into account the relations between variables the total cost is:

$$Nq = Q,\ \ Nh = T,\ \ \frac{h_1}{h} = \frac{s}{q},\ \ \frac{h_2}{h} = \frac{q-s}{q},\ \ h = h_1 + h_2,$$

the relation (8) becomes (9):

$$C_r(q,s) = c_L \frac{Q}{q} + r\, c_H T \frac{s^2}{q} + (1-r)\, c_P T \frac{(q-s)^2}{q}.$$

The extreme points for the function $C_r(q,s)$ in *q* and *s* are given by:

$$\frac{\partial C_r(q,s)}{\partial q} = 0,\ \ \frac{\partial C_r(q,s)}{\partial s} = 0,$$

and we obtain successively:

$$s = \frac{(1-r)c_P}{r\, c_H + (1-r)c_P} q;$$

Notation: $\rho(r) = \frac{(1-r)c_P}{r\, c_H + (1-r)c_P}$, $0 < \rho(r) < 1,\ \rho(1) = 0$

$$q^* = \sqrt{\frac{c_L}{rc_H}\frac{Q}{T}\frac{1}{\rho(r)}},\ \ s^* = \sqrt{\frac{c_L}{rc_H}\frac{Q}{T}\rho(r)}$$

$$C_r(q^*, s^*) = 2\sqrt{r\rho(r)c_L c_H QT} \text{ and } N^* = \frac{Q}{q^*},\ h^* = \frac{T}{N^*}.$$

Remark. For $r=\frac{1}{2}$ we obtain all the results from Wilson's model, with $\rho\left(\frac{1}{2}\right)=\frac{c_P}{c_H+c_P}$.

4. The Mathematical Model 3

The total cost per unit time is denoted C_r where:

$$C_r=\frac{c_L+c_H rs(t_W+t_S)+c_P(1-r)(q-s)(t_P+t_{WP})}{t_W+t_S+t_P+t_{WP}}. \qquad (*)$$

Between the variables q,s,t_W,t_S,t_P,t_{WP} and the constant elements T,W,D there are a lot of relations.

We suppose that the client's demand D satisfies the assumption $D=Q/T$.

Now we have to decide what variables are the main variables in formula (*).

Related with W and D there are three cases: a) $W-D<0$ impossible problem; b) $W-D=0$ uninterested problem; c) $W-D>0$ interested problem.

Version 1: We keep the variables t_W,t_S and eliminate t_P,t_{WP}. The method doesn't work.

Version 2: We keep the variables t_S,t_P and eliminate t_W,t_{WP} together with q and s. The method works and we obtain successively:

$$s=Dt_S,\ q-s=Dt_P,\ t_W=\frac{Dt_S}{W-D},\ t_{WP}=\frac{Dt_P}{W-D},\ W-D>0$$

$$C_r(t_S,t_P)=\frac{c_L(W-D)+DW[c_H rt_S^2+c_P(1-r)t_P^2]}{W(t_S+t_P)}.$$

The main variables are t_S,t_P.

Remark: For $r=1/2$ in (22) we obtain the Wilson's result from references.

Notation:

$$\rho(r)=\frac{(1-r)c_P}{r\,c_H+(1-r)c_P},\ 0<\rho(r)<1,\ \rho(1)=0,\ \rho\left(\frac{1}{2}\right)=\frac{c_P}{c_H+c_P}$$

$$t_P = \sqrt{\frac{W-D}{DW}\frac{c_L c_H}{c_P^2}\frac{r}{(1-r)^2}\rho(r)} = t_P^*,\ t_S = \sqrt{\frac{W-D}{DW}\frac{c_L}{c_H}\frac{\rho(r)}{r}} = t_S^*$$

$$t_W = \sqrt{\frac{D}{W(W-D)}\frac{c_L}{c_H}\frac{\rho(r)}{r}} = t_W^*,\ t_{WP} = \sqrt{\frac{D}{W(W-D)}\frac{c_L c_H}{c_P^2}\frac{r}{(1-r)^2}\rho(r)} = t_{WP}^*$$

$$s = \sqrt{\frac{D(W-D)}{W}\frac{c_L}{c_H}\frac{\rho(r)}{r}} = s^*,$$

$$q = \sqrt{\frac{D(W-D)}{W}c_L c_H \rho(r)}\left(\frac{1}{c_H}\sqrt{\frac{1}{r}} + \frac{1}{c_P}\sqrt{\frac{r}{(1-r)^2}}\right).$$

Now we compute the total cost C_r for the best main values t_S^*, t_P^* and obtain successively:

$$C_r(t_S^*, t_P^*) = \frac{2c_L(W-D)}{W(t_S^* + t_P^*)},\ C_r(t_S^*, t_P^*) = 2\sqrt{\frac{D(W-D)}{W}c_L c_H r\rho(r)}.$$

5. The importance of holding rate $r \in (0,1)$

Compute the partial derivative $\frac{\partial C_r(t_S^*, t_P^*)}{\partial r}$ and put the condition $\frac{\partial C_r(t_S^*, t_P^*)}{\partial r} = 0$. We obtain the algebraic equation in variable *r:*

$$(c_P - c_H)r^2 - 2c_P r + c_P = 0,\ c_P - c_S > 0$$

$$\Delta = 4c_P c_H > 0,\ r_1 = \frac{c_P + \sqrt{c_P c_H}}{c_P - c_H} > 1,\ 0 < r_2 = \frac{c_P - \sqrt{c_P c_H}}{c_P - c_H} < 1.$$

For $r \in (0, r_2]$ the function $C_r(t_S^*, t_P^*)$ is increasing function; for $r \in (r_2, 1)$ the function $C_r(t_S^*, t_P^*)$ is decreasing function. Generally the stock manager has to choose the value $r \in (0, r_2]$.

Remark: For the manager it is very important to know the best value of working time t_W^* (formula (28)) and the best value of stop time t_S^* (formula (27)).

We denote:

$t_W + t_{WP}$ = the work cycle; $t_S + t_P$ = the stop work time;

$\frac{T}{t_W + t_{WP} + t_S + t_P}$ = the total number of work-stop cycles over the period $[0, T]$. Generally this is a real number, but the manager can take the integer part.

6. Validation of C++ program by independent computations

We can verify the correctitude of numerical computations by the following tests:

$$t_W^*(W - D) = s^*; \ (t_W^* + t_{WP}^*)(W - D) = q^*.$$

Finally we denote $t_W + t_{WP}$ = the work cycle.

7. The Informatics Models. C++ Codification and Program Results

Now we write a C++ program for each mode 1, model 2 and mode 3.

For model 1 we use the input data T, Q, c_L, c_H, r and the formulas (6) and (7).

For model 2 we use input data T, Q, c_L, c_H, c_P, r and the formulas (11), (12), (13) and (17).

For model 3 we use input data $T, Q, W, c_L, c_H, c_P, r$ and the formulas (28), (27), (26), (29), (30), (31) and (39).

The numerical simulation is done by the values of variable *r* hold in vector rn[21]. The dimension 21 could be changed by the user. In C++ program the identifiers of variables look like in the theory, with small modifications. For example:

c_L = cL, c_H = cH, c_P = cP, q^* = qs, s^* = ss etc.

All the input data are introduced by computer keyboard. The program asks for input data step by step.

8. The correspondence between theoretical notations and C++ notations and meanings

Theory	C++	Theory	C++
T	T	W	W
Q	Q	D	D
q^*	qs	t_W^*	tws
s^*	ss	t_S^*	tss
N^* Ns	t_{WP}^*	twps	
$[N^*]$	Nsi	t_P^*	tps
h^*	hs	$C_r(q^*)$	Crs
$[h^*]$	hsi	$C_r(q^*, s^*)$	Crs
c_L	cL	$C_r(t_S^*, t_P^*)$	Crs
c_H	cH	r	r
c_P	cP	$\rho(r)$	ro

Theory	C++
$t_W + t_{WP} + t_S + t_P$ sumti	
$t_W + t_{WP}$	work cycle
$t_S + t_P$	stop cycle
$r_1, r_2, \cdots, r_n$	rn[21], n < = 20
q_1^* (first supply)	qs1
$q_{N^*}^*$ (last supply)	qsL
Q	Qcontrol
Q	Qcontroli (integer)
$\frac{T}{t_W^* + t_{WP}^* + t_S^* + t_P^*}$	Nworkstopcycle.

9. C++ Programs

C++ program for Model 1
C++ program for Model 2
C++ program for Model 3.

10. Applications for model 1

$Q = 1800\,000$ Kg (of flour, let us say, in a bred factory).

T = one month; $T = 30$ days.

$c_L = 3000$ units (of money).

$c_H = 1$ unit / 600 Kg / day, $c_H = 0.00166666$

$r = \frac{1}{4}$; $r = \frac{1}{3}$; $r = \frac{1}{2}$ (3 cases for r).

Find the optimal values $q^*, N^*, h^*, C_r(q^*)$ and draw a supply plan.

Solution. We arrange the results in the table 1. The value of stock rate r is at the manager's disposal. The numerical results show the best version.

Table 1

	$r = \frac{1}{4}$	$r = \frac{1}{3}$	$r = \frac{1}{2}$
q^*	657 267	569 209	464 757
N^*	2.738	3.16	3.87
$\overline{N}^*$	3	3	4
h^*	10.95	9.419	7.75
$\overline{h}^*$	10	10	7.5
$C_r(q^*)$	16432	18974	23274

The supply plan is:

$q_1^* = 657\,267$	$q_1^* = 569\,209$	$q_1^* = 464\,757$
$q_2^* = 657\,267$	$q_2^* = 569\,209$	$q_2^* = 464\,757$
$q_3^* = 485\,466$	$q_3^* = 661582$	$q_3^* = 464\,757$
	$q_4^* = 405\,729$	

Verification $Q = 1800\,000$ $Q = 1800\,000$ $Q = 1800\,000$.

11. Applications for model 2

$Q = 30\,000$ TV sets (let us say, in a supermarket);

T = one year; $T = 360$ days;

$c_L = 500$ units (of money); $c_L = 500$;

$c_H = 2$ units / 1 TV set / day; $c_H = 2$;

$c_P = 10$ units / 1 TV set / day; $c_P = 10$;

$r = \frac{1}{3}$; $r = \frac{1}{2}$; $r = \frac{c_P - \sqrt{c_P c_H}}{c_P - c_H} = 0.69 < 1$;

$r = \frac{3}{4}$ (we simulate 4 cases related with r).

Find the optimal values $q^*, N^*, h^*, C_r(q^*, s^*)$ and draw a supply plan.

Solution. We arrange the results in the table 2.

Table 2

	$r = \frac{1}{3}$	$r = \frac{1}{2}$	$r = 0.69$	$r = \frac{3}{4}$
$\rho(r)$	$\frac{10}{11}$	$\frac{5}{6}$	0.691	$\frac{5}{8}$
q^*	262.20	223.62	208.26	210.82
s^*	238.26	186.33	144.44	131.75
N^*	114.41	134.16	144.05	142.30
$\overline{N}^*$	114	134	144	142
h^*	3.14	2.68	2.5	2.52
$\overline{h}^*$	3	3	3	3
C_r^*	114415	134164	143413	142302 the max cost

The supplying plan is the following

$q_1^* = 262$ $q_1^* = 223$ $q_1^* = 208$ $q_1^* = 211$

$q_2^* = 262$ $q_2^* = 223$ $q_2^* = 208$ $q_2^* = 211$

…… …… ……. ……

$q_{113}^* = 262$ $q_{133}^* = 223$ $q_{143}^* = 208$ $q_{141}^* = 211$

$q_{114}^* = 394$ $q_{134}^* = 341$ $q_{144}^* = 256$ $q_{142}^* = 249.$

Verification $Q = 30\,000$ $Q = 30\,000$ $Q = 30\,000$ $Q = 30\,000$ (on each colon of r).

For the value $r = r_2 = 0.69$ the total cost has the maxim value 143413.

12. Conclusions

All the three economical models together with the C++ appropriate programs are useful tool for a manager wishing to realize an optimal activity. The programs make an economical mini-library.

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MODELLING THE REALITY FUZZY INFORMATION IN NATIONAL ECONOMICS

Wolfgang ECKER-LALA*

Abstract. *All models which are used in national economics – theory, practice and statistics – are based on precise numbers. In fact almost all information – which is used in national economics – becomes fuzzy to the uncertain conditions and parameters. If we think of "old" Keynesian economics all uncertainty in information has been ignored. Rational expectations theory assumes the availability of precise information – sometimes even stochastic components are ignored in it. In fact national economics run in a complex environment. So there must be a high degree of uncertainty about information and their relation. Enhancing all the models by fuzzy components enables the use of linguistic information such as "low", "medium", "high".*

This paper discusses topics of the theory of national economics with focus to uncertain information and presents the results of so gained economical functions.

Keywords*: fuzzy, fuzzy number, fuzzy information, characterizing function, gross domestic product, unemployment rate, uncertainty, imprecision*

It seems precise but.....

If we read books about microeconomics, macroeconomics or national economics it seems that all values – like:

- gross domestic product (GDP)
- price index
- unemployment rate
- inflation rate
- relative output gap
- etc.

which are used in all the mathematical or economical models are precise. If we have a closer look on those values or if we discuss them from a more critical point of view it becomes immediately obvious that almost all of

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them are not precise. Many of them are not precise because the necessary 100% availability is not feasible or cannot be guaranteed.

All the used information is based on data sampling or any kind of reporting. If we consider it on national level it is highly dependent if the information can be gained and on the quality of data which can be provided.

Finally based on these uncertainties we have to consider the impact on all of our calculation results because they are also uncertain and fuzzy.

Example Bosnia-Herzegovina: Consider a country in which a war took place. After the war it is separated from the original "mother" country. In this situation such a country lost all historical data. Almost no information about number of births, distribution of age of the population, unemployment, distribution of income, etc. is available for a certain period of time. If there is information it will be not complete, maybe partly wrong or is (based on political reasons) biased.

Example "bank's data": Does the bank really know how much money is available?

If we consider the case that a bank likes to know how much money is available we normally assume that someone can tell us yes we have EUR 45,567,234.13 on all accounts. But is this really the case? Of course every accountant will tell you that he knows the exact number. But this knowledge is based on a lot of digital systems. We all know that there might be some errors caused by erroneous data, mistakes done by "human interfaces", problems during data loads, different assumptions, etc. During my activities as data warehouse consultant I joined a lot of meetings where correctness of data and reports has been discussed. Correctness in huge systems or big companies is always a matter of tolerance. In some cases two reports are comparable if the values are equal up to ± EUR 50.00 in other cases they are seen as equal if the deviation is not more than EUR 500.00.

So it is obvious that in reality the question "How much money is available?" can only be answered using fuzzy information – even this is not convenient to everyone and has a touch of "being not serious".

Assuming that a "perfect" reporting is available and the data collecting system is working in a perfect way we have to do rounding, e.g. calculating interest rates and interests – so the uncertainty or impreciseness is at least when we consider that unit Eurocent.

Based on the consideration that life is not precise we can use the technique of fuzzy number arithmetic. Each number will be described by a so called characterizing function.

Definition of a characterizing function of a fuzzy number:

A real function $\xi_{x^*}(.)$ is called a characterizing function of a fuzzy number x^*, if following conditions are fulfilled:

(1) $\xi_{x^*} : \mathrm{R} \to [0,1]$

(2) $\forall \delta \in (0,1]$ the δ-cut $C_\delta(x^*) := \{x \in R : \xi_{x^*}(x) \geq \delta\}$ is a finite, non-empty and closed interval. So $C_\delta(x^*)$ is always a compact interval.

How models will change

Let us consider now some calculations which are often used in national economics. Based on the fact that the underlying information is not as precise as we assume in this model a change in the model happens and how it can be interpreted.

Unemployment rate

Let us first start with an – as it seems on the first view – "simple" topic – the unemployment rate. It is defined by:

$$\text{Unemployment rate} = \frac{\text{Registered unemployed population}}{\text{Active population + registered unemployed population}}$$

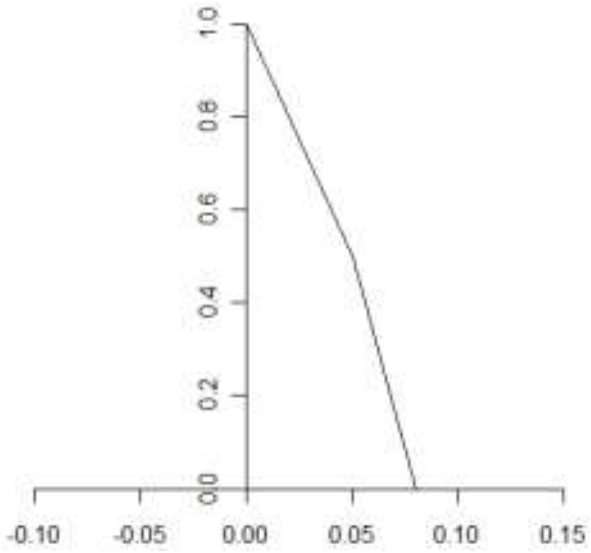
If we have a closer look on "active population" it means in national statistics that "self-employed" have not to be counted in the set of "active population". Also they cannot be seen as "registered unemployed" if they have no work (which means no or not enough orders). And of course there are some people which are employed and in parallel do their own business like a self-employed person.

Last but not least we can asked the questions if really everyone who has no work is registered as "unemployed person".

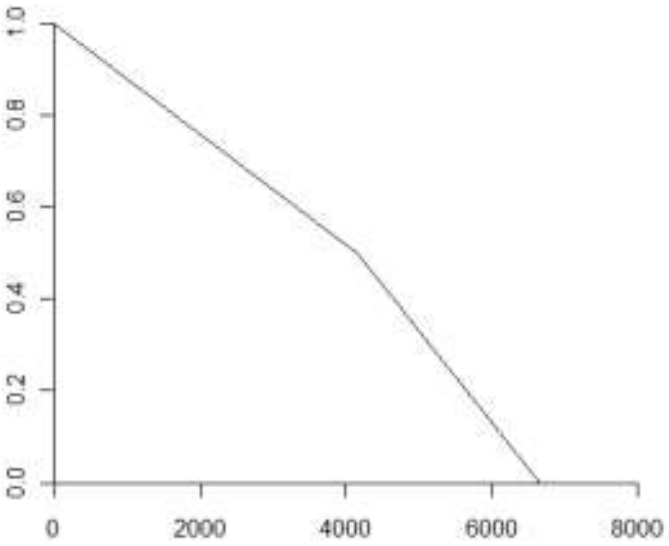
In 2008 we had in Austria 8,318,592 of resident population, about 4,090,000 have been seen as active population and around 162,000 have been registered unemployed people. If we assume that these figures are "precise" we get an unemployment rate about 3.81%.

If we consider that 0.05% of the resident population cannot be registered as unemployed and are of course not self-employed and should be within the set of "active population" and we formulate it with the degree

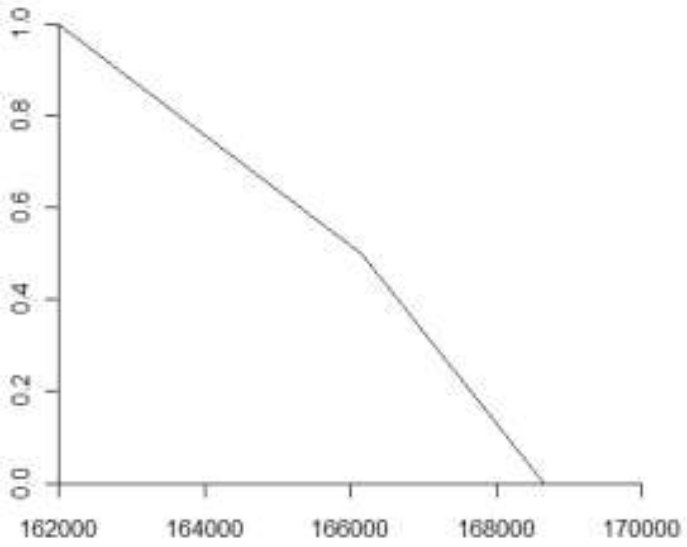
of believe of 0.5 and we say that it cannot be greater than 0.08% – we immediately get a fuzzy number of this factor of uncertainty with following characterizing function.



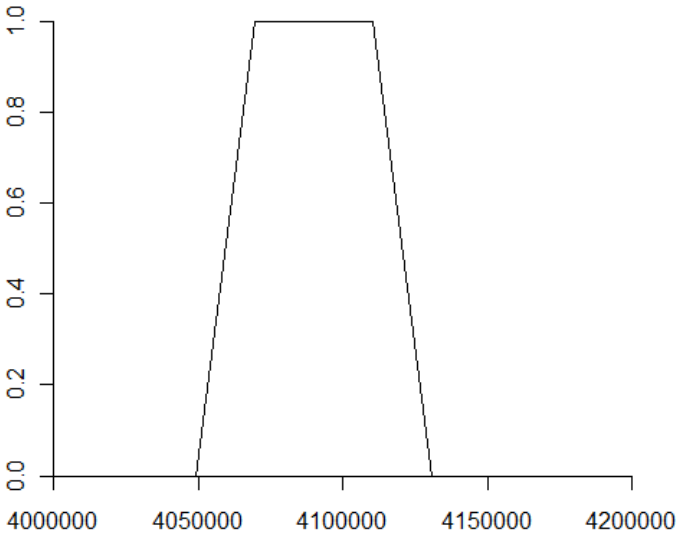
Based on this the number of "not considered" people has following characterizing function.



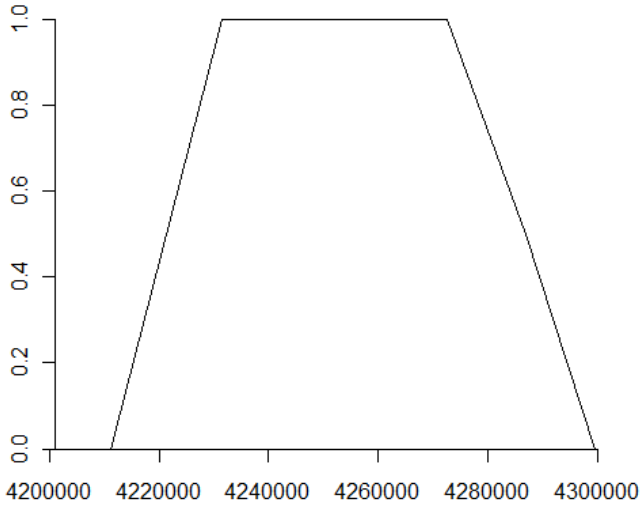
And immediately we get for “registered unemployed population” the fuzzy “unemployed population”.



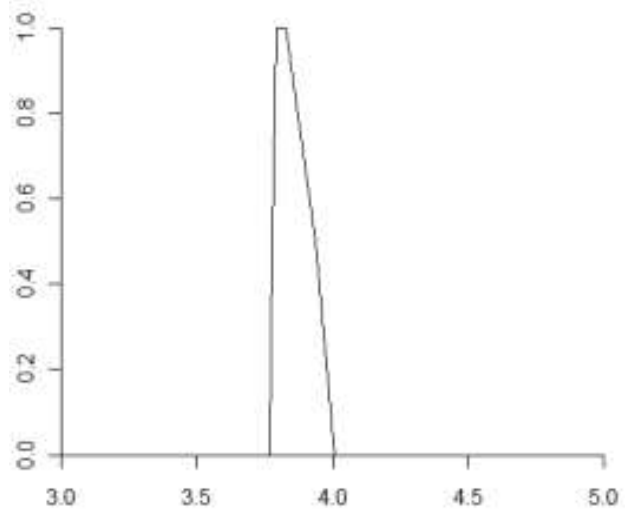
Let us assume that “active population” is also a fuzzy number with characterizing function shown below.



So we get for the sum of “active population” and “unemployed population” following characterizing function.



As result we get the characterizing function of the fuzzy number "unemployment rate" as shown below.



This shows us that the unemployment rate is for sure between 3.79% and 3.83% but e.g. with a degree of believe of 0.5 it is between 3.78% and 3.94%.

Calculation of gross domestic product (GDP)

The gross domestic product is calculated by:

$$Y_{market\ rates}^{gross} = C^{private} + C^{public} + I^{gross} + (Ex - \mathrm{Im})$$

where:

$Y_{market\ \ rates}^{gross}$ is the gross domestic product at market rates

$C^{private}$ is the private consumption

C^{public} is the consumption of the public sector

I^{gross} is the investment

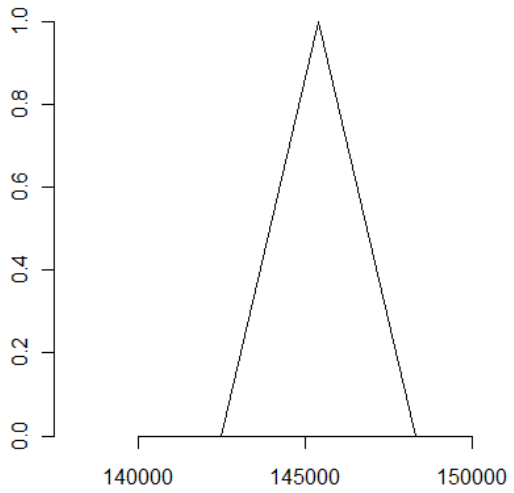
Ex is the export

Im is the import

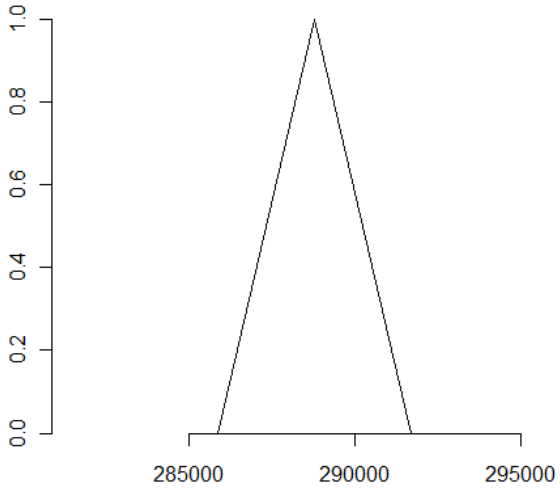
If we use the classical approach we get e.g. for Austria following figures for the year 2009 (in EUR).

$C^{private}$	145,408,500,000 EUR
C^{public}	143,364,000,000 EUR
I^{gross}	58,149,200000 EUR
Ex_IM	–75,462,300,000 EUR
$Y_{market\ \ rates}^{gross}$	**271,459,400,000 EUR**

Let us now consider that $C^{private}$ is not a precise number and we see it as a fuzzy number which has a triangular characterizing function. Assuming that with a degree of believe of 0.5 we have a deviation from the reported value of ±1% we get following characterizing function.



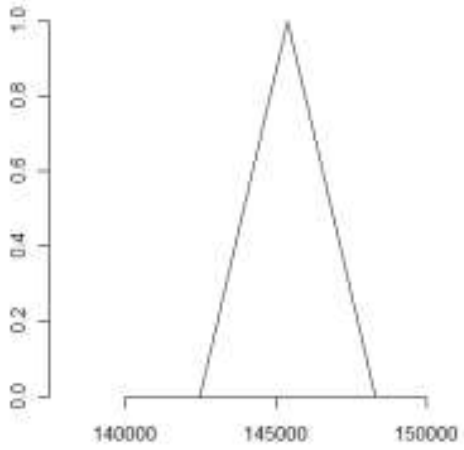
If we now calculate the gross domestic product we will get a fuzzy number which has a characterizing function shown in the next picture.

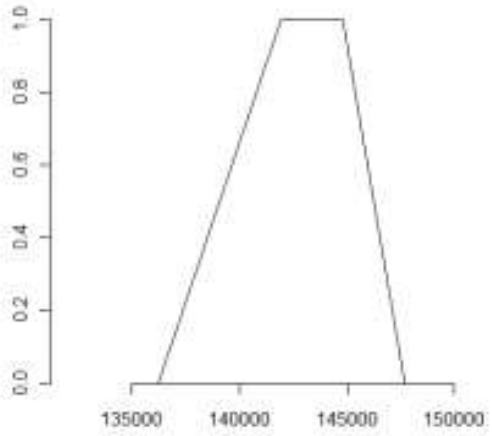
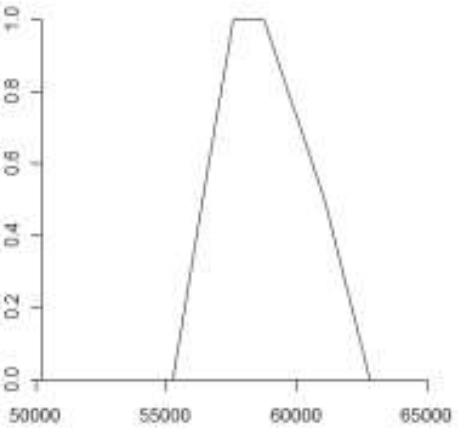
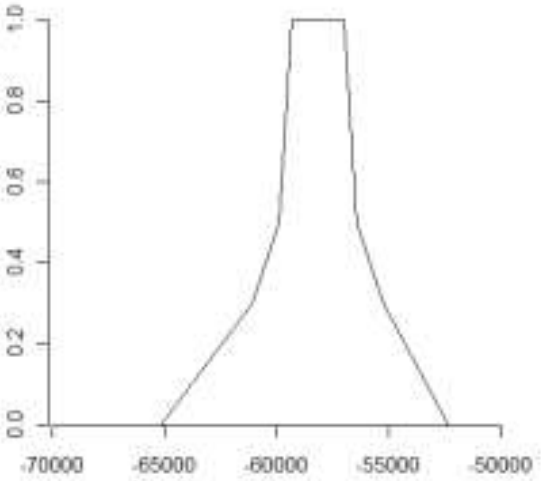


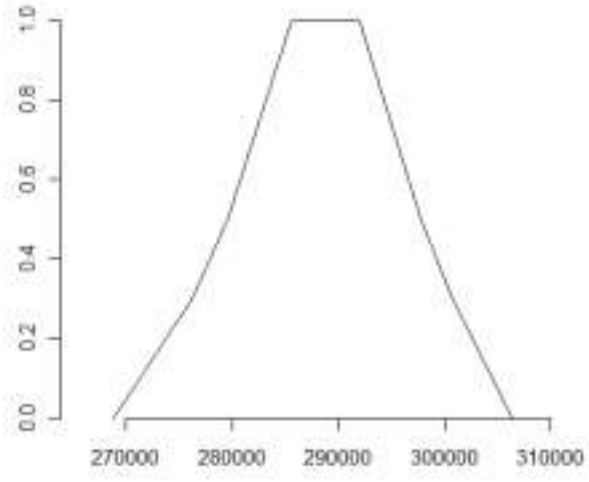
It has the same shape as the characterizing function of $C^{private}$.

Considering a degree of believe of 0.5 it is between 287,318,400,000 EUR and 290,226,600,000 EUR which is a deviation of 5.52% to the lower bound and 6.91% to the upper bound from the original reported value.

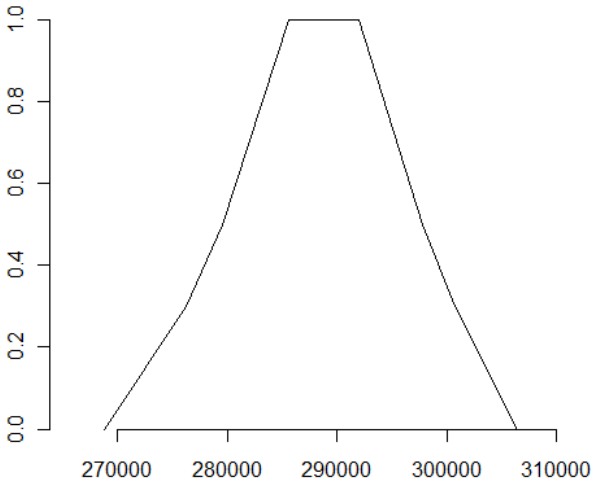
In the next step we make this model more complex taking into consideration that none of the input values are precise. We define the characterizing functions as shown in the table below.

$C^{private}$	145,408,500,000 EUR	

C^{public}	143,364,000,000 EUR	
I^{gross}	58,149,200000 EUR	
Ex_Im	–75,462,300,000 EUR	

$Y_{market\ rates}^{gross}$	**271,459,400,000 EUR**	

If we have a look now on the resulting characterizing function of $Y_{market\ rates}^{gross}$ we see that it is mostly influenced by the shape of the trapezoidal characterizing functions of the input values and also a small bit of the characterizing function of *Ex_Im*.



The values of the $Y_{market\ rates}^{gross}$ show us now that we cannot exclude that the gross domestic product is between 285,594,400,000 EUR and 291,950,600,000 EUR. Considering a degree of believe of 0.5 it is between 279,528,500,000 EUR and 297,745,800,000 EUR.

Out of this you can see that the interpretation is much more complex as it has been assuming that the underlying information is an exact one.

Comparison problems

Economical thinking means always taking decisions. A single decision is considered as a good or optimal decision if at least one of the following criteria are fulfilled:

- minimized costs
- maximized profit
- minimized loss
- maximized utility.

If a decision has to be taken out of 2 options it will be based on a comparison which might be e.g.

- less costs
- greater profit
- less loss
- greater utility.

If all the calculated or measured values are precise the comparison can be done in the classical way and the decision finding is "simple".

In the case of calculations or measurement of fuzzy number it has to be considered what means "less" or "greater".

One method can be to compare δ-cuts for each δ-cut level. But at first let us define the "δ-cut" of a fuzzy number x^*.

Definition of δ*-cut:*

$\forall \delta \in (0,1]$ the δ-cut is defined by $C_\delta(x^*) := \{x \in R : \xi_{x^*}(x) \geq \delta\}$ where $\xi_{x^*}(x)$ is the characterizing function of the fuzzy number x^*.

If we define:

$$\underline{x}^\delta := \min\{x \in R : \xi_{x^*}(x) \geq \delta\}$$

and

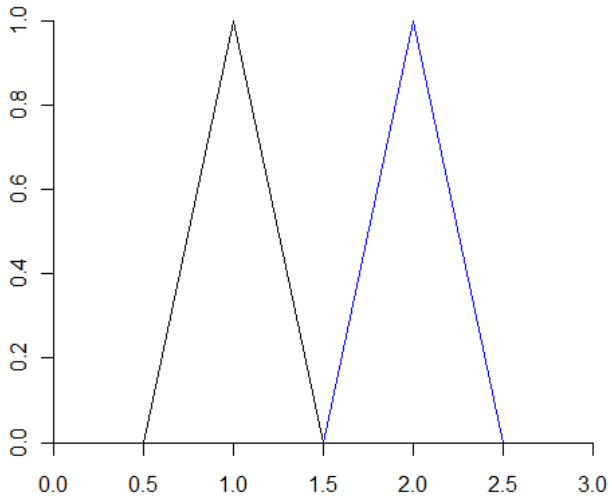
$$\bar{x}^\delta := \max\{x \in R : \xi_{x^*}(x) \geq \delta\}$$

we get:

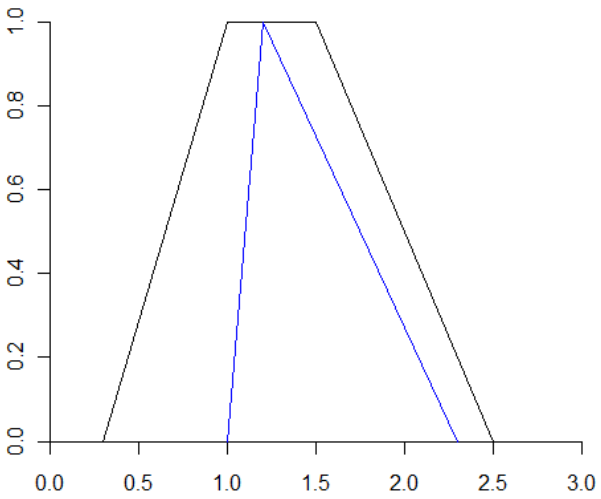
$$C_\delta(x^*) = [\underline{x}^\delta; \bar{x}^\delta]. \ .$$

If we try to compare the two fuzzy numbers x^* and y^* by using the corresponding δ-cuts we can say that x^* is less or equal than y^* if for each δ-cut off $C_\delta(x^*) = [\underline{x}^\delta; \bar{x}^\delta]$ and $C_\delta(y^*) = [\underline{y}^\delta; y^\delta]$ we get $\underline{x}^\delta \leq \underline{y}^\delta$ and $\bar{x}^\delta \leq \bar{y}^\delta$.

This is valid if we try to compare fuzzy numbers x^* and y^* with characterizing functions as shown below.



Unfortunately in case of fuzzy numbers with characterizing function shown in the next picture this approach will not work.



So another approach is to use the method of “Steiner point”.

Definition of "Steiner point":
The "Steiner point" is defined by:

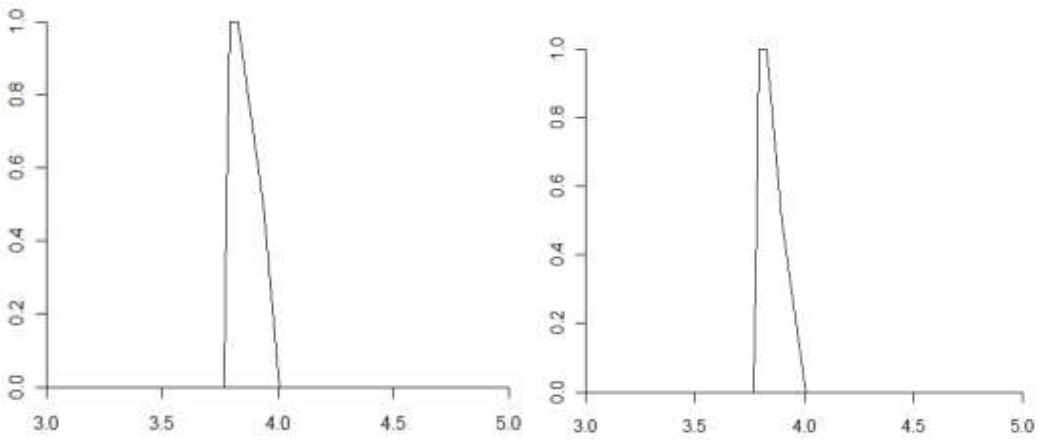
$$\delta_{x^*} = \int_0^1 \frac{\underline{x}^{\delta} + \bar{x}^{\delta}}{2} \, \mathrm{d}\delta,$$

where:

$$C_{\delta}(x^*) = [\underline{x}^{\delta}; \bar{x}^{\delta}].$$

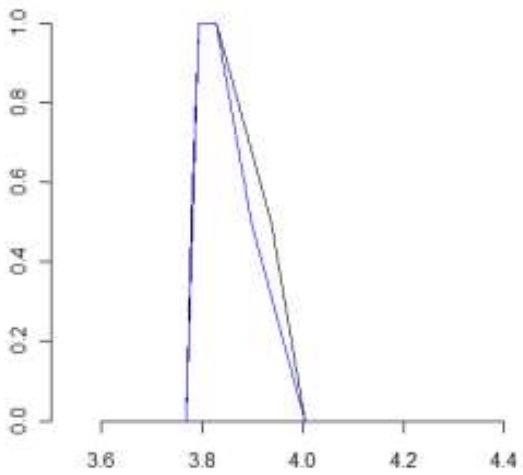
Unemployment rate

Let us now consider the unemployment rate of Austria in 2008. If we assume that the measurement could be improved in 2009. Now assuming 0.03% of the resident population (instead of 0.05%) cannot be registered as unemployed and are not self-employed and should be in the set of "active population". We get following characterizing functions.



2008 2009

Answering the question which of these two unemployment rates is the better one – in the sense of "which is lower?" – We expect that it is the unemployment rate of year 2009 if we have a look on the picture below.



The calculation of the Steiner point shows

Steiner point of unemployment rate 2008 is 3.85.

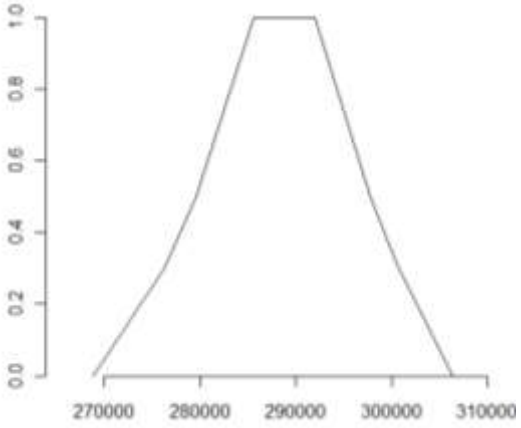
Steiner point of unemployment rate 2009 is 3.84.

So the unemployment rate of 2009 is lower than the unemployment rate of 2008.

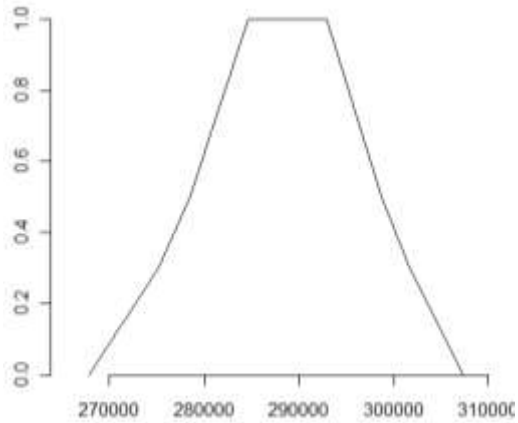
GDP of 2 different countries

Let us assume that the GDP of two different countries are almost equal. The figures of country B are more "uncertain" or "imprecise" than the figures of country A.

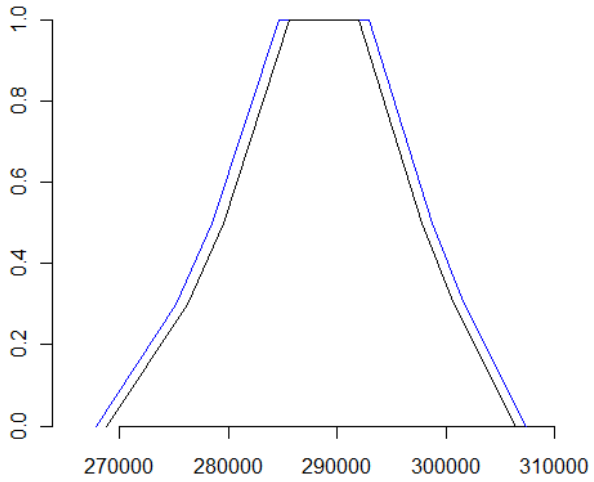
Country A



Country B



If we print both characterizing function in the same graph it can be easily seen that GDP of country B is more imprecise (black...A, blue...B).



If we calculate now the Steiner points of the two GDPs we get the same value 288,477.30. This is because of the fact that the characterizing function of country *B* has the same shape as the characterizing function of country *A*. It has been shown that two fuzzy numbers are "equal" although their degree of uncertainty is different. Maybe this can be seen as the weakness of the Steiner point method.

Conclusions

Using the power of characterizing functions to describe fuzzy information and the underlying calculation methods the reality can described in a better and more realistic way. Maybe it is not the most convenient method for decision finding – as we have seen in the example of comparison of 2 "similar" GDPs – but in future the modelling using fuzzy information techniques will increase.

In many cases we have to deal with imprecise information, imprecise figures and uncertainty. In classical calculation methods this uncertainty is ignored.

In the next years methods of calculation, analyzing and comparing fuzzy information have to be improved. Of course there are many applications in reality for this topic but at the moment most of them are ignored and classical or stochastic methods are used instead. Not every uncertainty can be explained by stochastic methods and it is not a proper way to ignore it in mathematical models.

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NEW ECONOMY Section

NEW TIMES, NEW ECONOMY ...
A NEW BORN LEADER: THE ECO-LEADER

Elena PELINESCU [*], Mădălina RĂDULESCU [**]

Abstract. *Nowadays, businesses face new demands in their rush of generating profit. Performance management indicators received new values and they are part of everyday business. In the meantime natural resources are on a decreasing pattern unless new unconventional resources start to be discovered and used. Societies are also confronted with ethical and moral crisis.*

At the intersection of the Environment, Economic and Social fields, the concept of Sustainable Development becomes more and more powerful. To make informed decisions about performance management in a sustainability manner, organizations have to understand that economy, social and environment must co-exist in harmony on long term. To make this almost new paradigm viable, the environmental perspective must be taken into account rapidly.

In this context, the winners appear to be those who succeed to develop sustainable processes for the future. Less is more seems to be the new model.

Are leaders prepared for the new approach? Do they have to develop new skills and competences? Is there a need for a new type of leader? The Eco-Leader? This is the question on which we will develop in this paper a new concept for a new type of leader.

Keywords: *Ecological economics, sustainability, management, social responsibility.*

JEL Classification: M12, M14, Q01, Q56, Q57.

1. Introduction

Forty years ago, the experts of Club of Rome rose up the importance of keeping the environment safe and approaching the sustainable development based on harmonious integration of the social, environment

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and the economy. Nowadays, the financial crisis reopened these discussions. Although the ecologists' work started to be recognised, a series of laws and projects taking into consideration the environment protection, there is not yet a major change on the global mentality. The capitalist society based on consumption, continued its way to an accelerated profit increase despite the signals of irreversible destruction of the resources and the environment.

We are facing, today, global crisis, which, no matter how we call it: "financial-economical crisis", "energy crisis", "urban crisis" or "demographic crisis", "all have the roots in a bigger crisis of our narrow perceptions, inadequate over the reality" (F. Capra, 2004, p. 273, quoted by Carmen Costea, Popescu şi Taşnadi, 2010, p. 448). Societies and "companies today must pay careful attention to what they produce and how they produce it" (D. Esty, 2009, p. 51).

Obviously a new approach on sustainable development implies a new leadership approach based o a new defined (eco) vision focused also on social and environment different from the old monetary vision oriented on money, wealth and poverty which appears today obsolete. A new generation of leaders started to grow up in order to further develop new businesses the so called green businesses. The years to come might bring over new green strategies to create new values for the businesses. Key performance indicators might be updated taking into consideration the sustainable approach by which economic, social and environmental must be taken into consideration all together. Is there a need for the new leaders to develop new competencies; is there a must for the new leaders to think on a different way of actions? We will develop on the questions above on the following sections of this paper.

2. Sustainable Development. What is it?

"Meeting the needs of the present without compromising the ability of future generations to meet their own needs" this is how the Sustainable Development is defined by the Brundtland Commission of the United Nations, March 20, 1987.

Figure 1. Sustainable development triangle – key elements and interconnections.

Source: adapted from Munasinghe 1992a, 1994a, quoted by Munasinghe Institute for Sustainable Development, Mohan Munasinghe in www.eoearth.org/article/-Sustainable_development_traingle.

Referring to sustainable development issue, at the G8+5 Conference held in London in 2009, professor Johnston, representative of Club of Rome considered that the last global financial-economic crisis highlighted the necessity of a common effort, "a concerted approach, worldwide, to stimulate investment in infrastructures and services for an energy-diverse and low-carbon economy which offers new opportunities for prosperity for all", and that all these efforts must be integrated "into a holistic strategy for the world's future prosperity and stability" (Johnston, 2009, p. 1). On the same idea, at the Amsterdam Conference, Professor Mohan Munasinghe (2009, p. 33) talked about the *sustainomic* as a framework for a more sustainable world "with balanced consideration of sustainable development triangle (economic, social and environmental elements)" that "transcend conventional boundaries using innovative, holistic, integrative approach".

Sustainable Development comes with the Ecological Economics concept, whose one of the founders was the Romanian-born mathematician and economist, Nicolae Georgescu-Roegen (1906-1994). His great contribution to the ecological economy concept was to introduce the second principle of thermodynamics into the economic process. He took into consideration the solar energy and the use of the other natural

resources and demonstrated that human economic systems can be modelled similar to thermodynamics systems. He introduced the idea that the economic systems always use matter, energy, entropy and information based on the idea that we can use some resources at a fixed flow rate and others at the expense of future generation. Today the laws of thermodynamics are also considered one of the fundamental laws of the Ecological Economics. In 1971, Georgescu-Roegen published *The Entropy Law and the Economic Process*, where the second law of thermodynamics plays a central role in production theory, with implications for the sustainability of economic growth.

"Sustainable Development is not a religion, although some seem to treat it as such" (H. Daly, 2007, p. 38). We consider that is an alternative way of thinking and action besides the traditional economical approach based on cost-benefit analysis. In time, series of indicators and benchmarks have been developed for different industries, sectors and products. This is because without a measuring frame of reference businesses can be run by chaos under the name of sustainable development as a very fashioned concept and style. The measurements are the only way to prove the benefits of the sustainable development approach.

What started 40 years ago as a signal rose by the Club of Rome representatives, receives today more and more values and is in front of more and more associations. Sustainable Development is about ethics relationship, re-engineering, social responsability and competitiveness. Correctly assessing the environment and population potential development will allow leaders to think of alternative green business solutions. They will be able to develop such solutions based on the interdependency of the human and natural eco-systems.

3. Think on the future: A new leadership approach of a new born leader: the Eco-Leader

It used to be a trend in 1960s, 1970s that the businesses (corporations) refused to accept "their negative impact on the environment" (Hart S. quoted by Harvard Business Review, 2007, p. 100). Then, in 1990s and 2000s until 2008, what happened had primarily and almost unique focus on economical growth and economy was seen mostly in terms of the stock market and other financial instruments. Thinking on sustainable development was not very useful due to the pressure of investors for rapid Return of Investments rates. The strategic thinking, based on short term results, prevailed in establishing business objectives and competitions even

between the employees of the same company were not a lonely example. Today shifting to the Ecological economics is actually a shift to a strategic thinking based on long term results. After the collapse of the economy in 2008, there are many visible examples of lessons learned that already became best practices in corporations. We've noticed their implications at the society level and the engagement on the Corporate Social Responsibility projects that seems to be nowadays part of the new business focus.

Although there several definitions for the concept of leader and there are multiple speakers and companies developing and teaching on this concept all over the world, we will start to define, here bellow, the concept of the Eco-Leader. While the Leader appears to be the one who leads or guides (The Free Dictionary by Farlex), the Eco means the branch of sociology that is concerned with studying the relationships between human groups and their physical and social environments (also called human ecology). Having the two words one close to the other, The Eco-Leader will be the one who leads by harmonising the relationships between economic, social and environment. We propose an initial list of Top 10 characteristics of the Eco-Leader based on our research and reading.

i. Deriving from the definition, the first characteristic we envisage for the Eco-Leader is the capacity of seeing the "big picture" rather than just parts of it. This new type of leader is the one who understands that outstanding performance just on financial indicators is not enough in view of future developments. Financial indicators performance must be correlated with social and environmental indicators performance in order that the business has a future. When speaking on viewing the general picture we refer to internal but also to external environment of the business. Internally applies to diversity of the processes and procedures and externally refers to create and keep the global equilibrium of the supply chain. "A clear and fully integrated environmental strategy should not only guide competency development, it should also shape the company's relationship to customers, suppliers, other companies, policymakers and all its stakeholders" (Hart S., quoted by Harvard Business Review, 2007, p. 120

ii. It is also to mention that the Eco-Leader has a long term thinking (the so called strategic thinking). This is part of the idea that short term results are good but not sufficient unless there are correlated with long term results. We also do not argue that the leaders do not have a long term thinking but this is mainly referring to penetration on different territorially markets and investing in

trainings for the employees. The Eco-Leader is rather thinking on how to "bring the same long term perspective to environmental strategy" (D. Esty, A. S. Winston, 2009, p. 148)

iii. Transparency is the third characteristic of the Eco-Leader. "A successful journey toward Eco-Advantage starts with the right mindset and a focus on driving environmental thinking deep into corporate strategy" (D. Esty, A. S. Winston, 2009, p. 143). It is the Eco-Leader who has the view but it is also him the one who has to cascade it down to the next levels in the organization. People need to understand the "why" in order to do the "how" and to remain engaged. They need to be told the real stories with positive and negative aspects.

iv. Innovation is also important for the Eco-Leader. By innovation we understand both the capacity of generating new ideas but also the capacity of creating the necessary frame within organization in order to sustain the innovation. Asking for "redesigning the processes within the organization taken into considerations its business impact on the environment; new efficiency of the resources creates a better attitude towards consumption, which will have to be implemented to even individual people within the organization, in order to realize the impact of every day usage of the resources." (Radulescu Madalina, Pelinescu Elena, 2011 p. 6) "Innovation is critical to twenty-first-century competitive advantage" (D. Esty, A. S. Winston, 2009, p. 197)

v. Integrity as a characteristic comes by the concept of the leader itself. But in view of the Eco-Leader receives new values. A mindset switch is not an easy action. It requires time, power and persuasion in their positive aspect. As in any process of change management it is necessary that the leader should be a trustful person.

vi. Anticipation is one of the attributes of the Eco-Leader because it is the ability to see the social and environmental changes in resources and consumption.

vii. Intuition. Intuition is in everyone but under the pressure of formal trainings on decision making, leaders are sometime running from the intuition because it cannot be formalized. Intuition is a natural process and is linked to the idea of common sense thinking towards consumption, relationships, responsibility. Intuition will help Eco-Leaders in dealing with uncertainty processes. This might require "a leap of faith". Instead of feeling that "the risks

associated with investing in unstable and unfamiliar markets outweigh the potential benefits" better "recognize the power of such a positive mission to galvanize people in the organization" (Hart S., quoted by Harvard Business Review, 2007, p. 120)

viii. Capacity of partnership. The Eco-Leader is the one who understand the necessity of community implication and responsibility, of strong relationships. He has to be capable to choose the right partners based on long term value and to create and develop the sense of belonging of the business to the local communities.

ix. Sense of humility. The time of "big egos" started to lie off. Sense of humility is part of a strong character in the sense in which as a leader you admit your own mistakes and you encourage the others to do the same in order to take actions and further improve the situation. The Eco-Leader is the one who also admit that he does not know everything but in the same time he knows how to make the right people in the organization contribute to the collective sustainable goal.

x. The Eco-Leader acts under the "how" paradigm, the coaching paradigm. Looking to the future and creating scenarios for the future forces the leader to find alternative solutions.

The Eco-Leaders will have to create a new type of corporate culture, the "Eco-Advantage culture" (D. Esty, A. S. Winston, 2009, p. 143), built on trust; trust is build on good performance, competencies and on the accepted responsibility. "Without a good performance, no trust within organization can exist. Better processes, a better work place, direct communication inside and outside the organization, involvement of people in business' social responsibility, a culture of candour are some of our proposals for the new type of leaders". (Radulescu Madalina, Pelinescu Elena, 2011, p. 6)

We do not consider the above mentioned characteristics being as the only ones; the list can be further challenged and improved and we encourage you to do so. The list is just a beginning of a topic on which we will further develop and research.

4. How is the new leadership approach influencing Performance Management?

Performance management (PM) includes activities that ensure that goals are consistently being met in an effective and efficient manner. In view of a sustainable development approach of the businesses, the Eco-

Leaders might introduce new sustainable business objectives that will go "from SMART to SMARTEST, where SMART is:

S	Specific/ Significant/ Simple
M	Measurable/ Meaningful/ Motivational
A	Attainable/ Achievable/ Agreed
R	Realistic/Relevant
T	Time-Bound/ Time limited/ Timetabled
	and SMART**EST** stands for:
S	Specific/ Significant/ Simple
M	Measurable/ Meaningful/ Motivational
A	Attainable/ Achievable/ Agreed
R	Realistic/Relevant
T	Time-Bound/ Time limited/ Timetabled
E	**Environmental / Ecological**
S	**Social responsibility**
T	**Team oriented**

(Radulescu Madalina, Pelinescu Elena, 2011, p. 7)

"In line with SMARTEST objectives, Corporate Social Responsibility (CSR) reporting measures an organization's economic, social, and environmental performance and impacts. The measurement of CSR's three dimensions is commonly called the triple bottom line (TBL)".

As of 1997, The Global Reporting Initiative (GRI) was created in order to establish an internationally accepted standard for TBL reporting.

In order to achieve the SMARTEST objectives it is necessary to redefine the performance from "seen just on financials – profit, turnover-revenues-" to "firstly in a human being approach" because "people who grow up spiritually and are satisfied and happy are also more efficient" (Costea Carmen, Popescu, Taşnadi, 2010, pp. 38-39).

For the scope of enforcing the above we will make the following assumptions that will have as a consequence the measurement of the performance through SMARTEST objectives rather than SMART ones:

i. The business is run under a „green" policy;
ii. People are (to be) aware, depending on stage of introduction of the green policy, why it is good to have it and how they can apply it in their job within the organization but also in their personal lives. In this respect clear green policies are made available for employees, stewards of the new concept are identified within the organization and they are spreading the new approach together with the leaders;

iii. People are not alone in what they do but in a team, therefore a collective approach should be taken into consideration. Employees will have individual objectives cascaded from the collective objective but they will also have shared objectives in their teams but also with other departments in the organization, where the case;
iv. Time-Bound receives now two values: a long term objective with break downs for short term;
v. Special objectives linked to the environment will be defined at each level within the organisation. (e.g.: reducing paper usage for printing is an environmental objective and the simplest possible to be introduced wherever);
vi. Responsibility for society is ours and in order to be aware of it, it has to start being formalised, however a culture of volunteering has to be created first in the sense that each employee to adhere to the cause, otherwise any imposed action end by not being accepted.

An Environmental objective will take into consideration, depending on the activity type to be assessed: no damage to the environment, or improvement on resource allocation. For the measurement of these objectives, there will be used "Environmental metrics that show company where it stands. Data and indicators are critical to fact-based decision making and sound environmental management" (D. Esty, A. S. Winston, 2009, p. 179). There are already set up Environmental Management Systems and standardized EMS were developed. ISO 14000 is the template for an environmental management system.

Environmental objectives will refer to the usage and re-usage of energy, water, air, waste. They can be implementing in any sector. They are even part of regulations in case of applying for certificates such as European Eco-Label. Introducing them into the Performance Management system will allow organizations become part of an elite and selective group of companies thinking on sustainable development.

Social responsibility objective will be that, and do not necessarily link to the core business of an organisation but to the way people volunteer on the society, the organisation and people participate to different „green programs", allocate part of their time on behalf of the community they belong, actions that in the end will create a social cohesion. The different stages in world economies as well as the discrepancies between poor and wealth economies will require different steps in approaching the social

responsibility objectives but the common attribute is that there is a must for a long term and innovator view that has to be introduced and further be developed. "The emerging economies cannot afford to repeat all the environmental mistakes of Western development". (Hart, S., quoted by Harvard Business Review, 2007, p. 111) The danger is that one view and then stopped just because of changing the leadership. The mitigated factor is to build that organizational culture based on trust and respect with true, authentic and uprights leaders.

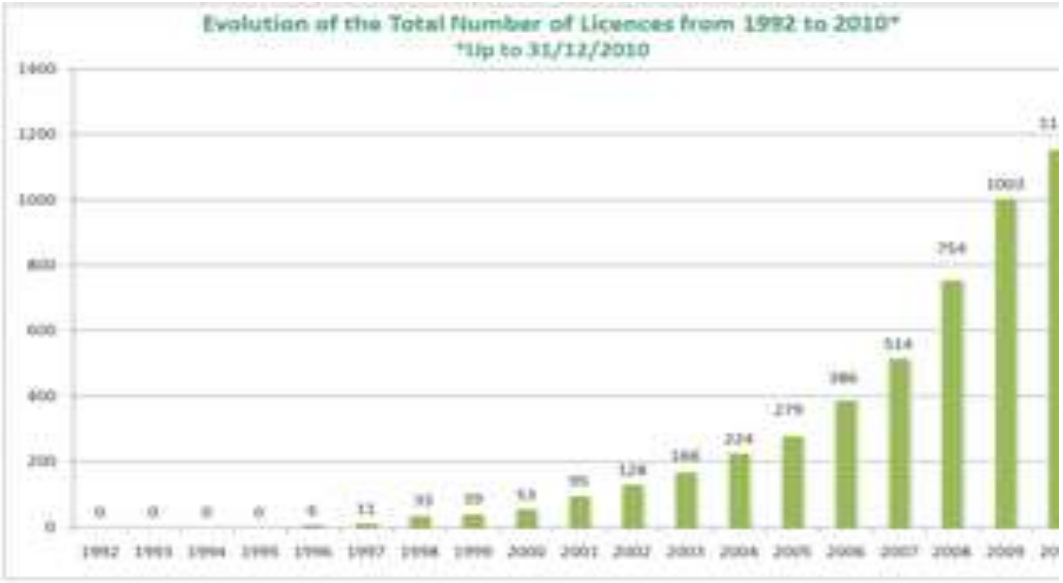
"For those who will argue that what people are doing after working hours is their problem, we respond that we fully agree but in the sense of sustainability the society now needs more. For example, companies may allocate part of their employees' time for social actions/programs etc. This is an issue of social implication, a next level on the development of humans by assuming that each of us has the right but also has an obligation to be socially responsible". (Radulescu Madalina, Pelinescu Elena, 2011, p. 7).

5. How a business is certified as one lead by a Sustainable Development Approach

As part of developing the Sustainable Development approach, regulations were drafted and than introduced at a global scale. More and more the final products and services bearing the "eco" or "bio" signs are penetrating the economies all over the world. In order to distinguish these products/services and to be somehow validated in front of the consumers, the eco-label certificate has been developed.

There are several types of Eco-labels, some are nationally developed (more spread on the European Nordic countries) or regionally such as the European Eco-label developed under the regulations established by the European Commission for Environment.

What it is to be mentioned is the evolution on license granted for the European Eco-label since 1992 when it was created until the end of 2010.



Source: http://ec.europa.eu/environment/ecolabel/about_ecolabel/facts_and_figures_en.htm#evolution

The trends in evolution are on direct relationship with the evolution of the Sustainable Development Approach. The figures show an increase between 2008 and 2010, despite the economic downsizing of the businesses.

Although a critical mass was not yet obtained, it is important to see figures in evolution.

In order to obtain this certificate, businesses are evaluated for their efforts in implementation SMARTEST objectives (including environmental and social responsibility objectives). What is more, this is a label that consumers can genuinely trust. The criteria are agreed at European level, following wide consultation with experts, and the label itself is only awarded after verification that the product meets these high environmental and performance standards.

Criteria on which a business is assessed take into consideration the supply chain, so that the one who applies for the Eco-label is interested in dealing with other sustainable businesses. Eco-label criteria are not based on one single factor, but on studies which analyse the impact of the product or service on the environment throughout its life-cycle, starting from raw material extraction in the pre-production stage, through to production, distribution and disposal.

The EU Eco-label is part of a broader action plan on Sustainable Consumption and Production and Sustainable Industrial Policy adopted by the Commission on 16 July 2008.

In Romania there are a number of 3 license granted, thus we consider this activity in a very early stage. The regulatory framework was set up as 2009, following the EU Regulation. The reduced number of applicants shows that Romanian leaders have to learn to think on sustainability. If we add to this number the few "green ONGs", the few big companies implicated on Corporate Social Responsibility Activities, some researchers on the eco-economy field organizations and some leaders who took decisions to develop their businesses under the "green policy" we might say there is still an insignificant number of Romanian Eco-Leaders, which raise the necessity and also the opportunity for new businesses creation.

6. Conclusions

For the last decades, the society grew under the thought of rapidly return on investment no matter what, no matter how. „Results oriented" are still the key words in a lot of curriculum vitas ... and are still highly appreciated by some of the employers. Societies pushed the limits beyond their limits in even area from education to financial, from manufacturing to real estate, from services to sports. We still leave in a demand-offer curve of goods and services without real usual think on a demand-offer curve of natural resources ...But this is going to be changed though stepping to a new mentality.

"Converting our economy into an eco-economy is a monumental undertaking. There is no precedent for transforming an economy shaped largely by market forces into one shaped by the principles of ecology" (L. Brown, 2001, p. 81).

To do this, it is necessary a paradigm shift both at individual and collective level. There is a need for strong and uprights characters, role models and informal education. The wealth and winner concepts need to be re-defined and the actual economic downsizing might be an important opportunity to do this. "An economy that is in synchrony with the earth's ecosystem will contrast profoundly with the polluting, disruptive and ultimately self-destructing economy of today. One of the attractions of the western economic model is that it has raised living standards for one fifth of humanity to a level that our ancestors could not have dreamed of, providing a remarkably diverse diet, unprecedented levels of material consumption and unimagined physical mobility. But unfortunately it will

not work over the long term even for the affluent one fifth, much less for the entire world" (L. Brown, 2001, p. 83).

Today the Ecological economics proposes a shift in our paradigm: it is about a "steady-state economy at optimal scale" (Daly, H., 1996, p. 31). The proposed long term thinking on sustainability seems to be an alternative. Less is more is actually defined as: with less resources we might obtain more results. We wanted to bring to your attention the concept of Sustainable Development and how the leadership approach might sustain it. The concept of Eco-Leader and an initial list of Top 10 characteristics of the Eco Leaders have been created based on our academic research. The newly proposed approach towards SMARTEST objectives stands from the definition of Sustainable Development through harmonious equilibrium between economic, social an environment.

Sustainable Development is based on a common sense approach. The visionary people from the Club of Rome raised the first signals 40 years ago. Since then, they were argued but also sustained. What happened in the last 5 to 10 years was that the idea of Sustainable Development penetrated and organizations such as World Business Council for Sustainable Development are putting their entire efforts in making it available to everybody.

Our belief is that in the years to come, the Sustainable Development approach will be the leading way and it is just a matter of time and mindset change on who will be the winners of the new type of economy.

As shown on the part 5 of the present paper, Romania is in a very early stage of thinking in terms of sustainability but this might be turn out as an opportunity to develop new Eco-Leaders.

We have challenging times in front of us and we have also the chance to step on a new way.

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BUCOVINA TOURISM RECOVERY STRATEGY

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Liana BADEA[**]

Abstract. *In recent years tourism industry has become an area of high importance in the European economy, the rate of job creation in this sector exceeded the overall average in the EU. For these reasons it is considered that the tourist industry has an important role in achieving the objectives set by the European Commission under Agenda 2020.*
With a significant tourism potential, Romania could implement a strategy for economic recovery in the tourism and economic activities to support local economic development adjacent to significant regional effects propagated. To assess the potential economic recovery of the Romanian tourism research the authors conducted a survey based on about one of the most valuable tourist areas of Romani -Bucovina.

Keywords: *economic crisis, economic recovery, tourism industry, cultural tourism.*

JEL classification: L83, R53

1. Introduction

Global economic recession has affected most of the structures of the economy from the monetary sector on the real economy effects: increased funding costs, rising unemployment and declining economic activity have affected the income, corporate profits have declined significantly, bankrupting many of them (1). Currently, most economies are faced with major adjustments, including the need to stabilize the public debt, financial sector reforms. In many of these economies, the financial sector is still vulnerable to shocks, and the slow recovery is due to reduced tax incentives. Economic activity in developing countries depend on the demand in advanced economies: IMF forecast global activity increased by 4.8% in 2010 and is expected to increase 4.2% in 2011, with a temporary decrease in the second half of 2010 and first half of 2011. Production in developing countries is expected to have increased by 7.1% in 2010

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following an increase of 6.4% for 2011. In the event conditions and the need to overcome global recession minimum point called the economic crisis, the smaller states need to make serious efforts to find new ways to attract foreign capital, namely to use all available means to overcome economic recession. Among the economic recovery means, supporting the development of tourism has an important place because of the potential impact on regional endogenous growth.

However, in terms of infrastructure and tourist facilities, our country is far from being called a tourist attraction, with a number of tourist facilities 3.23 times lower than the European average in 2009 (according to data from Eurostat). In terms of demand on tourist nights spent by residents and non-residents in Romania, in 2009 it was 4.77 times fewer nights spent in tourist locations than the EU average Because of the lack of a coherent strategy, Romanian tourism in 2009 reached the second lowest in Europe, as a percentage of GDP (according to the World Tourism Organization), 5.7% of GDP, while the European average was 10% of GDP. There are European countries that receive significant revenues from tourism such as Croatia (25% of GDP), Austria (14.5% of GDP) or Slovakia (12.6% of GDP).

Considering these aspects, Romania's economic recovery efforts could be directed towards developing the tourism industry: having multiplier effect on national economy by creating jobs, attracting surplus labour from rural areas respectively by a positive influence on the balance of payments.

2. Opportunities for improving Bucovina tourism

To assess the potential of tourism sector, in support of Romania's economic recovery we have focused our research efforts on one of the most important tourist areas in our country – Bucovina. To achieve the objectives of the research, it was conducted a representative survey study area. The overall aim of this survey was the need to obtain data and information on tourism in Bucovina and possibilities for improvement.

The survey was conducted during January and February 2011. Appropriate target audience of this survey was chosen taking into account the interests of Bucovina as a tourist area. To do this we must ensure that work is included in the sample of potential tourists and not especially visitors (people who move through the area for business or visiting relatives). In addition, we aimed to avoid the subjective attitude of “local

patriotism" by not including it in the analysis of Moldova. Taking into account these considerations and the limited financial resources we chose the area of investigation: Bucharest-Ilfov region and South-Muntenia, plus the counties of Buzau and Braila. Starting from the fact that the population structure is known as a variable strongly correlated with the subject of the research sample reflects the regional structure built of the total population, using stratified sampling. Given the requirements of representativeness of the literature we have assembled a sample of 400 subjects. Following verification and validation of questionnaires we obtained a database of 312 observations covering the study area.

The questionnaire consisted of 32 operational questions and 3 questions for the identification and structuring. Questions were divided into six operational groups of interest to know the socio-economic characteristics of the area's heritage and tourism potential of the area, its contribution to the tourist area of Romania's economic and social cohesion, respectively the possibilities of integration into European and national tourism industry. Questionnaire was processed using SPSS version 14 for the Academy of Economic Studies licensed. Structurally, the questionnaire was divided into six areas of interest: Knowledge of Bucovina in the context of North-Eastern region of our country, knowledge of the tourism in North-East, knowledge of the cultural potential Bucovina, Bucovina strategy of transforming the most important tourist areas of Romania and the European Union, cultural tourism as a source of fulfilment Bucovina human life and social cohesion, need to integrate cultural tourism in the tourism industry Bucovina in Romania and the European Union.

For this article we choose the most relevant questions for the tourist development of Bucovina. The first question of the questionnaire was aimed at the perception that the Bucovina region of Romania. *For you, Bucovina is known as a region: a) economic b) historical c) culture d) religious e) natural geography.* It can be seen (Figure 1) that the Bucovina region is seen as cultural (51% of respondents) – history (49.7%) and natural geography (49.4%). Very few respondents (5.1%) perceive Bucovina as an economic area. The fact can be explained by trying to avoid confusion between the region and economic development regions (NUTS 2) and through membership in the poorest region in the area of economic development in Romania (2).

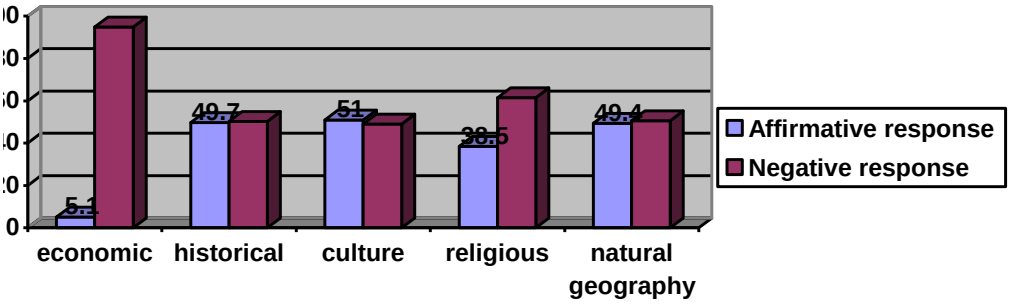

Figure 1. Response distribution for question no. 1.

Another item of interest to our study area was the quality of infrastructure. *Bucovina infrastructure in terms of tourism, you think: a) very good b) good c) satisfactory d) not satisfactory.* This time (Figure 2) very good and good responses are barely over half (56%) indicating once again the gap between natural and human talents in Romania's tourist offers.

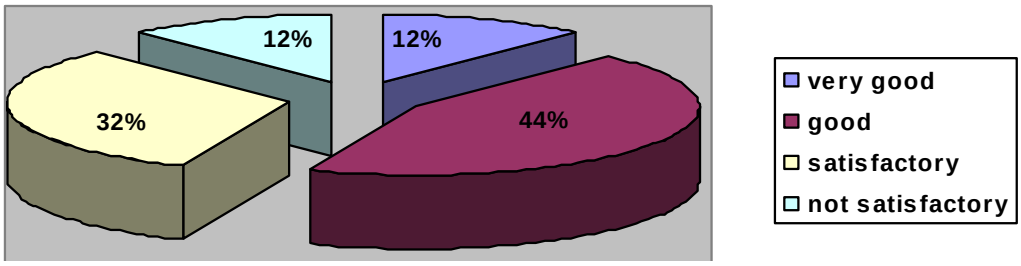

Figure 2. Response distribution for question no. 3.

As the tourist attraction force of the Bucovina area can be amplified by the tourist objectives of the North-East Region, another focus of our survey was the level of knowledge of the legacy of this tourist region by the target audience. *North-Eastern Region, from which Bucovina is part has the following specific forms of tourism: a) mountain tourism b) spa c) tourism business d) cultural tourism e) Scientific.*

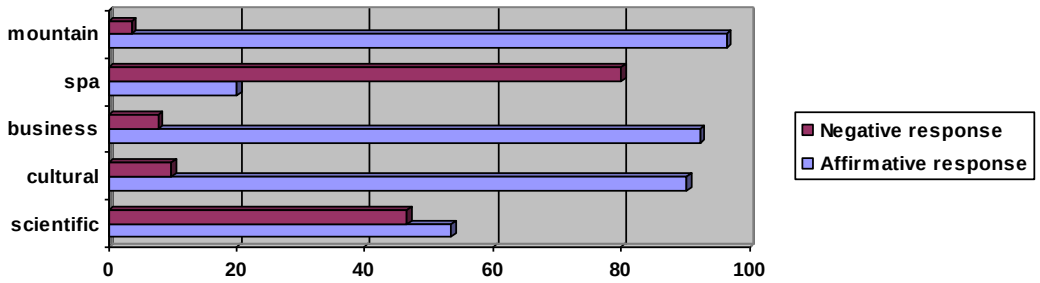

Figure 3. Response distribution for question no. 6.

This time (Figure 3) target audience no longer appears to be well informed. There are several elements contradictory responses to this question:

✓ It is possible some "eclipse" of the North-Eastern region by the target area of Bucovina. This area is perceived as a tourist attraction of cultural interest, the entire Northeast region is seen as attractive for cultural tourism (80% of responses). Although it is known the outstanding contribution to Romanian culture of this area (M. Eminescu, I. Creanga, V. Alecsandri, N. Iorga, G. Enescu, G. Bacovia etc.) however the gap is very large compared with other responses;

✓ Amid declining health tourism, respondents do not perceive that this area is the (Touristic) Pearl of Moldova-Slanic Moldova spa is still operational, unlike the former stations of local interest Baltatesti and Oglinzi;

✓ The target audience seems to like the mountain tourism due to proximity: for Bucharest – the Bucegi mountains, and for other respondents – Fagaras mountains, Buzau mountains, or Vrancea mountains. Thus, mountain tourism is not seen as a representative form of tourism by 56% despite the endowment of the North-East region "jewels mounted" like Ceahlau mountain, Cheile Bicazului, Rarau-Giumalau, Rodna mountain, mountain resorts Durau and Vatra Dornei etc.

✓ Although in the North East region there are three universities – Iasi, Bacau and Suceava that host each year science events of national and international interest, very few respondents (5.1%) recognize scientific tourism opportunity.

✓ Only responses on the desirability of business tourism seem to be in tune with reality (North-East is the poorest in Romania), only 11% of respondents indicating this opportunity.

Relevance to research objectives depends on respondents' opinions of their interest for certain forms of tourism. *For you, do you think are interesting forms of tourism the following: a) mountain tourism b) spa c) tourism business d) cultural tourism e) rural tourism?*

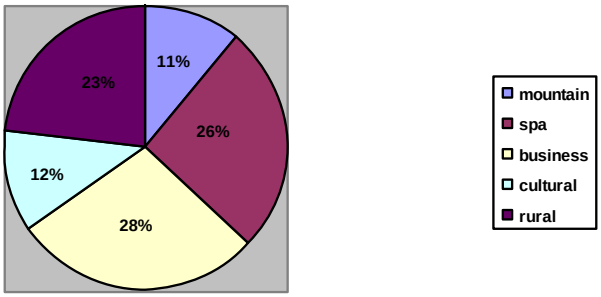

Figure 4. Response distribution for question no. 7.

Answers (Figure 4) are particularly interesting for the research objectives. This is because it shows that the target audience has a different profile of tourist interest in relation to tourist facilities in the North East region. Thus:

- the majority the respondents (28%) are interested in business tourism (we included here travel for work) – but only 11% of them find such opportunities in the North-East;
- health tourism as the second option (26%) is inconsistent with the perception of this opportunity (only 10.7%) of the answers, nor to endowment of the region (Slanic Moldova);
- a third option is rural tourism (23%) that could be covered by area facilities (many hostels in rural areas);
- cultural tourism and the mountain for which the region has remarkable objectives has very little interest among respondents (12% and 11%).

Correlation of interest for different forms of tourism with consumption of tourism products is very interesting. *In the past five years have you practiced the following forms of tourism: a) mountain tourism, b) spa c) business tourism d) circuit tourism e) cultural tourism.*

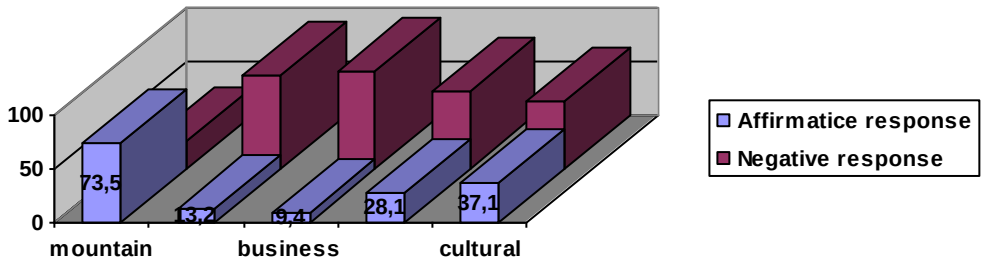

Figure 5. Response distribution for question no. 8.

By comparing the distribution of answers to this question with that of the previous question (no. 7) we can see a significant change in the areas of interest in relation to consumer's experience of tourism products in the past five years (Figure 5). The overthrow of the view is radical: tourist experience is overwhelming supported (73.5%) by mountain tourism while the interest for this form of tourism lies in last place (11%). A second option about the tourist's experience is that cultural tourism (37.1%) ranks second lowest on interest. Knowledge of the Bucovina cultural potential concerns about the spirit of respondents believe the region's history, traditions,

costumes, crafts and creative elements. *For the tourism in Bucovina the historical spirit of this region is considered: a) dominant b) significantly, c) normal d) useful.*

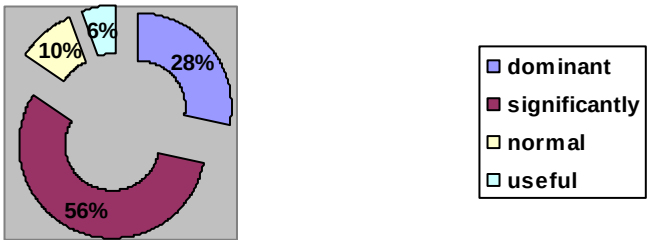

Figure 6. Response distribution for question no. 11.

It is noted (Figure 6) that the "historical spirit" of tourism is the main feature of the Bucovina (28% of respondents considered it the dominant, and 56% is considered significant). These responses match those of the first question, where 49.7% of respondents perceive Bucovina as a historical region.

Bucovina's customs represents for tourism a key of: a) great interest b) high interest c) normal d) attractive.

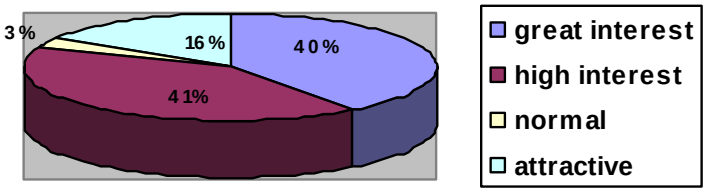

Figure 7. Response distribution for question no. 12.

The overwhelming majority of respondents (81%) consider traditions as a factor high or of great interest to the tourist offer of Bucovina (Figure 7). Beyond the clichés and automatism in the perception and evaluation of areas of the country cannot fail to notice an important factor for defining the tourist area Bucovina.

Folk specific area, beautiful people, moral cleanliness is for you: a) an unrivalled attraction b) reference point, c) something normal, d) elements of sustainability; e) irrelevant items.

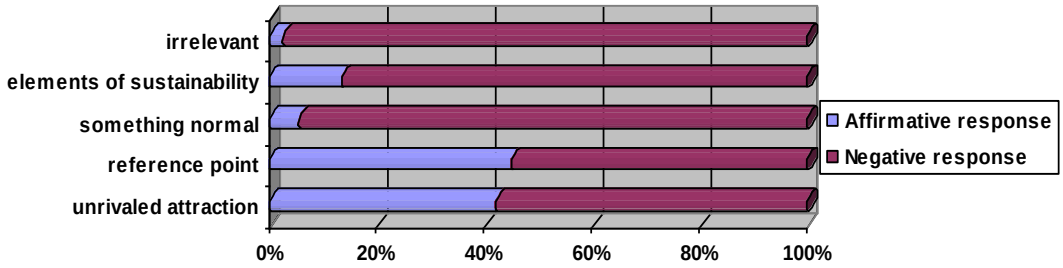

Figure 8. Response distribution for question no. 14.

Costumes component (Figure 8) of tourism in Bucovina is rather a reference point (42%) and unrivalled attraction (40%). This means that although taken together, the two choices for folk make a possible element of the tourist area's strengths, however, the folk begins to decrease as importance to today's tourists.

Crafts and other items of human creativity represents for you: a) special attractions b) factors of interest c) commonplace d) things uninteresting e) news.

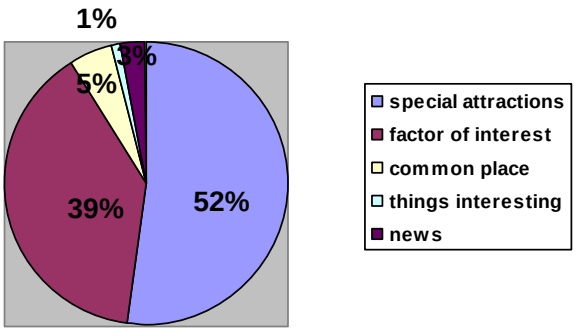

Figure 9. Response distribution for question no. 15.

It seems that the crafts are the main point of attraction of the tourist offer traditional area of Bucovina (Figure 9), since most respondents (52%) consider them as special attractions, and 39% of them consider factor of interest.

Bucovina transformation in one of the most important tourist areas of Romania and the European Union requires a well-based tourism strategy. Opinions of target audience could provide very important suggestions for the design of such a strategy. An important step in this direction would be the development of a tourism plan for development of the Bucovina.

A tourism plan under which to proceed in practice for the implementation of tourism strategy for Bucovina must include: a) area delimitation of tourist interest b) the definition of types of tourism areas c) establishment of touristic responsibilities d) develop a touristic budget e) tourism marketing factors.

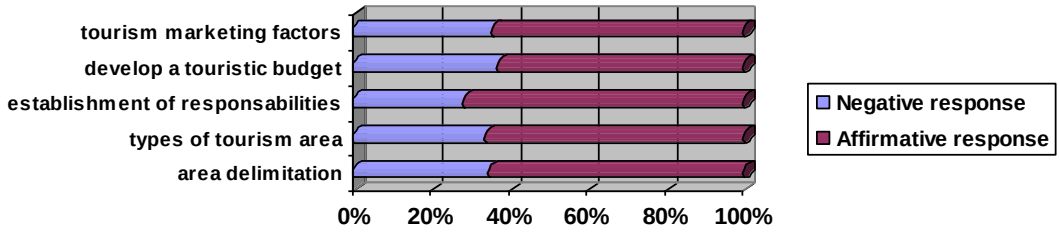

Figure 10. Response distribution for question no. 18.

There is consensus on the need to develop a tourism plan for Bucovina (Figure 10), and respondents considered largely (over 63%) that all elements are important for such a plan. The most important factor (71.8%) is considered to be the establishment of responsibilities for those involved in the development of a tourism development plan of the Bucovina.

The local urban and/or rural community must be integrated in tourism support by means of: a) adequate infrastructure b) the necessary institutional c) appropriate education d) traditional promotions e) religious.

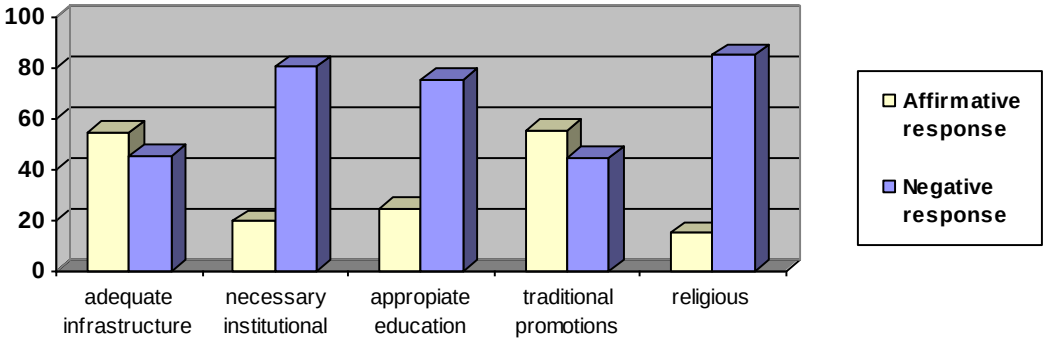

Figure 11. Response distribution for question no. 20.

Clearly the best part of the local community is, in the opinion of respondents (Figure 11), in support of the tourism product through traditional means (55.3%). The next item that would be necessary to support the local community is linked to the development of adequate infrastructure for tourism (54.7%). The other choice is not rated by respondents as being important enough to involve the local community.

Since Bucovina is perceived as a cultural-historic area and its facilities can support an outstanding tourist offer in this respect our study tried to capture the deeper meanings of cultural heritage of Bucovina for fulfilling the aspirations of respondents to the fundamental values and cultural cohesion can sustain implicit social cohesion.

How would you rate the quality of cultural tourism in Bucovina compared to your expectations: a) superior to my expectations b) above my expectations c) as expected d) below expectations e) significantly lower than my expectations?

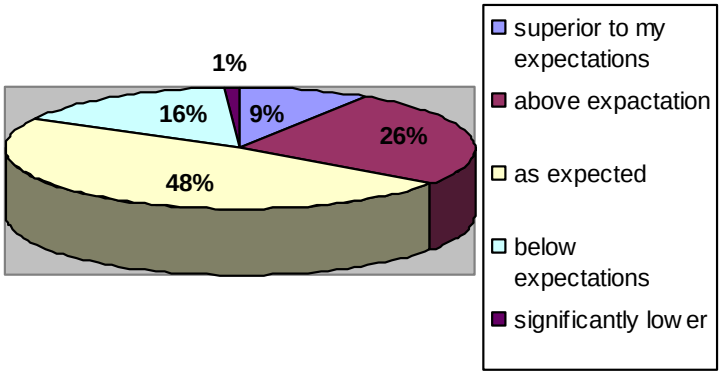

Figure 12. Response distribution for question no. 21.

It is noted (Figure12) that the quality of Bucovina tourism largely corresponds (48%) target audience expectations, but that there is a significant percentage to those who believes that this level exceeds expectations (33%). That may be gratifying in view of the cultural feature – the area associated with historical perspectives of its development potential.

What impressed you in Bucovina?: a) landscape b) monasteries c) traditions d) hospitality e) craftsmanship.

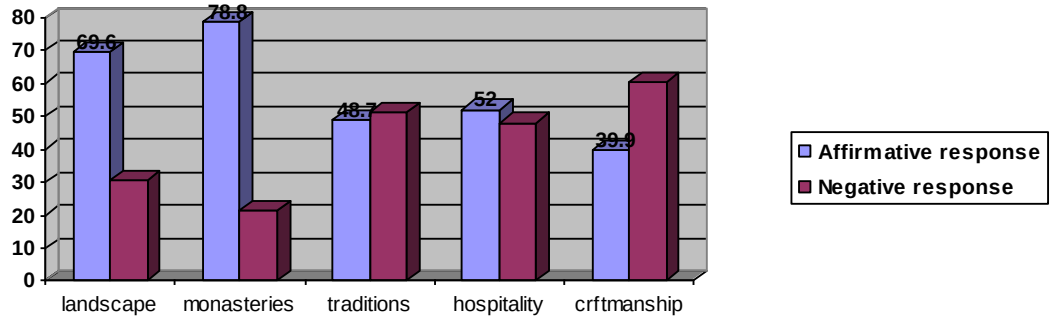

Figure 13. Response distribution for question no. 22.

As expected (Figure 13) famous monasteries in the area have impressed most respondents (78.8%), and was followed by landscape (69.6%)

and the hospitality of locals (52%). Although the important elements to Bucovina heritage, traditions and crafts impressed the respondents in a lesser extent (48.7% and 39.9%). In light of those answers we can say that there are elements with a strong impact on potential tourists who could support the development of a competitive tourist offers in the Bucovina.

Monasteries visited impressed you by: a) harmony with the spirit of the place b) the beauty of style c) the spiritual food you received d) ability to make us love past e) how to cultivate faith and hope.

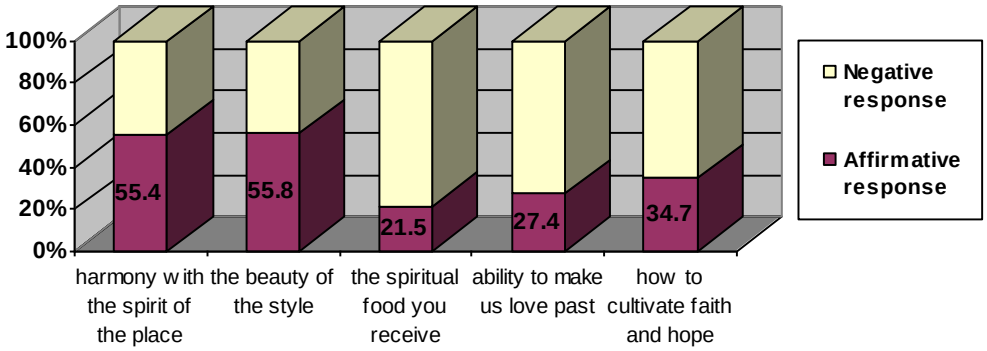

Figure 14. Response distribution for question no. 23.

Without a spectacular distribution (with high values for affirmative response), the responses clearly delimited (Figure 14) harmony with the spirit of place (55.4% – absolutely natural for a spiritual establishments) and beauty style (55.8 %). It should be noted that the other choice do not support a significant extent (21.5%, 27.4% and 34.7%) other tourist attraction spiritual characteristics – the monasteries.

Developing a competitive tourism offers the potential of cultural exception of Bucovina, requires a coordinated effort, and involvement of government (central and local) is essential.

What do you think of to state involvement in the development of cultural tourism in Bucovina?: a) very good b) good c) Neutral d) Poor e) very bad.

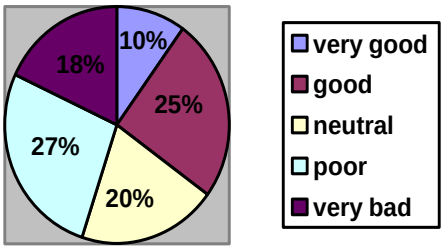

Figure 15. Response distribution for question no. 25.

Interesting is the high percentage (20%) of those who have a neutral opinion to this problem (Figure 15), however understandable given that local and/or central government support in sustaining tourism is often lacking, and it is not well highlighted. Beyond this neutral feedback can find that respondents are rather dissatisfied (45% of opinions supporting poor and very poor alternatives) than satisfied (35% very good or good alternatives). Given that the cultural heritage of Bucovina is well known and appreciated by the audience appears normal the concern for the area's tourism product integration in Romanian specialized circuit, respectively the European Union.

List of Romanian tourism areas that you think we can join the EU: a) Western Carpathians b) Danube Delta c) North of Moldova d) Olt Valley e) Transylvania Centre.

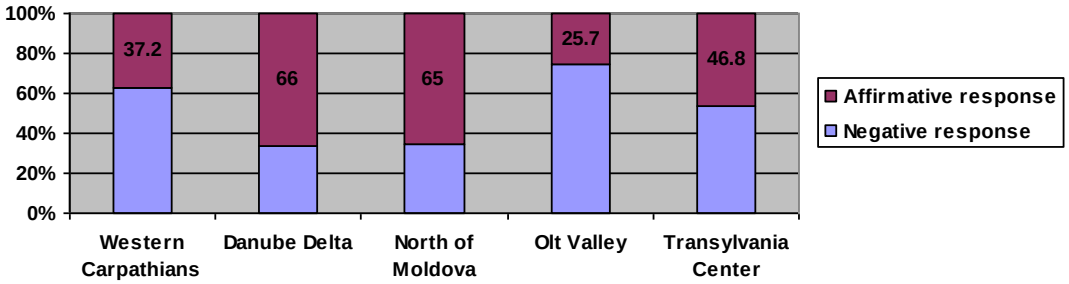

Figure 16. Response distribution for question no. 26.

It is noted (Figure 16) that Northern Moldavia (Bucovina) is considered by most respondents (65%) as impetus to offer real possibilities of integration of European tourists. Only Delta tourism region is higher with 66% score, which is normal in view of its unique natural heritage in the EU. Of the other regions only Transylvania Centre have significantly approach the limit to positive statements (46.8%). This means there is actually an area of particular interest to Bucovina, and its potential for cultural tourism is considered as representative of EU.

Integrated cultural tourism duration: a) 14 to 21 days b) 10-12 days c) 5-7 days d) 2-3 days e) weekends.

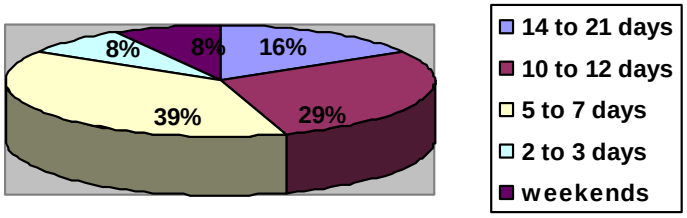

Figure 17. Response distribution for question no. 27.

Opinions are varied (Figure 17), but focus on stays for 5-7 days (39%), respectively for 10 to 12 days (29%). This means that the offer of cultural tourism in Bucovina is seen as a main destination and not transit.

For what purpose have you visited Bucovina? a) for work b) travel c) religious pilgrimage d) business e) I have not visited.

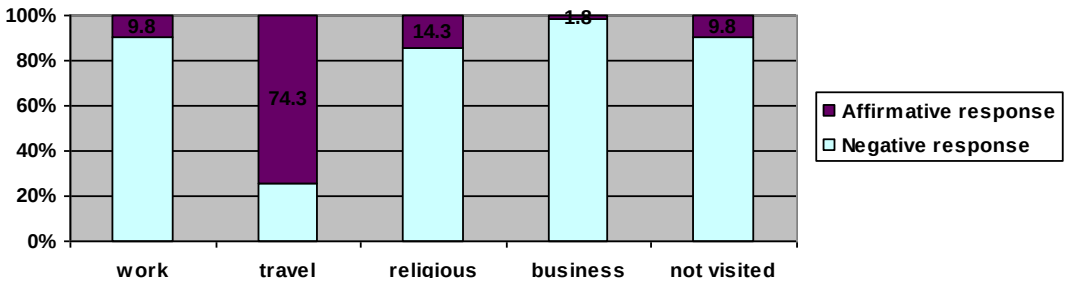

Figure 18. Response distribution for question no. 31.

Response distribution (Figure 18) highlights the correct selection to the sample since the vast majority of respondents visited tourist Bucovina (74.3%), religious motivation also contributed to the knowledge of the area of interest values (14.3%). Only a very small (9.8%) of those surveyed haven't visited the area.

3. Conclusions

Bucovina is perceived by the audience as a tourist area with great interest that we could integrate into to EU tourism industry. Predominantly cultural-historical character of the area maintains its tourist offer specialization in cultural profile. We could say that subjects perceive Bucovina as a "treasure of the Romanian traditions legacy". Among the most important elements of this treasure we found: crafts (traditional), gourmet cuisine, and folk respectively. However, the survey reveals interesting contradictions between the answers to questions revealing a poor perception of the tourism potential of North-Eastern part of Bucovina. We noted: ignorance of the region's tourist gift items, the disparity between areas of interest and the tourist experience and tourism product development complexity referral to the North East region. Clearly the explanation of these differences is largely a deficiency of information on North-East region, due to totally inadequate promotional programs that do not take into account domestic demand. Respondents felt the need to develop a strategy for improve integration Bucovina into highly competitive area of tourism in the EU. However, the target audience does not

have sufficient powers to properly assess the direction of developing a specific strategy, respectively to strong elements that could support such a strategy. Although Bucovina cultural tourism is valued as an important opportunity for the tourist development to the area and its elements of interest are well revealed by the target audience, there isn't adequate support from government. Moreover, any recommendations for improving the tourist tourists of Bucovina not show a clear perception of desirable improvements for the development of this offer.

The target audience believes that Bucovina cultural tourism offer has remarkable qualities for integration into EU and national tourist circuit, but felt the acute shortage of adequate promotion of this offer. Furthermore, with the caveat that tourism can contribute significantly to improving Bucovina their cultural contributions and has a positive influence for people of other regions of the country and especially for young people.

Note: (1) Europe estimated 200,000 insolvencies in 2009, according to Euler Hermes; (2) D. Ailenei, A., Cristescu, *Regional distribution of inflationary pressures in Romania,* Romanian Journal of Economic Forecasting, 4/2010.

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A NEW APPROACH ON TWO WILSON'S MODELS OF DETERMINISTIC STOCK MANAGEMENT

Nicolae POPOVICIU*

Abstract. *The work is a generalization of two Wilson's models related with the management of stocks in deterministic case. A variable r, called stock rate assures a better stock controlling. For* $r = 1/2$ *we obtain all Wilson's results from [3], [4]. For each model the mathematical foundation is given, together with several numerical applications and economical interpretations.*

Keywords: *Stock model, stock management, stock rate, the absence of stock.*

1. Introduction. Notations and definitions

The work is based on two Wilson's deterministic stock management models:

Model 1. The absence (the insufficiency) of stock is not allowed.

Model 2. The absence (the insufficiency) of stock is allowed.

For both models we introduce a new variable, denoted $r, r \in (0,1)$, called the **stock rate**. The stock rate is at user's (manager's) disposal. For $r = 1/2$ we obtain all the Wilson's results.

The both models use the following notations, with the appropriate meanings:

T = the whole period to assure the optimal stock management.

Q = the total number of pieces (items) which are necessary on period $[0,T]$.

q = the number of pieces per one order (the demand rate); q is **constant** for each supply.

s = the number of pieces which are necessary in stock, between two consecutive supplies.

N = the total number of supplies.

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h = the period length (the number of days, let us say) between two supplies; h is **constant**.

c_L = the launch cost for one demand of supply (the ordering cost per one order).

c_S = the stock cost (holding cost) pet unit, per day.

c_P = the penalty cost per item, per day (when s is less then the client's demand).

$C_r(q)$ = the total ordering and holding cost for interval $[0,T]$, in model 1.

$C_r(q,s)$ = the total ordering, holding and penalty cost for interval $[0,T]$, in model 2.

In the above description the elements T, Q, c_L, c_S, c_P and r are **input data**.

The elements q, s, N, h are **unknown data** (positive real numbers). They must be found by using the mathematical stock models.

Remark 1. Generally the values N, h must be positive integer numbers. When they are real numbers then we take the integer part $[N]+1$ or $[N]-1$ and similarly $[h]+1$ or $[h]+1$. After that a final correction is necessary (as we will see at the numerical examples).

The aim of the stock theory is to determine the best values q^* or q^*, s^* which minimize **the total costs**, respectively:

$$C_r(q^*) = \min_{q\in(0,\infty)} C_r(q); \qquad C_r(q^*, s^*) = \min_{q\in(0,\infty),\ s\in(0,\infty)} C_r(q,s). \tag{1}$$

Remark 2. Generally there exists the inequalities $c_L >> c_P > c_S > 0$, where, for example: *a>>b* means *a* is much greater than *b*. When the supply order of magnitude *q* was done, the receipt is quite instantaneous.

Remark 3. Between the described elements there are some important relations i.e.:

$$Q = Nq, \ \ T = Nh. \tag{2}$$

2. Model 1: the absence of stock is not allowed

2.1. The mathematical model

For one period the cost is $c_L + rqc_S h$ and for *N* periods of length *h* the total cost is

$$C_r(q) = (c_L + rqc_S h)\ N \tag{3}$$

where the quantity rq is the average stock. Because $N = \frac{Q}{q}$ and $h = \frac{T}{N}$ the equation (3) becomes:

$$C_r(q) = c_L \frac{Q}{q} + rc_S Tq^2. \tag{4}$$

From the first derivative $C_r'(q) = 0$ we obtain:

$$q = \sqrt{\frac{c_L Q}{rTc_S}}. \tag{5}$$

Because $C_r''(q) = 2c_L Q \frac{1}{q^3} > 0$ then the value q from (5) assures the minimum value of $C_r(q)$.

We denote by * the optimal values for q, N, h:

$$q^* = \sqrt{\frac{c_L Q}{rTc_S}},\ N^* = \frac{Q}{q^*},\ h^* = \frac{T}{N^*}. \tag{6}$$

The total ordering and holding cost for interval $[0,T]$, in model 1 is:

$$C_r(q^*) = 2\sqrt{r\, c_L c_S QT}. \tag{7}$$

Because $\frac{\partial C_r(q^*)}{\partial r} = \frac{\sqrt{c_L c_S QT}}{\sqrt{r}} > 0$ then the function $C_r(q^*)$ is increasing with r.

Remark 4. If we take the value $r = \frac{1}{2}$ then we obtain the results from Wilson model.

2.2. The results interpretation

The manager of the stock chooses the appropriate value of $r \in (0,1)$ in order to satisfy its desires. Sometimes in applications we take the integer part:

$[N^*]+1$ or $[N^*]-1$; $[h^*]+1$ or $[h^*]-1$, denoted $\overline{N}^*$ and $\overline{h}^*$

and arrange the values of demands in order to satisfy the value Q.

2.3. Applications for model 1

$Q = 1800\,000$ Kg (of flour, let us say, in a bred factory).

T = one month; $T = 30$ days.

$c_L = 3000$ units (of money).

$c_S = 1$ unit / 600 Kg /day.

$r = \frac{1}{4};\ r = \frac{1}{3};\ r = \frac{1}{2}.$

Find the optimal values $q^*, N^*, h^*, C_r(q^*)$ and draw a supply plan.

Solution. We arrange the results in the table 1. The value of stock rate r is at the manager's disposal. The numerical results show the best version.

Table 1

	$r = \frac{1}{4}$	$r = \frac{1}{3}$	$r = \frac{1}{2}$
q^*	657267	569209	464757
N^*	2.738	3.16	3.87
$\overline{N}^*$	3	3	4
h^*	10.95	9.419	7.75
$\overline{h}^*$	10	10	7.5
$C_r(q^*)$	16432	18974	23274.

The supply plan is:

$q_1^* = 657\,267$	$q_1^* = 569\,209$	$q_1^* = 464\,757$
$q_2^* = 657\,267$	$q_2^* = 569\,209$	$q_2^* = 464\,757$
$q_3^* = 485\,466$	$q_3^* = 661582$	$q_3^* = 464\,757$
		$q_4^* = 405\,729$
Verification $Q = 1800\,000$	$Q = 1800\,000$	$Q = 1800\,000$.

3. Model 2: the absence of stock is allowed

3.1. The mathematical model

A. Because it is allowed a deficit of stock, the penalty cost c_P appears. Then, the constant interval h is divided into two parts $h = h_1 + h_2$.

During the interval h_1 the quantity s of stock from deposit satisfies the demand of each client. During the interval h_2 the quantity $q-s>0$ means a deficit of stock and this implies a penalty cost c_P per unit and per day.

We look for the total cost in the activity of the optimal stock management on $[0,T]$.

For one period h (for one supply) the cost is $c_L+rsc_S h_1+$ $+(1-r)(q-s)c_P h_2$ and for N periods of length h the total cost is $[c_L+rsc_S h_1+(1-r)(q-s)c_P h_2]N$. We denote it by:

$$C_r(q,s)=[c_L+rsc_S h_1+(1-r)(q-s)c_P h_2]N. \tag{8}$$

If we take into account the relations between variables:

$Nq=Q,\quad Nh=T,\quad \frac{h_1}{h}=\frac{s}{q},\quad \frac{h_2}{h}=\frac{q-s}{q},\quad h=h_1+h_2,$ the relation (8) becomes:

$$C_r(q,s)=c_L\frac{Q}{q}+r\,c_S T\frac{s^2}{q}+(1-r)\,c_P T\frac{(q-s)^2}{q}. \tag{9}$$

B. The extreme points for the function $C_r(q,s)$ in q and s are given by:

$\frac{\partial C_r(q,s)}{\partial q}=0,\quad \frac{\partial C_r(q,s)}{\partial s}=0$ and we obtain successively:

$$\frac{\partial C_r(q,s)}{\partial q}=-c_L\frac{Q}{q^2}-r\,c_S T\frac{s^2}{q^2}+(1-r)\,c_P T\frac{q^2-s^2}{q^2};$$

$$\frac{\partial C_r(q,s)}{\partial s}=2r\,c_S T\frac{s}{q}-2(1-r)c_P T\frac{q-s}{q};$$

$$q^2=c_L\frac{Q}{T}\frac{r\,c_S+(1-r)c_P}{r\,c_S(1-r)c_P},\quad s=\frac{(1-r)c_P}{r\,c_S+(1-r)c_P}q.$$

By notation: $$\rho(r)=\frac{(1-r)c_P}{r\,c_S+(1-r)c_P},\ 0<\rho(r)<1,\ \rho(1)=0 \tag{10}$$

we obtain:

$$q^*=\sqrt{\frac{c_L}{rc_S}\frac{Q}{T}\frac{1}{\rho(r)}},\ s^*=\sqrt{\frac{c_L}{rc_S}\frac{Q}{T}\rho(r)} \tag{11}$$

$$C_r(q^*, s^*) = 2\sqrt{r\,\rho(r)\,c_L\,c_S\,QT} \tag{12}$$

$$N^* = \frac{Q}{q^*}, h^* = \frac{T}{N^*}. \tag{13}$$

Remark 5. For $r = \frac{1}{2}$ we obtain all the results from Wilson's model, with $\rho\left(\frac{1}{2}\right) = \frac{c_P}{c_S + c_P}$.

The Hessian matrix assures us that $C_r(q^*, s^*) = \min_{q,\,s} C_r(q, s)$.

3.2. The results interpretation

The interpretation of the results is similarly with model 1. The manager of the stock chooses the appropriate value of $r \in (0,1)$ in order to satisfy its desires. Sometimes in applications we take the integer part $[N^*]+1$ or $[N^*]-1$; $[h^*]+1$ or $[h^*]-1$, denoted $\overline{N}^*$ and $\overline{h}^*$ respectively, and arrange the values of demands in order to satisfy the value Q on interval $[0, T]$.

Generally it is necessary that:

$$s^* \le q^* \le Q, \quad s^* \le Q, \quad s^* T \le QT, \quad \frac{c_L}{r\,c_S}\rho(r) \le QT. \tag{14}$$

If the inequality (14) is not satisfied, then:

$$\frac{c_L}{r\,c_S}\rho(r) > QT \;\Rightarrow N^* = 1 \tag{15}$$

i.e. we need only one supply with the value $q^* = Q$.

3.3. The importance of stock rate $r \in (0,1)$

Compute the partial derivative $\frac{\partial C_r(q^*, s^*)}{\partial r}$ and put the condition $\frac{\partial C_r(q^*, s^*)}{\partial r} = 0$, we obtain the equation in variable *r*:

$$(c_P - c_S)r^2 - 2c_P r + c_P = 0, \;\; c_P - c_S > 0 \tag{16}$$

$$\Delta = 4c_P c_S > 0; \quad r_1 = \frac{c_P + \sqrt{c_P\,c_S}}{c_P - c_S} > 1; \quad 0 < r_2 = \frac{c_P - \sqrt{c_P\,c_S}}{c_P - c_S} < 1. \tag{17}$$

For $r \in (0, r_2]$ the function $C_r(q^*, s^*)$ is increasing function; for $r \in (r_2, 1)$ the function $C_r(q^*, s^*)$ is decreasing function. Generally the stock manager has to choose the value $r \in (0, r_2]$.

3.4. Applications for model 2

$Q = 30\,000$ TV sets (let us say, in a supermarket)

T = one year; $T = 360$ days.

$c_L = 500$ units (of money).

$c_S = 2$ units / 1 TV set / day.

$c_P = 10$ units / 1 TV set / day

$r = \frac{1}{3}$; $r = \frac{1}{2}$; $r = \frac{c_P - \sqrt{c_P c_S}}{c_P - c_S} = 0.69 < 1$; $r = \frac{3}{4}$.

Find the optimal values $q^*, N^*, h^*, C_r(q^*, s^*)$ and draw a supply plan.

Solution. We arrange the results in the table 2.

Table 2

	$r = \frac{1}{3}$	$r = \frac{1}{2}$	$r = 0.69$	$r = \frac{3}{4}$
$\rho(r)$	$\frac{10}{11}$	$\frac{5}{6}$	0.691	$\frac{5}{8}$
q^*	262.20	223.61	208.26	210.82
s^*	238.36	186.33	144.44	131.75
N^*	114.41	134.16	144.05	142.30
$\overline{N}^*$	114	134	144	142
h^*	3.14	2.68	2.5	2.52
$\overline{h}^*$	3	3	3	3
C_r^*	114415	134164	143413 max cost	142302

The supply plan is the following:

$q_1^* = 262$ $q_1^* = 223$ $q_1^* = 208$ $q_1^* = 211$

$q_2^* = 262$ $q_2^* = 223$ $q_2^* = 208$ $q_2^* = 211$

…… …… ……. ……

$q_{113}^* = 262$ $q_{133}^* = 223$ $q_{143}^* = 208$ $q_{141}^* = 211$

$q_{114}^* = 394$ $q_{134}^* = 341$ $q_{144}^* = 256$ $q_{142}^* = 249.$

Verification $Q = 30\,000$ $Q = 30\,000$ $Q = 30\,000$ $Q = 30\,000.$

For the value $r = r_2 = 0.69$ the total cost has the maxim value.

4. Conclusions

In applications, for model 1 we use the formulas (6), (7). For model 2, at the beginning we test (14) and use (17). Then, the formulas (10), (11), (12), (13) give the main numerical results: $q^*, s^*, N^*, \overline{N}^*, h^*, \overline{h}^*, C_r(q^*, s^*)$. This string of conditions and deterministic formulas give the possibility to write a computer program. For a stock manager, the computer program gives the possibility to simulate – by different values of r – the best stock control.

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THE PROCESS ORIENTED COMPLEXITY OF THE ENTERPRISE'S INFORMATION SYSTEM

Ioana ARMAŞ*

Abstract. *The competitivity of an enterprise is strongly determined by the information context that supports all the activities and the decisions. Thus, the information problem must be considered and solved accordingly, one main aspect being the complexity of the context.*
From this point of view in the paper will be developed the process oriented complexity model of the information context of the enterprise considering the followings: the main and critical process of the enterprise and the processes interconnection structure; the main types of data and information; the process oriented complexity of the information context.
For the above determined context, the main requests for the information development of the enterprise and for IT implementations will be determined.

Keywords: *information systems, information complexity, enterprise's processes, information system development, process oriented complexity.*

1. Introduction

The decision and planning activities are critical functions in the evolution of any enterprise, and are based on information and data processing by using specific knowledge (expert knowledge) and experience. In this context, the following definitions will be considered:

1. The data or the fundamental information are quantitative or qualitative signals from the internal and external environments of the enterprise that have an intrinsic signification and that are true or not.

2. The information represent an assembly of data between which relations as classification, reduction, extrapolation, organization, presentation, etc. are established such that a desired signification is obtained.

3. The knowledge represents rules, laws, principles attached to a specified environment, process, state or action.

The information systems represents the framework of the data and information processing through databases, organization, storage, retrieval,

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etc., and represent an important support for decision, control, diagnosis, etc. Thus, the development of the enterprise's information system is a critical task that, if not correctly designed and implemented, can rather perturb the activities, than create a positive framework for the enterprise's functions and objectives.

From this point of view results that the problem regarding the development of the enterprise's information system is a complex one due to the following main aspects:

- the reliability of the information;
- the internal and external heterogeneity of the enterprise.

Considering that the representation of any enterprise, at the both above levels, can be constructed based on its dominant processes, the complexity of the information system will be analyzed in a process oriented manner.

2. The complexity measures of the enterprise's information system

The complexity characteristics of a system are determined by the type of the system and its functions, according to the following definition:

Definition 1. A system is a complex one if it has multiple inputs, at least one internal or external feedback, and at least one control unit that takes logical decisions regarding the performed functions according to the internal states parameters, and its external working environment.

By applying the above definition to the system representation of the enterprise results that any enterprise is a complex system as in figure 1.

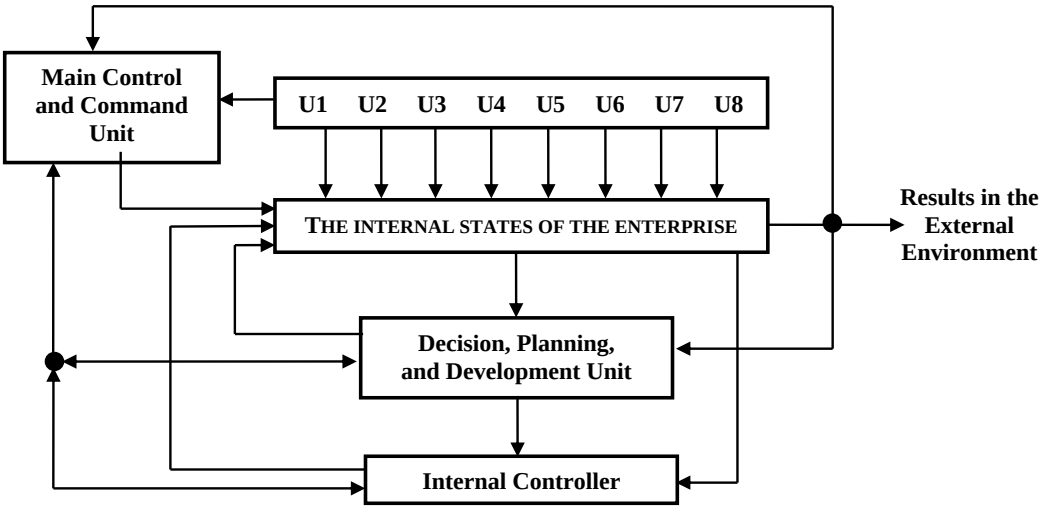

Figure 1. The system representation of the enterprise.
U1 ÷ U8 – the data and information inputs.

According to the above model, the systemic complexity measures are the following:

A. The number of the control units = 3.

B. The number of the hierarchical levels in control = 3, as following:

B0. The base control unit = "Internal Controller";

B1. The management (medium) control unit = "Decision, Planning, and Development Unit";

B2. The top control unit = "Main Control and Command Unit";

C. The number of the feedbacks = 6.

Thus, the systemic complexity of the enterprise is determined by the corresponding complexity vector (SCV – System Complexity Vector):

$$SCV(Enterprise) = \{A;\ B;\ C\} = \{A = 3;\ B = 3 = \{0\ 1\ 2\};\ C = 6\}. \quad (1)$$

In the model of figure 1, for the development of the enterprise's information system, the following data and information will be considered, some of them representing inputs to the enterprise:

I1 = U1: Information and data regarding the markets and clients;

I2 = U2: Information and data regarding the competition;

I3 = U3: Information and data regarding the business relations;

I4 = U4: Information and data regarding the institutions;

I5 = U5: Information and data regarding the society;

I6 = U6: Information and data regarding the contractors;

I7 = U7: Information and data regarding the contractors in the research areas;

I8 = U8: Information and data regarding the natural environments;

I9: Information and data regarding the internal states of the enterprise;

I10: Information and data regarding the decision, planning and developments;

I11: Information and data regarding the control.

Thus, the enterprise's information system complexity (ISC) will be determined by the following relation:

$$ISC(Enterprise) = SCV(Enterprise) + IC(Enterprise) =$$

$$= \begin{bmatrix} SCV(Enterprise) \\ IC(Enterprise) \end{bmatrix}, \quad (2)$$

where IC is the information complexity vector with the components:

$I = 11$ – the types of information / data;

$R = ?$ – the relations between the information / data according to the enterprise's activities, this measure being unspecified previously to the information system development and implementation.

The above information set is not sufficiently developed due to the fact that **I9** is not specified according to the internal activities of the enterprise, such that the information system will lack many aspects and will not be complete, further upgrading being necessary with important economical costs together with a low level of the quality and reliability of the information system.

In order to consider the internal activities of the enterprise, these must be grouped in the corresponding processes, respectively the enterprise's processes, according to the following definition:

Definition 2. [1, 2] The processes represent the functional events (activities) deployment and are characterized by finality, components, performed functions, and the applied rules.

Finally, results that the enterprise's information system complexity (ISC) for the system representation in figure 1 is determined as:

$$\mathrm{ISC}(\mathrm{Enterprise}) = \left[\begin{array}{c} A = 3;\quad B = 3 = \{0\ \ 1\ \ 2\};\quad C = 6 \\ I = 11;\quad R = ? \end{array} \right]. \qquad (3)$$

According to relation (3) results that the information complexity of the enterprise is completely determined for the further development and implementation when the relational measure, *R*, is established. This measure is the result of the enterprise's processes and the connections between these. Thus, the system model of the enterprise is not the complete framework for the information system development due to the fact that the relational parameter *R* cannot be specified.

3. The processes of the enterprise and the process oriented complexity of the information system

The main processes of an enterprise that integrate all the activities are the following:

P1 – the internal and external analysis and marketing processes;

P2 – the development (of products and services) and design processes;

P3 – the manufacturing / production / implementation processes;

P4 – the commercial processes;
P5 – the support, service, and maintenance processes;
P6 – the processes regarding the deployment of the relations with the clients;
P7 – the decision, planning, and development processes;
P8 – the top management processes;
P9 – the control processes;
P10 – the learning processes.

Considering the above processes and the information identified in section 2, the following types of process oriented data and information are determined:

I1 – Information and data regarding the markets, including part of **U1**, **U6**, **U7**, and part of **U3**;
I2 – Information and data regarding the clients, including parts of **U1** and **U3**;
I3 – Information and data regarding the competition, including **U2**;
I4 – Information and data regarding the legislation, institutions, and society, including **U4** and **U5**;
I5 – Information and data regarding the macro- and micro-economic context;
I6 – Information and data regarding the financial context;
I7 – Information and data regarding the technical aspects, technology, the natural environment, and the user, including **U8** and part of **U7**;
I8 – Information and data regarding the documentations from the interest areas or related areas, including part of **U3**;
I9 – Information and data regarding the strategy of the enterprise;
I10 – Information and data regarding the products or services design and development;
I11 – Information and data regarding the conformities and non-conformities;
I12 – Information and data regarding the quality management, and products / services quality, including reliability and maintenance;
I13 – Information and data regarding the working procedures, and internal rules;

I14 – Information and data regarding the evaluating activities;

I15 – Information and data regarding the predictions and forecasting in the areas of interest;

I16 – Information and data regarding the enterprise's organization, hierarchies etc.

In this context, the relations corresponding to the interconnection structures will be determined:

1. the interconnection structure of the enterprise's processes (Fig. 2);

2. the interconnection structure between the enterprise's processes and the information types (Fig. 3);

3. the interconnection structure of the information context of the enterprise, determined by the process oriented framework (Table 1).

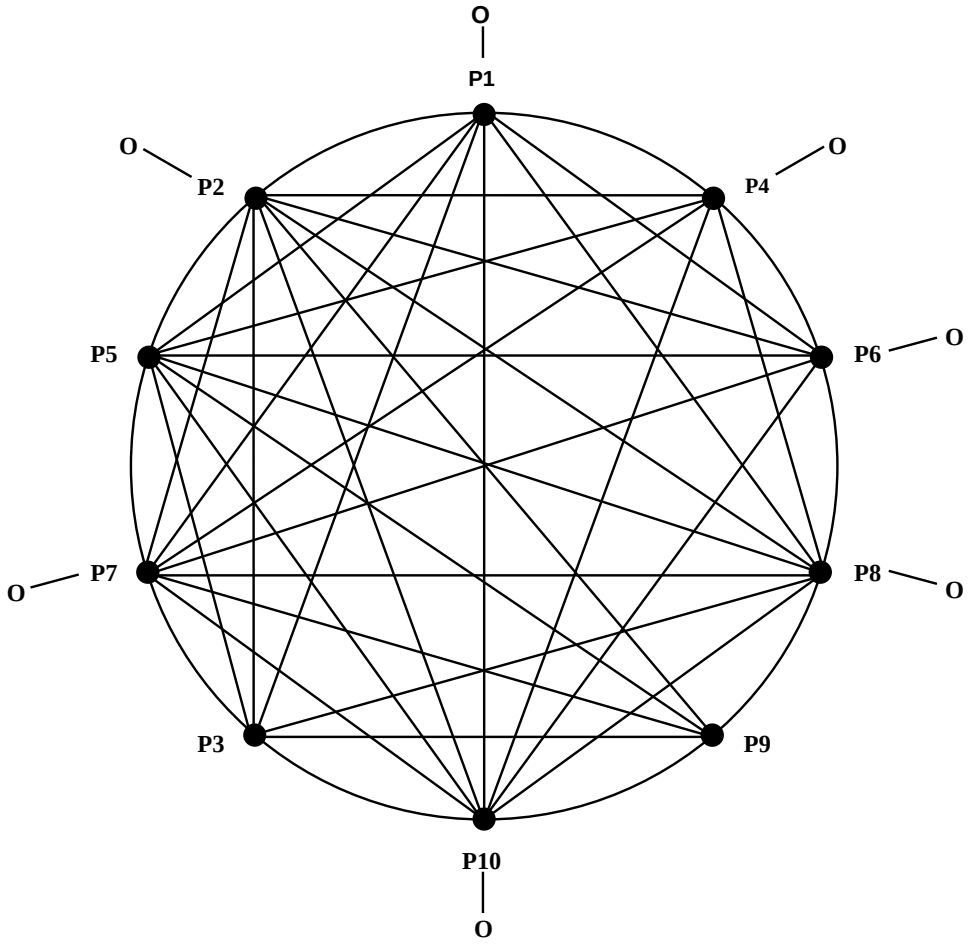

Figure 2. The interconnection structure of the enterprise's processes. P1 ÷ P10 – the processes of the enterprise; O – the interaction of the processes with the external environment of the enterprise.

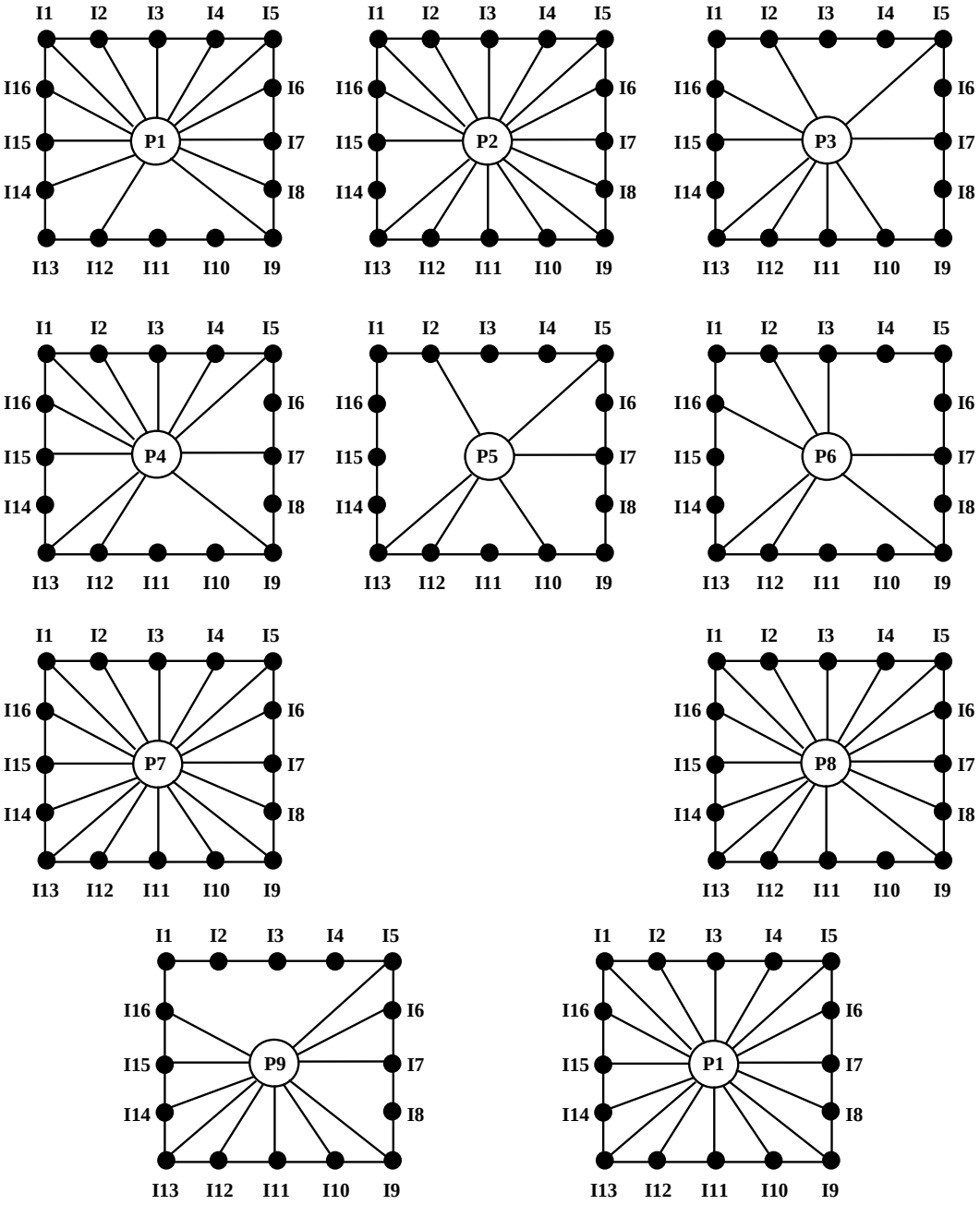

Figure 3. The interconnection structure between the enterprise's processes and the information types. P1 –÷P10 – the processes of the enterprise; I1 –÷I16 – the information types.

Table 1

The interconnection structure of the information context of the enterprise determined by the process oriented framework. P*i* – enterprise's processes; E – inputs from the other processes; O – the external environment of the enterprise; I1 – I16 – the information types.

P*i*	E	**I1**	**I2**	**I3**	**I4**	**I5**	**I6**	**I7**	**I8**	**I9**	**I10**	**I11**	**I12**	**I13**	**I14**	**I15**	**I16**
P1	**O**	X	X	X	X	X	X	X	X								
	P2							X									
	P4		X	X									X				
	P5		X														
	P6		X	X									X				
	P7					X	X			X						X	X
	P8					X	X			X							X
	P10	X	X	X	X	X	X	X	X	X						X	X
P2	**O**				X			X	X								
	P1	X	X	X	X	X		X					X			X	
	P3					X		X					X				
	P4												X				
	P5					X		X					X				
	P6												X				
	P7					X	X			X			X			X	X
	P8					X	X			X						X	X
	P10	X	X	X	X	X		X	X				X			X	
P3	**P1**		X														
	P2		X			X		X			X	X	X	X		X	
	P5					X											
	P7					X							X			X	X
	P8					X										X	X
	P10					X		X				X	X	X		X	
P4	**O**		X	X	X												
	P1	X	X	X	X	X										X	
	P2							X					X				
	P5		X														
	P6		X	X									X				
	P7					X	X			X				X			X
	P8					X	X			X				X			X
	P10	X	X	X	X			X					X	X			
P5	**P2**					X		X			X		X	X			
	P3							X					X				
	P4		X										X				
	P6		X														
	P7					X											X
	P8					X											X
	P10							X					X	X			
P6	**O**		X	X				X									
	P1		X	X				X		X							
	P4		X	X													
	P5		X														
	P7									X				X			X
	P8									X				X			X
	P10		X	X										X			

P*i*	E	**I1**	**I2**	**I3**	**I4**	**I5**	**I6**	**I7**	**I8**	**I9**	**I10**	**I11**	**I12**	**I13**	**I14**	**I15**	**I16**
P7	**O**				X	X	X		X								
	P1	X	X	X	X	X	X	X		X			X		X	X	
	P2					X		X			X	X	X			X	
	P3					X		X				X	X				
	P4		X	X		X	X						X				
	P5		X			X		X					X				
	P6		X	X									X				
	P8					X	X			X						X	X
	P9					X	X					X	X		X		
	P10	X	X	X	X	X	X	X	X	X	X	X	X		X	X	
P8	**O**				X	X	X		X								
	P1	X	X	X		X	X			X			X		X	X	
	P2					X						X	X				
	P3					X						X	X				
	P4		X	X		X							X				
	P5		X			X							X				
	P6		X	X									X				
	P7					X	X			X			X		X	X	X
	P9					X	X					X	X		X		
	P10	X	X	X	X	X	X		X	X		X	X		X	X	X
P9	**P2**							X			X	X	X	X		X	
	P3							X				X	X				
	P5							X					X				
	P7					X	X			X			X	X		X	X
	P8					X	X			X				X		X	X
P10	**O**	X	X	X	X	X	X	X	X								
	P1	X	X	X	X	X	X	X		X			X		X	X	
	P2					X		X			X	X	X	X		X	
	P3					X		X				X	X				
	P4		X	X		X	X						X				
	P5		X			X		X					X				
	P6		X	X									X				
	P7					X	X			X			X	X	X	X	X
	P8					X	X			X				X		X	X
	P9					X	X					X	X		X		

According to the above results, the process oriented complexity of the information system will be determined as:

$$\mathrm{ISC\,(Enterprise)} = \mathrm{SCV\,(Enterprise)} + \mathrm{PC(Enterprise)} + \mathrm{IC\,(Enterprise)} =$$

$$= \begin{bmatrix} \mathrm{SCV(Enterprise)} \\ \mathrm{PC(Enterprise)} \\ \mathrm{IC(Enterprise)} \end{bmatrix}, \qquad (4)$$

where: $\mathrm{PC(Enterprise)} = N_P = 10; \quad \mathrm{ISP}(\mathrm{P}i, i = \overline{1, N_p}$, (5)

represents the process complexity vector with N_P the number of the enterprise's processes, and ISP – the interconnection structure between the enterprise's processes (Fig. 2):

$$\text{IC(Enterprise)} = \tag{6}$$

$$N_I = 16; \quad \text{ISP - I}(\text{P}i, i = \overline{1, N_p}, \ \text{I}j, \ j = \overline{1, N_I}); \quad \text{ISIC}(\text{I}j, \ j = \overline{1, N_I}),$$

represents the information complexity vector with N_I the number of the enterprise's information types; ISP-I – the interconnection structure between the enterprise's processes and the information (Fig. 3); and ISIC – the interconnection structure of the information context of the enterprise (Table 1).

4. The implementation of the process oriented complexity of the information context in the development of the enterprise's information system

The information process oriented complexity represents the corresponding framework for the enterprise's information system development due to the fact that defines explicitly all the relational structures between the activities of the enterprise (through the corresponding processes), and between the processes and the information according to relations (4) ÷ (6).

On this basis, the corresponding information processing and communication flows can be determined for each type of information I1 ÷ I16. Thus, results that the development and implementation of the information systems need to:

a) determine the processes and the types of information;

b) determine the information process oriented complexity according to relations (4) ÷ (6), figures 2, 3, and table 1;

c) identify the corresponding processing and communication flows for each type of information I1 ÷ I16 (see the examples presented in figure 4);

d) develop the processing frameworks at the level of each process by identifying the methods and the corresponding correlations between the different types of information;

e) determine the information and communication security requests;

f) identify the corresponding IT&C solutions that satisfy the results determined in a ÷ e.

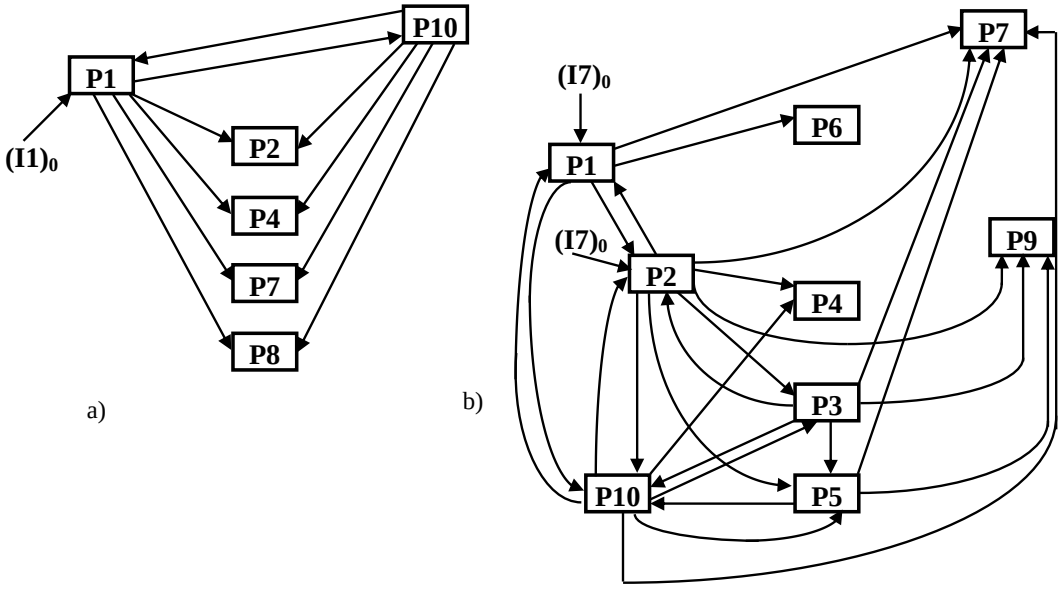

Figure 4. The information processing and communication flows for:
a) – I1 information type; b) – I7 information type.

5. Conclusions

The present developments of the information system of any enterprise and organization represent an important problem due to the fact that its design and implementation will have important influences, and even will determine, the competitively dimension of the enterprise / organization.

In the present paper, the process oriented complexity of the enterprise's information context is developed in a manner that represents the support for the information system design.

The proposed model can be applied to the development of the information systems or for redesigning the existing ones, is compatible to the general information and communication technology, and represents a new vision of the information system design based upon the optimal process – information structure, being oriented to flexibility and adaptability. Also, the proposed model is compatible with further development of the decision system support of the enterprise.

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CHINA'S GEOSTRATEGIC POSITION – FDI FLOWS AND STOCK ANALYSIS

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Abstract. *2010 brings news regarding China's economic strategy. It has strengthened its trade relations with emerging economies, making significant investments, plus significant imports and exports, proving again that it is the first commercial power in the world. China, considered being "the manufacturer of the world", along with Brazil and Russia, major exporters of raw materials, and India, the country which offers the cheapest technology services, has made the world organization, named as BRIC. In 2009, China has consolidated its position as the main trading partner with Brazil, a position that enabled it in 2010 to become the largest investor in the Brazilian territory. In the last years, China has made a lot of investments not only in Asian territory, but also in Europe. China has focused its investments in strategic regions, developing its trade relations.*

One of the most important Chinese strategies is the monetary one, through which China is trying to grow internationally Yuan's importance, reducing the dependence on the dollar by driving autonomous trade flows. It is expected that Yuan will become the main currency in Asia, main goal that will be achieved by the constitution of large reserves of Yuan on the Asian territory.

Knowledge of Chinese economic policy and relations with emerging economies is essential, since 2010 shows the economic power of this nation, the largest trading power in the world, which has led the economists to study China's economic situation. We used for this study, data extracted from UNCTAD and ASEAN's reports from 2010, plus various U.S. studies on China's geostrategic position. We tried to analyze Chinese FDI flows and stock in correlation with its economic growth rate, analysis based on an econometric model. This study is based on UNCTAD ASEAN's reports and on an econometrical model which gives us the possibility to create different analysis concerning FDI flow in this country. So we defined a simple regression model, in which the dependent variable is represented by Nominal and real GDP, total and per capita, variable explicated by FDI flows, using as method the Least Squared, including 29 observations. Through this paper, we tried to illustrate the relation between the FDI flows and the economic growth rate in the past years in China, member of BRIC cooperation.

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China's geostrategic position is an important one, especially compared with the other BRIC countries, making energy investments in the Middle East, strategy that was adopted also by India and Russia; so Russia and China created ESPO project, Eastern Siberia – Pacific – Ocean, through which China is making huge investments in energy and Russia is trying to stand out for European markets. Through this paper, we tried to evidence China's financial and trade relations with USA, European Union and emerging economies, in the context of a severe economical crisis, named by Nouriel Roubini in his book, White Swan.

Keywords: *market liberalization, FDI inflows and outflows, GDP per capita, economic grows, trade leader.*

1. Introduction

There are a lot of investors that, nowadays, mention about the business field attractiveness and about the opportunities that China gives them. In another study that we have done involving China's geostrategic position, we mentioned about Jim Rogers, an investor whose name is linked to the index of market goods[1], namely the Rogers International Commodity Index, one of the most successful investors and the cofounder of the Quantum Fund[2]. He's not only drawing attention to the opportunities that China offers at the moment for all the external investors, but also for the internal ones, due to the legal opportunities that the state has created, but also he encourages investments in Chinese mainland, counting on long-term profit opportunities offered by this Asian country.

Why all the investors consider this country more attractive than the other Asian countries, why investing in China? The answer for all this questions will be given through this paper. The main goal of our study is to underline why China is such an attractive business investing mainland, through a personal approach, a personal analysis on GDP per capita, related to FDI flows and stock. This analysis will evidence all the advantages of investing in China.

Currently, even if we are in the middle of a global economic crisis, this country has become an increasingly attractive market and will continue to be. Beginning with 2002, China has created special national programs, such as Qualified Foreign Institutional Investor and Qualified Domestic

[1] World Economics Institute, *International Market, World Economy Information*, No. 41, October 11th 2010, Bucharest, p. 4.

[2] Huidumac-Petrescu, C. E., Joia, R., Babonea A., *China's strategic investments and its relations with developing economies*, EIRP Conference 2011, Danubius University, Galati.

Institutional Investor, programs through which it liberalizes its' markets . In August 2010, China has made an announcement that it would continue the liberalization of capital markets, something that according to experts will lead to the development of Chinese financial markets, almost at the same level as Western ones.

Now, strategically speaking, China is trying to grow internationally Yuan's importance, reducing the dependence on the dollar by driving autonomous trade flows. This can be explained by the fact that the Chinese national currency has begun the single currency in South-East Asia cross-border trade, but also in some trade agreements that China concluded with its partners.

Thus, in 2011 China wants to achieve two strategic objectives, namely financial market liberalization and increasing importance of the national currency. These two strategic steps are primarily aimed to reduce the dependence on the U.S. dollar in foreign trade transactions. According to experts, financial market liberalization will lead to a significant increase in FDI flows in financial markets in China.

2. Chinese FDI flows and stock analysis

The liberalization of the markets has led to a very significant development of the FDI flows. When we make the analysis, we talk about the inward and outward of FDI. Of course there always differences between the FDI flows and stock. These differences we'll try to evidence, correlating them with the spectacular Chinese economical growth. Analyzing the Foreign Direct Investments realized by China, but also the FDI attracted by China is essential in our study.

Over the last 5 years, beginning with 2006, the developing countries from Asia represented a major area of attraction for foreign investors so that they have owned more than two thirds of total FDI flows to this group of countries, especially China. FDI inflows to South, East and South-East Asia have reached in 2006 a new record of $200 billion, meaning an increase of 19% from a year earlier. At the sub regional level, the transfer in favor of South Asia and South East continued, while countries that were the biggest attraction for FDI in the region, namely China (including Hong Kong) and Singapore continued to keep ahead[3].

[3] Huidumac-Petrescu, C. E., Joia, R., Hurduzeu, Gh., Vlad, L. B., *Foreign Direct Investments expansion – essential globalization factor,* Theoretical and Applied Economics magazine, Volume XVIII (2011), No. **1**(554), pp. 166-175.

When we talk about FDI, one of the major indicators is the transnational mergers and acquisitions. In China the high corporate profits have increased the transnational mergers and acquisitions. China and India, members of BRIC organization, were during this period the leaders in developing investment projects, especially in the service sector. Nowadays, China, the "world's manufacturer" and India, the "cheapest technology services provider", are two emerging countries with great potential, countries that offer great opportunities in business developing projects. But why China is so attractive, how could we explain this?

To answer to these two questions, we extracted from UNCTAD statistics the value of GDP per capita and the values for FDI flows and stock beginning with 1990 to 2009. So, we have 20 years, which will be analyzed through an econometrical model, we will underline the evolution and correlation between the investments and economical growth, and so we would explain why China has become the "world's manufacturer" and one of the most powerful economies in the world.

In 2007, FDI flows to South, East and South-East Asia were higher than ever, achieving $249 billion. Most sub regions and countries have received greater investments, thanks to favorable perceptions of business course, progress towards deepening regional economic integration and facilities supported by a number of countries. China and Hong Kong (China) remained the top choice, but important FDI have turned to India, ASEAN countries, Afghanistan, Cambodia, Sri Lanka and Timor-Leste. There has also been a record level on FDI outflows, approximately $150 billion. Intra and inter-regional investments were more representatives, but also flows to developing countries increased, including acquisitions and mergers. The stock of FDI out of this area suddenly jumped from $1.100 billion in 2006 to $1.600 billion in 2007.

What has happened in 2008, globally and in China? Globally, FDI flows declined by about 10% in 2008 compared with the record level registered in 2007, standing at approximately $1.870 billion. 2008 marked the end of a cycle of increasing international investments which began in 2004[4]. This situation has generated a considerable reduction of the cumulative value of cross-border mergers and acquisitions, from 29% in 2008 to approximately $1.200 billion. FDI decline was more pronounced in the developed countries, almost 12%, up to about $1.500 billion. In the transition countries, a reasonable growth of around 14% has maintained,

[4] Huidumac-Petrescu, C. E., Joia, R., Hurduzeu, Gh., Vlad, L. B., *Foreign Direct Investments expansion – essential globalization factor",* Theoretical and Applied Economics magazine, Volume XVIII (2011), No. **1**(554), pp. 166-175.

with a volume of $58 billion. FDI growth in developing countries fell to only 2% to $ 274 billion.

Table 1 presents the data concerning the evolution of inward and outward of FDI flows in China, the evolution of FDI stock in China and also the value of the Chinese GDP per capita starting with 1990 to 2009. As we will see there are 20 observations analyzed.

Table 1

FDI flows and stock evolution & GDP per capita value
from 1990 to 2009 in China

Measure: US Dollars at current prices
and current exchange rates in millions

Year	GDP	FDI_flows	FDI_stock
1990	404.494,19	3.487,00	20.690,62
1991	424.116,83	4.366,00	25.056,96
1992	499.859,31	11.007,00	36.064,47
1993	641.068,50	27.514,00	63.579,42
1994	582.653,43	33.766,00	74.151,00
1995	756.960,20	37.520,00	101.098,00
1996	892.013,94	41.725,00	128.069,00
1997	985.045,91	45.257,00	153.995,00
1998	1.045.199,12	45.462,00	175.156,00
1999	1.100.776,13	40.318,00	186.189,00
2000	1.192.836,27	40.714,00	193.348,00
2001	1.316.557,94	46.877,00	203.142,00
2002	1.454.040,33	52.742,00	216.503,00
2003	1.647.918,28	53.504,00	228.371,00
2004	1.936.501,83	60.630,00	245.467,00
2005	2.302.719,16	72.406,00	272.094,00
2006	2.779.871,00	72.715,00	292.559,00
2007	3.460.287,55	83.521,00	327.087,00
2008	4.327.024,44	108.312,00	378.083,00
2009	**4.699.911,21**	**95.000,00**	**473.083,00**

Source: *Data extracted from UNCTAD statistics*[5].

From Table 1, we can see the uptrend of all the three indicators, an increasing evolution; China has not been very affected by the financial

[5] http://unctadstat.unctad.org/TableViewer/tableView.aspx?ReportId=88

crisis. We can observe that the cycle 2004-2008 is a period of continuous growth of FDI flows and stock, 2008 being the year in which the highest value of FDI flows has been reached. 2008 represents a year of high value only for the FDI flows, because the stock of foreign investments in 2009 was higher than in 2008, even if the FDI flows value was lower than in 2008. What about 2010?

Generally, in 2010, FDI flows to developing economies rose some 10% to $525 billion in 2010[6], thanks to a relatively fast economic recovery and increasing South–South flows[7]. Thanks to its position as a leader of the global economic recovery, FDI flows to **South, East and South-East Asia** have picked up markedly, outperforming other developing regions. After a 17% decline in 2009, inflows to the region rose by about 18% in 2010, reaching $275 billion, due to booming inflows in Singapore, Hong Kong (China), China, Indonesia, Malaysia and Viet Nam, in that order. FDI flows (in the non-financial sector) to China, for example, reached more than $100 billion[8].

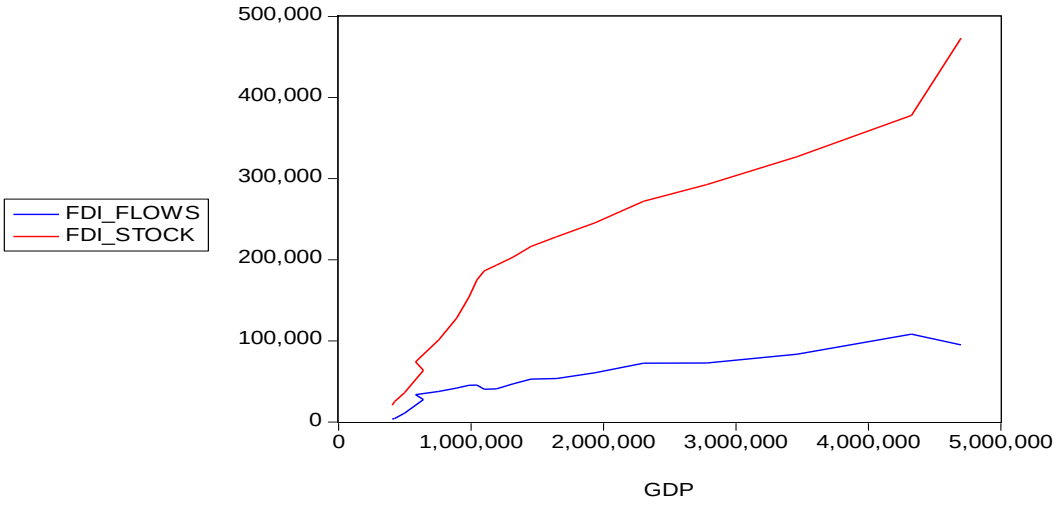

Figure 1. FDI flows and stock evolution & GDP per capita value from 1990 to 2009 in China.

Source: *Data extracted from Table 1.*

If we compare Table 1 with Figure 1, we can see that 2009 is very well underlined. While FDI flows are going down, the FDI stock is rising.

[6] UNCTAD, Global Investment Trends Monitor, No. 5, 17 January 2011, p. 4.
[7] World Investment Report 2010.
[8] UNCTAD, Global Investment Trends Monitor, No. 5, 17 January 2011, p. 5.

2009 represents an essential year for the FDI flows analysis, not only in case of China, but for all the regions, because it is in the middle of the economical crisis. China has attracted investments but also has invested itself outside the cross borders less that in 2008. Even if this has happened, the stock of FDI achieved in 2009 is the highest one from all the analyzed years.

In Table 2, it is presented the econometrical model that we have done to see the exact correlation that exist between the FDI flows, FDI stock and GDP per capita, in case of China.

Table 2
Least Squares Method – case of China

Dependent Variable: GDP
Included observations: 20

	Coefficient	Std. Error	t-Statistic	Prob.
FDI_STOCK	7.034159	2.610908	2.694143	0.0154
FDI_FLOWS	13.51879	11.39277	1.186612	0.2517
C	–372098.8	189163.2	–1.967079	0.0657

R-squared	**0.910943**	Mean dependent var	1622493.
Adjusted R-squared	0.900466	S.D. dependent var	1275054.
F-statistic	86.94470	Durbin-Watson stat	**0.157628**

Regression slope value is 7.034159 and 13.51879, statistically higher than 1, which does not show a marginal propensity to make investments; if the slope was less than 1, China's economy have had a marginal propensity to investment; the slope is positive, so the parameters are significant and correct, this being showed also by the value of R-squared, which is 0.910943, an addiction of 91.09% between the GDP per capita and the FDI flows and stock. In case of China, there is a significant relation between stock, flows and GDP per capita, relation which is highlighted by R-squared and Adjusted R-squared values, but we can not say that these foreign investments (stock and flows) lead to an increasing evolution of the Chinese GDP level, which has been achieved at this moment; this is demonstrated by the Durbin-Watson statistic, which is 0.157628. The value is higher closer to 1.5 or 2, the correlation and dependence between the analyzed variables is higher. In our case, the value is 0.157628, which means that the addiction, correlation or dependence is not so significant,

because the value of the Chinese GDP per capita is not due only to FDI flows and stock, but also to others economic activities.

Our econometrical model shows that FDI flows and FDI stock have a huge importance in the creation of the GDP per capita (this being highlighted by the value of *R*-squared), being a part of this macroeconomic variable, but the value of Durbin-Watson test underline that the three analyzed variables are not correlated during 1990 to 2009. So, China can achieve a high level of GDP per capita without FDI flows. Table 2 shows once again the complexity of Chinese economy.

Our model was created based on the next equation:

Estimation Equation:

$$GDP = C(1)*FDI\_STOCK + C(2)*FDI\_FLOWS + C(3)$$

After the calculations, we got the following results:

$$GDP = 7.03415861514*FDI\_STOCK + \\ +13.5187912036*FDI\_FLOWS – 372098.838331$$

China, as we can see from our study, represents a very complex economy and very interesting to be analyzed. So, we tried different analysis on FDI flows, FDI stock and GDP, to underline the exact correlation between them.

Table 3

GDP vs. FDI flows – case of China

Dependent Variable: GDP
Method: Least Squares
Included observations: 20

	Coefficient	Std. Error	t-Statistic	Prob.
FDI_FLOWS	42.87891	3.856210	11.11944	0.0000
C	–471805.3	215355.8	–2.190818	0.0419
R-squared	**0.872919**	Mean dependent var		1622493.
Adjusted R-squared	0.865859	S.D. dependent var		1275054.
F-statistic	123.6420	Durbin-Watson stat		**0.466563**

The results are identically with Table 2, the same interpretations are kept. The analysis from Table 3 has been done to strengthen what we already have mentioned above. We made a similar study for Romania,

where we have got different results, concerning the correlation between the FDI flows and GDP per capita, results in Table 4.

Table 4

GDP vs. FDI flows – case of Romania

Dependent Variable: REAL_GDP
Method: Least Squares
Included observations: 19 after adjustments

	Coefficient	Std. Error	*t*-Statistic	Prob.
FDI_FLOWS	12.04560	1.088876	11.06242	0.0000
C	27071.14	5912.561	4.578581	0.0003

R-squared	**0.878029**	Mean dependent var	68598.74
Adjusted R-squared	0.870854	S.D. dependent var	55406.32
F-statistic	122.3770	Durbin-Watson stat	**1.480325**

The regression slope value, the *R*-squared value and Adjusted *R*-Squared value are similar to China, but there is a huge difference, represented by the Durbin Watson test. The value of Durbin Watson statistic is 1.480325, closer to 2, which indicates that errors are independent and leads to the conclusion that the dependency equation is correctly specified. So, in case of Romania, for our economy is better to stimulate the inward and outward of FDI flows and it is better to create FDI stock. We have a different type of economy. The period that has been analyzed is from 1991 to 2009 and in this period the FDI flows have had a huge contribution for GDP per capita, the variables being correlated, not like in the case of China. Of course, we cannot compare China with Romania. We did not compare the two economies, but we wanted only to underline the two different types of results.

3. Conclusions

In 2011, China offers a lot of business opportunities. Most of the world's investors encourage investments in Chinese mainland, counting on long-term profit opportunities. Under the impact of the global economic crisis, we can say that this country has become an increasingly attractive market.

China announced that the liberalization of capital market would continue, according to experts this will lead to the development of Chinese

financial markets, almost at the same level as Western ones. One of the most important effects of the financial market liberalization is the development of the inward and outward FDI flows. Strategically speaking, China is trying to grow internationally Yuan's importance, reducing the dependence on the dollar by driving autonomous trade flows. In Asian territory, Yuan has become an exchange currency in trade markets.

Through our study, we tried to evidence why China has succeeded, which is the key of success. We underlined the complexity of the Chinese economy. Our multiple regression model evidence that FDI flows represented only one part of the Chinese economy, one little part of the GDP per capita value. They have a real great contribution to the GDP value, but the diversity of the economical activities could be the success of a huge economy and strong one. So, in our opinion, let's take the advice of the investors and let's make partnerships with China. The results that we have got during our study show that China is indeed one of the world's economical powers.

We consider that China's position in BRIC organization, China as "the manufacturer of the world", along with Brazil and Russia, major exporters of raw materials, and India, the country which offers the cheapest technology services, will help it in keeping the actual position as trade leader. If Nouriel Roubini mentions in his work about a White Swan, we could say that China is the White Swan of the global economy.

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DECISION MODELLING IN ITS SECURITY RISK ANALYSIS

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Abstract. *Modelling the decision in security risk analysis is very difficult because hazard must be modelled in quite many cases. The insurance of high security within an organization must be a permanent concern of its leadership. For this it's imperative that during a security risk management cycle a risk analysis to be done. Security Risk analysis, security risk management component mostly use estimative data during the extensive process. The results may not exactly reflect the further evolution of events. This is absolutely normal if we think about the fact that hazard must be modelled. Even though a way to model the events that affect the informational security of the company must be found. In this paper we will use the Monte-Carlo method to model a set of security parameters used in security risk analysis. Our focus will be made on estimating the frequency of unwanted events, damages and their impact and will be applied both to the qualitative and quantitative security risk analysis approach. The results will guide the experts to better allocation of resources for decreasing or eliminating the risk and will warn the leadership about some absolutely necessary investments.*

Keywords: *security, risk analysis, Monte-Carlo method, likelihood, impact, loss.*
JEL CLASSIFICATION CODES: *D81*

1. Introduction

The investments in controls that are designed to reduce or to eliminate the security risks are difficult to be reasoned if they do not have a solid base. In quite many cases the amounts of money that must be allocated are separated of direct investments, so the decision of allocating funds for security is even harder. Information security risk analysis comes to clarify the things somehow and to provide support for making the decision. This will model the security risk using parameters such as: probability, impact, impact class, exposure factor, costs, estimated (annual) losses etc. These parameters have a certain degree of uncertainty that will

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make the achievement of a consensus regarding information security rather difficult. The most often encountered case in such situations refers to the quantification of the probability of occurrence of an event with impact on information security. Risk analysis team will have to determine what is the occurrence probability. The team members' answers will be different in this case. Some will have values with a longer certainty in time, others with a lower certainty and some others' values will be outside the possibility of occurrence. These answers depend both on the team members and their experience.

We can already notice that the values of the given answers will create uncertainty due to both the random processes that must be quantified and the personal perception and estimation of the team members. What values are still possible? Based on these answers the resource owner must be capable of taking the correct decision based on data that will shape as good as possible reality by decreasing the degree of uncertainty. The answer can be given using the Monte-Carlo simulation. A Monte-Carlo simulation enables an analyst to quantify the uncertainly in an expert's estimate by defining it as a probability distribution rather than just a single expected value [5].

In the following we will exemplify the use of Monte-Carlo simulation for the qualitative and quantitative approach of information security risk analysis.

2. Risk and risk analysis

Risk, depending on the domain and context can have different definitions. Some of them are more complex and some others are simpler. According to ISO Guide 73 *risk is the combination between the probability of an event and its consequences*. A much more simple definition defines risk as being an event that is expected to happen. In information security, risk is defined as being a threat that can exploit the potential weaknesses of the system. Whatever the field, in order to occur risk needs two elements: *impact* and *probability*.

Impact refers to the action upon the organization's assets, in the sense that some assets must be protected against certain threats. An asset with a certain value which has a degree of exposure will generate impact. This impact is actually a loss for the organization. Impact rate is defined as:

Impact rate = Impact Class Value * Exposure Factor.

Probability refers to the degree at which a threat may occur.

Threat, with its components – vulnerability and mitigation will be successful if vulnerability is high, and will be a failure if mitigation is high. The two elements, vulnerability and mitigation are inversely proportional.

Finally the risk level is defined as:

Risk Level = Impact rate * Probability Rate.

Risk analysis involves a security risks identification process, determining their magnitude and identifying the high risk areas that must be secured. Risk analysis is a part of the set of measures called risk management. As objectives, risk management manages risk in the sense of decreasing it to an acceptable level for the organization's needs, and risk analysis identifies and classifies risks within the organization.

Risk management is a process that must be permanent within the organization, while risk analysis is a process that works in only one phase- when a risk evaluation is needed.

Microsoft approach defines rules and responsibilities within the risk management process as following (figure 1):

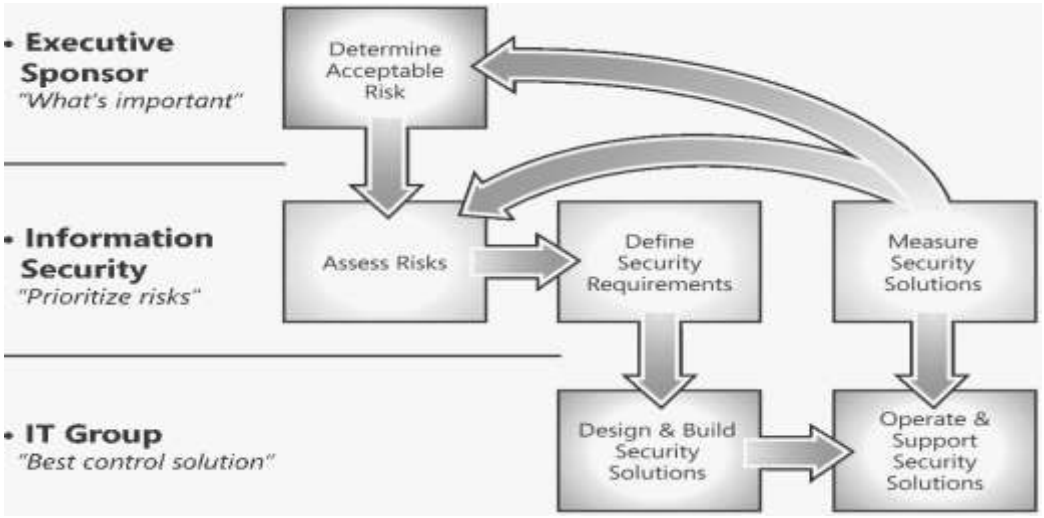

Figure 1. Rules and responsibilities in security risk management.

Source: http://www.microsoft.com/technet/security/topics/policiesandprocedures/secrisk/-default.mspx

If we analyze the scheme in figure 1 we will see that the main role goes to the resource owner. He must define an acceptable risk level for the organization he leads. This is where everything starts.

The resource owner will establish the things that are important to be protected within the organization and will impose an acceptable security risk level according to his objectives.

The hardest task belongs to the Security Group which has as main purpose the classification of risks. Other tasks will include risk analysis, defining security demands and measuring security solutions.

The IT group's responsibilities are to choose the adequate control solutions meant to reduce or to eliminate the risk.

The adopted solutions will have to be analyzed in order to determine their effectiveness. Following this process a feedback with the results will be sent to the resource owner for information on the costs and the solutions that must be adopted. The same results will be sent as feedback to the risk analysis stage in order to see which the new level of risk is.

Right from the involvement of the owner who has to define an acceptable risk level for the organization we can notice that we work with elements of uncertainty. In this case we talk about the human perception on an event. The same uncertainties will appear on the stage of risk analysis where he team will have to quantify certain events. As I previously stated some uncertainties will come for human perceptions but also from the fact that certain events are themselves uncertain. In the following we will try to model and solve these situations.

3. Qualitative approach

This method is more commonly used than the quantitative method and it refers to de small and medium size companies. The method operates with terms such as: high, medium or low – to quantify the probability of occurrence or the vulnerability level; high, medium, low – to quantify the impact; catastrophic, major, moderate, minor, insignificant – to quantify the consequences of the events etc. They are associated numerical values – 1, 2, 3, …, 5. With these numerical values calculations will be made and the risk level will be established. Due to these values it allows the faster achievement of a consensus within the risk analysis team. Due to the fact that determining the financial value of assets is not necessary, but especially because the quantification of the occurrence frequency of threats is not necessary this approach method can have as result risk level values that are not correct. The main culprit of this situation is the man who can't perceive correctly or who can't quantify an event correctly.

To determine the risk level we will use the previously stated formulae [6]:

Risk Level = Impact Rate * Probability Rate

Impact Rate = Impact Class Value * Exposure Factor

Probability Rate = Vulnerability Level + Control Efficiency.

Finally we have:

Risk level = (Impact Class Value * Exposure Factor) * (Vulnerability Level + Control Efficiency)

All these terms must be quantified by the risk analysis team members. It is obviously that there will be discrepancies between the appraisals of the members. Estimating the values for these terms is a challenge and can sometimes be done wrong. The probability of erroneous estimation for these factors is illustrated in the next table (table 1).

Table 1
Risk values and error estimation

Error estimation

Low High

Impact Class Value	Values	Vulnerability Level	Values	Exposure Factor	Values (%)	Controls Efficiency	Values
	2, 5, 10		1, 3, 5		20, 40, 60, 80, 100		0, 1, 2, 3, 4, 5

Let's take as example the quantification of controls effectiveness designed to reduce risk. For this we have to make the sum of answers to the following questions (table 2).

Table 2
Questions for exterminating the controls effectiveness (Microsoft)

Questions	**Answer** 0 for Yes, 1 for No
Are responsibilities defined and effectively applied?	
Are warnings communicated and their execution followed?	
Are the processes and procedures well defined and learned?	
Do the existing technology and the existent controls reduce threat?	
Are the current audit practices sufficient for detecting abuses or deficiency control?	
SUM	

Source: http://www.microsoft.com/technet/security/topics/policiesandprocedures/secrisk-/default.mspx

Team members can give different answers to these questions. Summarizing the answers we can determine which the dominant value is. Consider the dominant value 1 (one). What is the probability that this value

is closest to the truth? The probability is 50% (0.5 from 1). Can it be another value? Obviously yes. Which are these values and what is the probability of occurrence? These are the questions that make the decision hard to be taken.

To determine the risk level under uncertainty we will use a Monte-Carlo simulation. The input data are in accordance with the next table (table 3).

Table 3.
The input data for qualitative risk analysis

Impact Class Values		**Exposure Factor**		**Vulnerability Level**		**Control Efficiency**	
Values	Probability	Values	Probability	Values	Probability	Values	Probability
2	0.2	20	0.25	1	0.1	0	0.2
5	0.7	40	0.4	3	0.2	1	0.5
10	0.1	60	0.2	5	0.7	2	0.1
		80	0.1			3	0.1
		100	0.05			4	0.05
						5	0.05
	1		1		1		1

The values highlighted in the table are dominant values because they have received the greatest number of affirmative answers from the team members because they have the highest probability of occurrence. Associating each value an estimated occurrence value we will be able to simulate the way in which risk evolves over a period of time. In our example I have considered a number of 52 steps for simulation, corresponding to the 52 weeks of a year. Generating random numbers statistically independent for the four terms we will have the following values for the risk level (table 4).

Table 4
Random numbers and obtained values for qualitative risk analysis

Week	Impact Class Values	Exposure Factor	Vulnerability Level	Control Efficiency	**Risk Value**
1	2	20	5	1	2.4
2	10	40	5	0	20
3	10	20	5	3	16
4	5	40	5	1	12
…	…	…	…	…	…
51	5	40	3	1	8
52	2	20	5	1	2.4

Correlating the results with Microsoft data of determining risk level (table 5) and making a graphic for the obtained results (figure 2) we will be able to see the evolution for the 52 weeks of simulation.

Table 5
Corresponding between risk value and risk level

Risk Value	**Risk Level**
41 – 100	High
20 – 40	Medium
0 – 19	Low

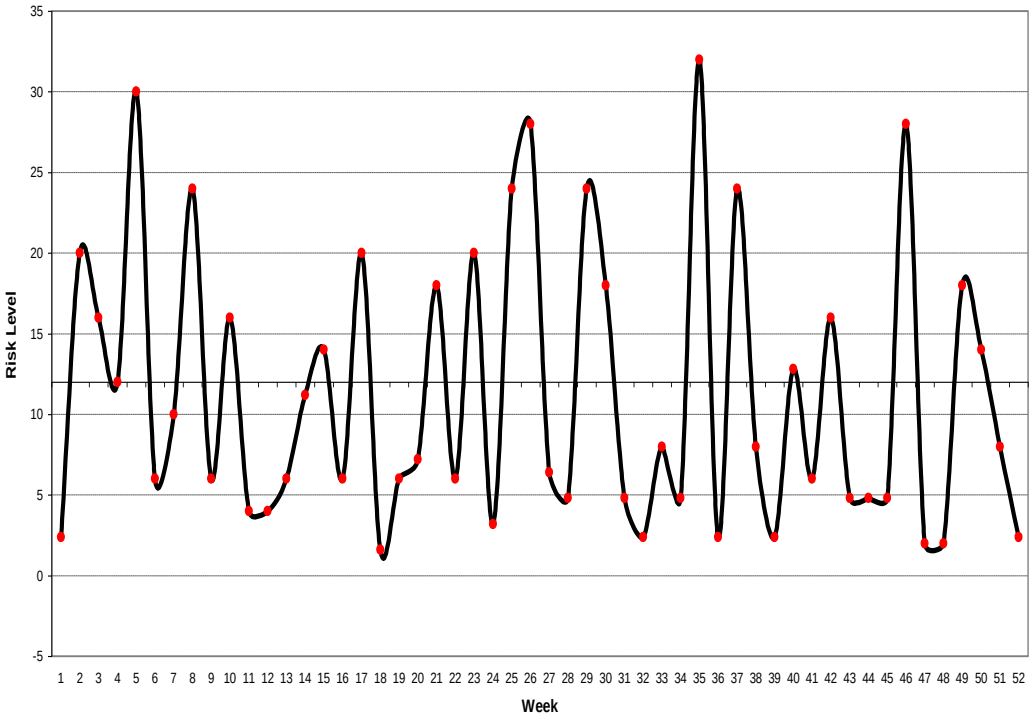

Figure 2. Estimated risk level evolution.

Compared to the reference value of a risk value of 12 (according to Impact Class Values = 5, Exposure Factor = 40, Vulnerability Level = 5 and Control Efficiency = 1) we can draw the following conclusions:

1. The risk level does not reach High.
2. There are only 8 weeks in which the risk level can be Medium.
3. In most of the weeks (44 weeks) the risk level is Low – similar to the one obtained with the dominant values.

It may be considered that extreme measures are not necessary in order to reduce the risk generated by this event.

4. Quantitative approach

Quantitative analysis works with statistical data in the field. It is suitable for large companies that have their own specialized personnel for risk analysis. The accuracy of the method tends to increase over time due to the fact that the company creates a database with the history of the events, in the same time the company gaining experience. Because of this calculating the impact is very important. Reaching a consensus is even more difficult this time because now we have a wide range of values.

Let's take the example of an organization that has a number of assets which are the subject of threats that will produce a certain level of losses (table 6):

Table 6
Assets, occurrence rate and losses expectancy

		Losses expectancy per every threat			
		Workstation	Dataserver	Webserver	Local Printer
	Pieces	**20**	**1**	**1**	**10**
Threat	**Occurrence Rate**				
Voltage shock	**5**	**500**	**10,000**	**500**	**500**
Theft	**0.5**	**100**	**1,000**	**100**	**0**
Reveal	**3**	**50**	**1,000**	**300**	**0**
Strikes	**2**	**200**	**300**	**50**	**400**

In order not to further complicate things we will consider that the values of estimated losses for each asset and threat have been correctly estimated. The only element of uncertainty is the rate of occurrence of a threat. Considering this data, the following question arises: What is the total value of Annual Losses Expectancy (ALE)? Taking into account occurrence rates as the ones in the table, the total value of annual losses – ALE – has a value of 152650 monetary units. Now we come up with another question: What will be the value if the threat occurrence rates vary around the values in the table? Obviously we will use a Monte-Carlo simulation. The input data are in accordance with the following table (table 7).

Table 7
The input data for quantitative risk analysis

Voltage shock		**Theft**		**Reveal**		**Strikes**	
Values	Probability	Values	Probability	Values	Probability	Values	Probability
4	0.2	0.25	0.1	2	0.2	1	0.2
5	0.5	0.5	0.6	3	0.6	2	0.7
6	0.2	0.75	0.2	4	0.2	3	0.1
7	0.1	1	0.1				
	1		1		1		1

The values highlighted in the table are dominant values. Even if these values are obtained by evaluations much more rigorous than the qualitative analysis, they can be contradicted over time. This time we want to see how the annual losses expectancy level evolves. We will use a number of 50 evaluations with statistically independent values for each threat (table 8).

Table 8
Random numbers and obtained values for quantitative risk analysis.

Tracking	Voltage shock	Theft	Reveal	Strikes	**ALE**
1	4	0.5	3	2	127150
2	5	0.5	3	2	152650
3	5	1	2	2	151900
4	4	0.5	3	2	127150
5	4	0.25	3	2	126375
6	7	0.5	2	2	201350
7	4	0.5	2	2	124850
8	7	0.5	3	2	203650
…	…	…	..	…	…
10	7	0.75	3	2	204425
49	6	0.5	3	2	178150
50	5	0.5	3	2	152650

The representation of the obtained values after the simulations is exemplified in figure 3.

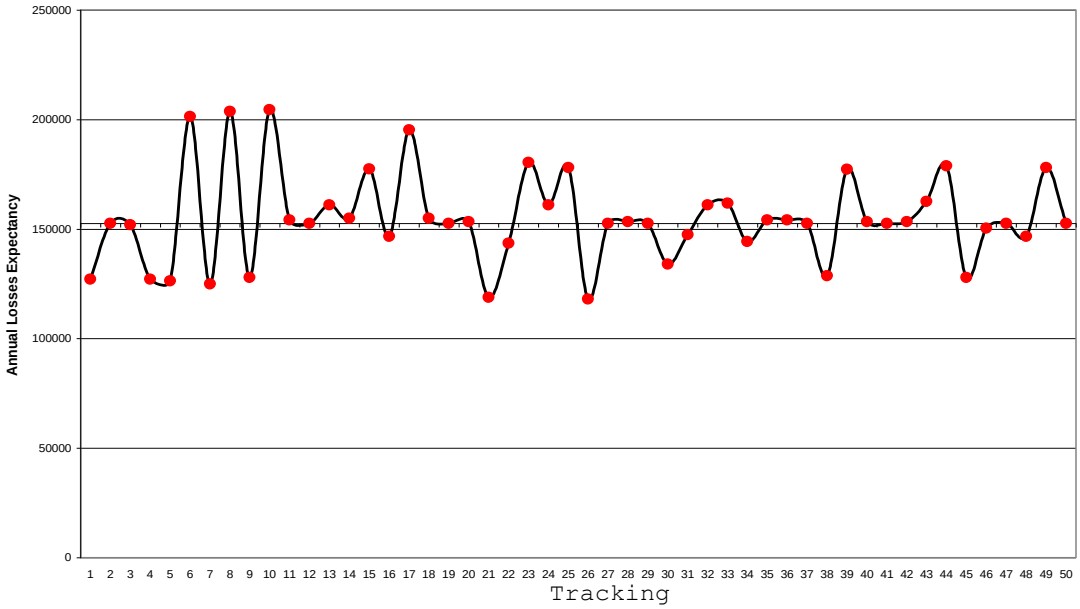

Figure 3. Annual Losses Expectancy evolves.

The calculated values for the estimated annual losses have a deviation of ±25% compared to the reference value. This is not an alarming value especially because we talk about estimation and this can be corrected during the implementation of controls.

5. Conclusions

The Monte-Carlo simulation will allow the risk analysis team to run different scenarios to be able to estimate all the possible future situations. Running different scenarios we will be able to manage uncertainty for the future and to think in future terms. It is very important to know what will happen tomorrow before happening today. Based on the data generated by the scenarios controls meant to reduce risks and of course the level of investments will be chosen.

The simulation is well suited to the events that are uncertain over time but it can be used for different scenarios in which the perception on an event is different from one individual to the other. In the latter case better results are given by the Delphi method. Using the Monte-Carlo simulation for security risk analysis will be expanded in security risk management. This will involve running scenarios to determine the risk level reduction for different applied controls or to establish the investment level for ensuring security.

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THE INCREASING OF THE ECONOMIC EFFICIENCY BY REDUCING THE PRODUCTION COSTS

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Abstract. *Worldwide this issue is subject to an extensive community of specialists, the complex measures developed to reduce costs came to be considered a possibility of management (costs method management).*
The management and the control of the entire manufacturing process through costs support and enhance industrial strategies adopted by companies who practice this method.
The method has worked in the Japanese economy which develops new products, not only to make better use of the available production capacity, but to sell them successfully in a predetermined market.

Keywords: *production cost, commodity production, scheduled cost, effective cost, value analysis.*

1. Introduction

In the market economy conditions, of the competition between producers of the same type of goods, the correct sizing of production costs, due to its multiple implications, is one of the most important issues around which revolve simultaneously the technical, economic and social factors' actions. Thus "knowing the level of production costs, the management of the industrial enterprise can pursue both their achievement and systematic reduction, ensuring the continuous increase in the benefits' level". [1]

Strictly related to this, the prices charged by traders in dealing with third parties will be set according to the supply and demand ratio, and it is very important for every trader to size their sale costs to a level that would ensure both the capital recovery and obtaining a higher profit.

The importance of reducing the production costs materializes in the special role this plays in the increasing of the business efficiency.

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2. The management role in the growth of the economic efficiency of the company

The main function of both the management and the science of management is the increasing of the business competitiveness. The last decades have marked many recognitions that science and practice of scientific management is a basic vector for economic growth.

Romania today is characterized in terms of management, by looking for design and implementation of sustainable management systems, favouring deep restructuring of the economy and increasing of the economic efficiency.

The main dimensions of this process, specific to our country, are:

– Strengthening the economic management, by increasing the role of economic-financial levers used to stimulate the participation of economic agents in pursuit of profitable activities in all areas;

– Decentralization of management, empowering the company by replacing the rigid management with a flexible management;

– Transition to the new organizational structures as an organizational prerequisite for success of the market economy;

– Promotion of best rated management methods, techniques for the company's rapid adaptation to new effective participation conditions in international economic exchanges;

– Opening the national economy to the world economy by attracting foreign capital in Romania.

Management influence on the economic efficiency of companies and autonomous administrations lies mainly in the following:

– Enhancing overall business functionality;

– Enhancement of performance work in each job, reflected in increasing labour productivity;

– Integration at a higher level of business activities in the market and the national economy resulting from improved efficiency in production specialization and cooperation;

– Social efficiency, with consequences for all stakeholders in the company's activity and the human factor (fluidity of the hierarchical relationships, the quality of internal climate, the intensity of staff motivation, etc.).

From the above, it appears that management is now an essential factor of the company competitiveness, with a tendency to amplify as transitioning to a true market economy, raising the level of economic development, first considering the qualitative factors of production activity.

3. The production cost – synthetic indicator for assessing the activity of the company

The cost "is an expense or an amount of expenses associated with (and recognized as) a resource consumption, a place of business, a made product or a management period". [2]

The production cost is a synthetic qualitative and quantitative indicator that shows the efficiency of the entire economic activity of the agent by its size, content, structure and dynamics. This cost is an economic category which is subject to the existence of commodity production.

It expresses all the production and sale costs of the economic goods, therefore differing from company to company, and even within the same company, from time to time. The production cost reflects the quality of all activities of the company, relative to each stage of production (supply, production, sales). It can be determined both for each company individually and for the industry (branch). It also can be determined for each product and productive activities across the company.

While the individual production cost is used to determine the task and the targets for reducing the production cost and increasing the profitability of the product at the enterprise level, the cost of production in the industry (branch) (which is an average cost) serves as a starting point for price fixing for various products by adding an appropriate average economic profit margin.

By reporting the different results of the costs activity, the company is able to know the efficiency of using every leu spent, consequently boosting the discovery of new internal reserves for increasing the efficiency.

Thus, the company, knowing the cost of its products, is considering its recovery through the selling activity of the obtained products, to assure the compensation of necessary resources for reproducing the material financial and personnel conditions, for further production. In this sense, the production cost is used for determining the offer price of their products by setting its minimum.

To achieve the cost function of recovering the production expenses should be made a clear distinction between the programmed cost (pre-calculated) – which includes only expenses recognized as needed for the product – and the actual cost (post-calculated), which includes all expenditure, including the unproductive ones, but which should be recovered through price. So, the scheduled cost is the guide cost, established according to the strategy imposed by the market and represents the

maximum consumption of resources allowed to conduct an efficient activity.

The actual cost is the consumption value of resources for the scheduled production and is determined based on the actual conditions for achieving the scheduled production foreseen in the approved technical documentation.

The evaluation of the production cost level has a particular importance for companies. The expenses for companies in terms of their inclusion in the production cost are divided into:

— Expenditures included both the scheduled and the effective cost – are considered necessary for manufacturing and selling of the production, calculated according to the set rules and norms of consumption;

— Expenditures which are included only in the actual cost – not scheduled because they are not needed for production and sales, which occur without anyone being responsible for this, namely: losses from interruptions caused by the internal or external causes (excluding those caused by natural disasters), losses from scrap (excluding those that someone can be charged), losses from cassation or downgrading of material elements according to the law etc.

The scheduled and the actual production cost do not include the costs of training and experience, the commissions paid to foreign trade agents, the fines and penalties (which are not due to someone's guilt), entertainment, advertising and publicity expenses that are paid directly from the financial results (deducted from income) and other expenses not affecting industrial production.

After the way the production cost changes with the changing of the physical volume of production, its various components are divided into two categories:

– Fixed costs are those costs that "remain constant in value, not being affected by the pace of operations or by the production volume" (e.g., lighting, rent, salaries of administrative and management staff, etc.). [3]

– Variable costs are "those operating costs that vary according to the pace of operations or the production volume" (e.g., fuel, raw materials, energy etc.). [3]

The amount of the fixed cost and the variable cost is the total cost of the company:

$$\mathbf{CT = CF + CV}$$

where:

CF = fixed cost;

CV = variable cost.

In relation to the formation stages of the production cost, the following cost categories are distinguished:

– the department cost includes: Raw materials and direct materials, direct wages, social security contributions and unemployment expenses, expenses common to the sections (heating, lighting etc.), and special manufacturing costs (with SDV's);

– the factory cost consists of the department cost plus the overheads of the company (interest, penalties, amortization of buildings etc.).

– the full cost is made up of the factory cost plus the sale related costs (storage, sorting, packaging, transport, advertising etc.), and the service activity expenses.

In relation to the covered subject, the production cost can be: cost per piece, CPS unit, cost per product (the average cost, per unit) CM; overall cost (the entire production of the company) CG.

It is very important for production cost analysis importance to know its structure. The production cost structure means share various items of expenditure which contribute to the formation of the aggregate cost value. The knowledge of the production cost structure is crucial for highlighting the ways in which this can be reduced.

Given the particular structure of production cost, the reduction programs will be adapted to focus on those structural elements which are holding a high percentage.

The concrete actions for reducing the production costs are different from one facility to another, depending on the object of activity, the technical equipment, the technologies used and the production cost structure.

The value analysis can be defined as a process aimed at achieving the economic functions of the product with the lowest possible cost, without affecting the characteristics of functionality, reliability and performance of the product by cost reduction.

The application of the value analysis is a method, a tool against uneconomical solutions and a means to increase the use value of products relative to a given cost, a means to increase the quality / price ratio.

The value analysis can be considered a method that can achieve cost savings, because it stimulates the activity in order to obtain an optimal ratio between the social needs and quality products, on the one hand and the cost of production, on the other. This method should be applied early to the product design phase, starting from marketing studies, but it can also be

applied to redesign products that have proved insufficient competitive on the market.

4. The reducing of the production cost – a growth factor for the overall economic efficiency

Because the production cost is the monetary expression of all expenditures incurred by production and sale of economic goods, execution of works and services, permanent reduction of production cost is one of the key issues facing any company operating in market conditions.

The increasing of the economic efficiency of enterprise activity requires permanent, systematic, reducing of the production cost. The reducing the production cost has a major economic importance because it creates additional resources for increasing the physical volume of production and ensures the economic competitiveness of goods on the market. At the same time, it creates opportunities to increase the company's cash accumulation that can be used for new investments, for improving and efficiency of the production process and for greater involvement of the company to the formation of public resources necessary for the overall development of the society and the national economy.

The importance of reducing the production cost consists in the fact that, given that production costs are crucial in determining the level of price offer; their reducing creates the necessary conditions for scheduled reduction of prices and raising the living standards by increasing the purchasing power. Knowing this "level is essential information for the efficiency calculation and further for the manufacturer's decision". [4]

The main routes used to ensure the production costs can be:

1) The reducing of the material costs – in those activities where the material expenditure ratio is relatively high in the cost structure. This reduction can be done as follows:

– Reducing the sales costs, and the technical – material supplies;

– Introduction of new technologies or improving the existing ones (aiming at reducing consumption of raw materials, fuels, materials, energy, etc.).

– Reducing the consumption norms by redesigning products, by recovering waste, by increasing the recovery of raw materials and materials etc.;

– Optimization of stocks of raw materials and finished products.

2) The increasing of the productivity of production factors, labour productivity – labour productivity growth, results in an increased volume

of the completed production quantity and reduces the variable costs per unit and the conventional constant costs per unit (average fixed cost reduction).

3) The streamlining administrative-household costs, a measure that is intended to reduce the participation of these expenses to the formation of plant cost.

4) “Improving the use of production capacities” [5] namely:

– Reduction of fixed capital depreciation per unit of product;

– Increasing the production volume (with the same effect on the size of production cost as the labor productivity growth).

The effects of reducing the costs for obtaining the economic goods are numerous and helpful throughout the company, namely:

– Increasing the competitiveness of their products on domestic and international market;

– Obtaining a high production volume, this is equivalent to increasing the base of raw materials without additional investment;

– Rapid growth of national income by reducing the material costs the country's gross national product;

– The possibility of reducing the selling price of goods and of services prices, starting from the actual prices of products, thereby ensuring the increase of the population’s real incomes and its material and spiritual welfare;

– Achieve savings due to rational use of human and material resources, resulting in improved opportunities for material stimulation of the employees.

5. Conclusions

The reducing of the production cost is in the heart of the economic efficiency because the production costs of the enterprise reflect its complex activity, the results in increased productivity, the savings of material resources, the efficient use of fixed capital and the multiple effects of introduction of the technical progress in all fields.

The economic demands of this period faced by the Romanian economy, and the future ones, that must be part of any economic activity, require the addressing with maximum responsibility for the problem of production costs in order to reduce them and improve their structure, and also the competitive alignment of the domestic and international market.

Thus, each economic unit must achieve a high level of economic efficiency, which requires the operational and complete knowledge of the

level and structure, which requires the continuous knowledge and analysis of the factors that have a permanent direct or indirect influence on the cost.

The orientation to reduce the production cost, especially the material, considers that the complex problems, generated by the relative reducing of the availability of raw materials and materials can only be solved by reducing technological consumption and by changing the consumption structure for each company towards increasing the spending' share on labour and material services in the production cost structure.

Increasing the profitability and company profit must be achieved not by increasing the offer price, but by reducing the production cost, making at the same sale price, the unit profit margin to increase. Even if the unit profit margin does not increase, by reducing the price for the cost reduction can increase sales volume, leading to increased overall profit obtained.

An important aspect of the production cost reducing is that this reduction shouldn't be at the cost of affecting the quality of use for these products. To follow, not to reduce the production cost in itself, but reduce the cost/quality ratio (increasing quality/price ratio).

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THE NEW GREEN DEAL IN TRANSPORTS. BIOFUELS – THE REDUCTION OF OIL DEPENDENCE IN THE TRANSPORT SECTOR

Marius CĂPĂȚÎNĂ*

Abstract. *This paper is part of the proposed research topics related to the development of biomass as an alternative energy resource. Improving automotive fuel efficiency and traffic flow is not enough to reduce CO2 emissions in the road transport sector. An integrated approach is required, which includes the development and supply of alternative fuels and a more efficient use of vehicles. The adoption of these measures will ultimately make CO2 reduction efforts compatible with economic growth. We need to decrease our dependence on oil, coal and gas and until now the substitution of oil fuels with biofuels is the most important measure for CO2 reduction.*

Keywords: *transport, efficiency, alternative, biofuel, renewable energy, development.*

1. Introduction

Biofuels have been championed as an energy source that can increase security of supply, reduce vehicle emissions and provide a new income stream for farmers. In recent years, biofuels have attracted increasing attention. Their selling points are many: they are made from renewable feedstock's that can be grown by farmers, and substituting them for petroleum products reduces greenhouse gases and dependency on foreign oil. The European Union, United States and numerous other countries have set ambitious calendars for their compulsory incorporation at filling stations. Farmers are ready for action, industry is investing, and governments have opened up their treasuries to help biofuels take off.

The impact on energy security – The idea that producing biofuels at home will reduce a country's dependence on foreign sources of energy, particularly oil from the Middle East, has helped to increase the political popularity of biofuels. A wide range of biologically-derived feedstock's can be transformed into liquid fuels. The technologies used to make that transformation are also numerous. The most basic is the chemical transesterification process used to convert oils and fats into fatty-acid

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methyl ester (FAME), commonly known as biodiesel because of its resemblance to diesel. Most commercial production of biodiesel is based on vegetable oils such as those obtained from oil palm, rapeseed, sunflower seed, and soybean, but some is made from tallow, used cooking oil and even fish oil. Ethyl alcohol, or ethanol, can be produced from any feedstock that contains relatively dense quantities of sugar or starchy crops, using nothing more than a flask. The most common feed stocks are sugarcane, sugar beet, maize (corn), wheat and other starchy cereals such as barley, sorghum and rye. Concentrating the ethanol from the 16% or so that exists in the beer to the high level of purity (typically 99.7%) required for use in spark-ignition engines requires distillation and dehydration equipment.

At present, the predominant liquid biofuels in use are ethanol and biodiesel. A much smaller amount of biomass-derived energy is converted into methane gas for use in transport.

Biofuels are thus not an easy solution for weaning the world from its dependency on petroleum. Because most liquid biofuels will be consumed as blends with gasoline or petroleum diesel, biofuels will, for some time to come, be complements to petroleum-based transport fuels, not major competitors with them. Their potential is limited and their environmental benefits rely on critical assumptions that must be met in order for biofuels to be sustainable.

Within the field of bio energy, a large number of actors are involved at different parts of various value chains, stressing the need for coordination of (pre-competitive) research. First research topics yet to be detailed, relate with biomass resources, combining thermo chemical and biochemical conversion pathways.

Brazil and the United States of America lead the production of ethanol while the European Union is at present the main producer of biodiesel.

2. Experimental conditions

We assume that the EU will consume 17.76Mtoe of bio ethanol and biodiesel by 2020 in order to achieve the mandate target of 10% renewable energy in road transport fuels. Only two biofuels with possible application in transport – bio ethanol and biodiesel – are investigated, since they appear to be the most feasible by the time horizon of the analysis. Bio ethanol and biodiesel can be mixed with conventional gasoline and diesel. When blended in low concentrations, these two biofuels can be handled

over the existing infrastructure for liquid fossil fuels and can be used in current engines without engine modifications

Well-to-wheel assessments indicate that the use of biofuels in vehicles yield definite benefits in terms of GHG emissions compared to petroleum-based automotive fuels, although the precise amount of saved CO_2 emission depends on the specific type of raw material used, the production process for the agricultural raw materials, the conversion process and several other elements. Europe strongly believes that biofuels, and in particular second generation biofuels (such as bio ethanol or biodiesel from ligno-cellulosic biomass or biodiesel from biomass gasification) has the potential to become an attractive replacement for fossil transportation fuels for both environmental and economic (depending on the oil price) reasons, and due to its potential of creating jobs in rural areas. To reach the 10% biofuels target, the EU urgently needs to draw up a comprehensive and coherent framework comprising all relevant policy areas. This will require a realistic roadmap to implement the different policies.

Future biofuel markets could be characterized by a diverse set of supplying and consuming regions.

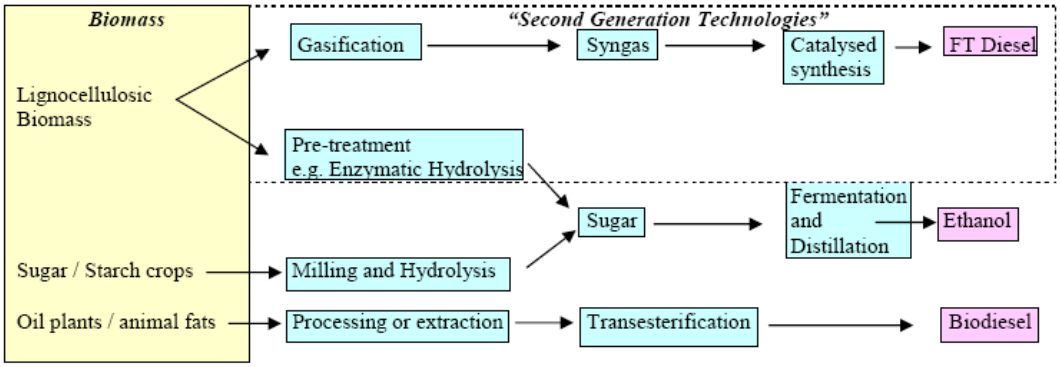
From the current fairly concentrated supply (and demand) of biofuels, a future international market could evolve into a truly global market, supplied by many producers, resulting in stable and reliable biofuel sources. This balancing role of an open market and trade is a crucial precondition for developing biofuel production capacities worldwide

Liquid biofuels was around 1-2% of global transport fuels in 2005 and currently supply 4% of global transport. The potential exists to significantly increase this share in coming decades. But, substantially displacing petroleum fuels will only happen with strong and credible drivers.

The conclusion of the European Council to establish a 10% biofuels target in 2020 for the EU was made “subject to production being sustainable, second-generation biofuels becoming commercially available and the Fuel Quality Directive being amended accordingly to allow for adequate levels of blending”. This therefore seems appropriate.

A key question is how to ensure that production will indeed be sustainable. One answer currently being explored intensively is to certify the conformity of biofuels with minimum environmental and social standards on a life-cycle basis

Second generation biofuels are those, which utilize ligno-cellulosic biomass, the most abundant source of renewable carbon on our planet.



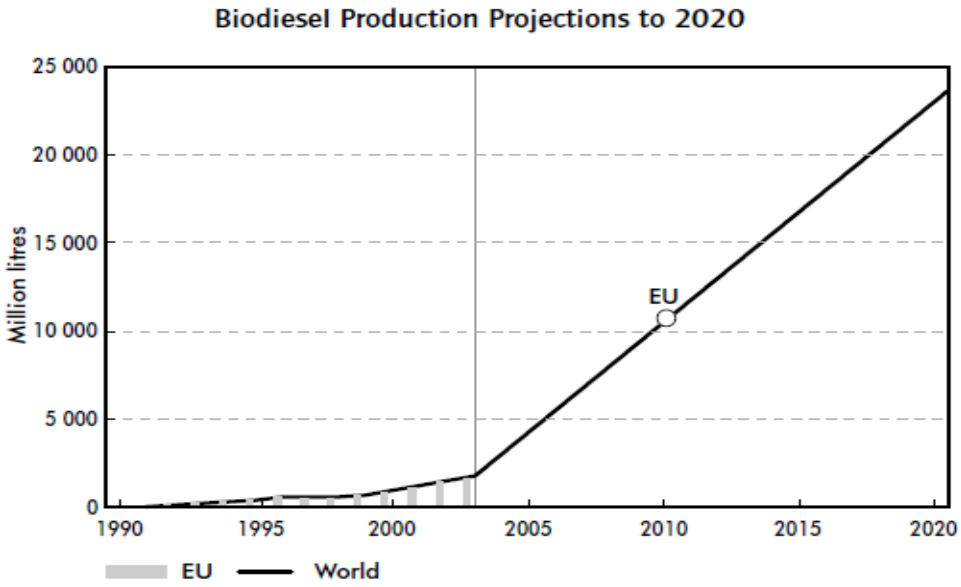
Source: www.wip-munich.de

The relative share of biofuels could be increased if a range of demand-side efficiency measures effectively reduce total fuel demand growth in the transport sector.

Commercial biofuels markets could become a major factor in raising the economic viability of rural enterprises, especially in developing countries. Increased investment in infrastructure for biofuels processing, distribution and transport would also result. At least some of this infrastructure will also contribute to the overall development of the agricultural sector

"Second generation" biofuels technologies produced from non-food ligno-cellulosic feedstock's are expected to become commercially viable on large scale, and hold considerable promise, compared to "first generation" biofuels, particularly for expanding the energy base and providing significant GHG emission reductions.

The demand side of the transport fuel problem should receive proportionally more attention than the supply side. If historical trends were to continue, annual growth rates in the future would be about 7% for Europe, 2.5% for North America and Brazil, and 2.3% for the whole world. This would lead to a global increase from about 30 billion litres in 2003 to over 40 billion by 2020. However, given recent policy initiatives and changes in trends, a very different picture could emerge: a quadrupling of world production to over 120 billion litres by 2020.



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Bioenergy encompasses a chain of technologies from the production of biomass in a sustainable manner, meaning cultivation, harvesting, transportation, storage and eventually pre-treatment before use in a conversion process to produce the final energy, biofuels or chemical feedstock. While many technologies in use are quite mature, there is still considerable work to ensure that a minimum sustainability threshold is exceeded. Combined production of heat and electricity (CHP) is moving to wide commercial exploitation in co firing systems with fossil fuels, particularly coal, while efficiency and scale of operation in purely biomass fired systems still needs some development before optimum efficiencies may be achieved. Production of biofuels from ligno-cellulosic biomass is only at the pilot scale, although demonstration projects will be on line by 2015. Biorefineries are some way behind ligno-cellulosic biofuels production and are unlikely to be fully demonstrated by 2015. Cost of investment is steadily being reduced for all bioenergy systems. Only approximate figures for ligno-cellulosic biofuels production can be given in the absence of large-scale demonstration performance data. With the exception of biomass co-firing in fossil power plants and biogas production from agricultural residues, all other technologies still require considerable research and development

A recent FAO report on food security concluded that there is enough land to accommodate additional food crops and biomass production to be transformed in biofuels. A similar conclusion was reached by a report

prepared by the European Environmental Agency. José Graziano da Silva, FAO's representative for Latin America has commented that the real problem is not arithmetic but social. In most cases, as already mentioned, people are not hungry on account of food scarcity, but because they lack purchasing power to buy food. There are at least five ways to reduce the competition for scarce agricultural land between biofuels and food crops:

- By concentrating the production of biomass for biofuels on waste and deforested land, leaving prime agricultural land to food crops;
- By promoting integrated food-energy systems (integration of biofuels production with dairy cattle, crop association and crop rotation, agro-forestry systems) which result in higher global yields per hectare and release pastures for crop production; 47
- By shifting, as quickly as possible, to second generation cellulosic biofuels, produced from non-edible parts of food crops, forest residues, wild grasses, tree crops, animal fat and all sorts of green residues;
- By promoting further increases in yields per hectare of both food and biofuel crops, resorting to agro-ecological practices predicated on the concept of 'evergreen revolution' 48 seeking knowledge and labor-intensive, yet land, water and capital saving production functions accessible to small farmers, and characterized by low fossil energy inputs;
- Finally, by supporting research aimed at identifying new oil producing plants (with special reference to different very promising kinds of palm trees), improving the productivity of the biofuels crops already in use and expanding the spectrum of biofuels.

Boeing and NASA are sponsoring research on biokerosene derived from babaçu nuts carried out by Professor Expedito Parente from Fortaleza, Brazil, a distinguished scientist who runs a successful biodiesel industry Tecbio. Parente used biokerosene in a plane in 1984, but no attention was given to his discovery until 2005, when he received the Blue Sky Award at a UN conference. According to G. Bisignani, Director General of IATA, aviation today is only responsible for 2 percent of global CO2 emissions with a total climate change impact of 3 percent. Projections for 2050 speak of 3 percent of global CO2 emissions with a total climate change impact of 5 to 6 per cent. With 28 per cent of costs coming directly from fuel, the airline industry has a strong incentive to keep fuel consumption low. Airlines are investing heavily in more fuel-efficient aircrafts. In the last 40 years, fuel efficiency increased by 70 percent and will improve another 25 per cent by 2020. Biofuels are part of the game.

Producing biofuels is thus only a part of a comprehensive energy strategy. The addition of ethanol to gasoline and of biodiesel to diesel can reduce the consumption of oil-based liquid fuels in the near term and for assisting in the reduction of exclusive dependency on oil-based liquid fuels at a later date.

The coming of age of biofuels is happening against the background of growing awareness of the urgent need for changing the present unsustainable pattern of energy use, characterized by a profligate (mis)use of abundant and cheap fossil fuels. It is helped by the recent sharp increase in oil prices. With oil barrel traded at 70 to 90 dollars, some biofuels become competitive. Furthermore, the imminent 'oil peak' is likely to keep the oil prices fairly high.

This brings us to the second generation biofuels such as cellulosic ethanol, that can be processed from lignocelluloses, using the inedible parts of food crops, wild grasses, forest residues, and trees.

Different industrial processes are being explored: enzymatic hydrolysis, thermochemical fuels obtained via gasification (Fisher-Tropsch liquidds, methanol, MTBE, gasoline, dimethyl ether, mixed alcohols, hydrogen), hydrothermal upgrading oils and pyrolysis oils. The first industrial plants are being set-up and it is hoped that within a few years some cellulosic biofuels will be brought to the market cost-effectively, significantly reducing, if not eliminating altogether, the conflict for land with food crops.

At the same time, research is being conducted on biofuel from power plant CO_2. At the heart of the technology is a plastic cylinder full of algae, which literally sucks the CO_2 out of a power plant's exhaust. The algae can in turn be converted into biofuel.

3. Risks and opportunities

Beyond energy security reasons, the main interest of biofuels as opposed to petroleum products thus lies in the reduction of CO_2 emission, and consequently air pollution. While burning gasoline is a net CO_2 emissions, burning bioethanol results in emitting CO_2 which was previously captured by the plants.

Biofuels aim to be carbon neutral, that is, to provide a zero sum balance between the carbon release generated by the burning of the fuel and the carbon absorption provided by the growing of the plant which will be used for the production of fuel.

Two key benefits of biofuels for transport are global in nature: oil savings and greenhouse gas emissions reduction. In both cases, reductions occurring in one country can provide global benefits. With oil savings, reductions, in global demand for petroleum could lower world oil prices and improve security of supply. Greenhouse gases have roughly the same impact on the global climate wherever they are emitted.

For more than a hundred years we have been living in an oil-age, which is now being put on check. According to many geologists, production of oil will soon reach its peak, and will be declining afterwards. The newly discovered reserves of oil do not match the current demand prospects; hence the trend towards depletion and higher prices. These high prices and projected shortages make biofuels increasingly competitive.

The question of how to organize an orderly transition from the oil-age to the post oil-age and how to cope with the volatile and often explosive geopolitics of oil will certainly dominate the international scene throughout the 21st century.

Biofuels production potential can be compared to projections of transport fuel demand, to determine the share of biofuels in total transport fuels, and how this may vary by region. Regions where the potential to produce biofuels is high relative to expected transport fuel demand may be interested in exporting biofuels to regions in the opposite situation.

Total production of biodiesel in EU-27 for 2010 was over 21.9 million metric tons, an increase of 384.21% from 2007 figures.

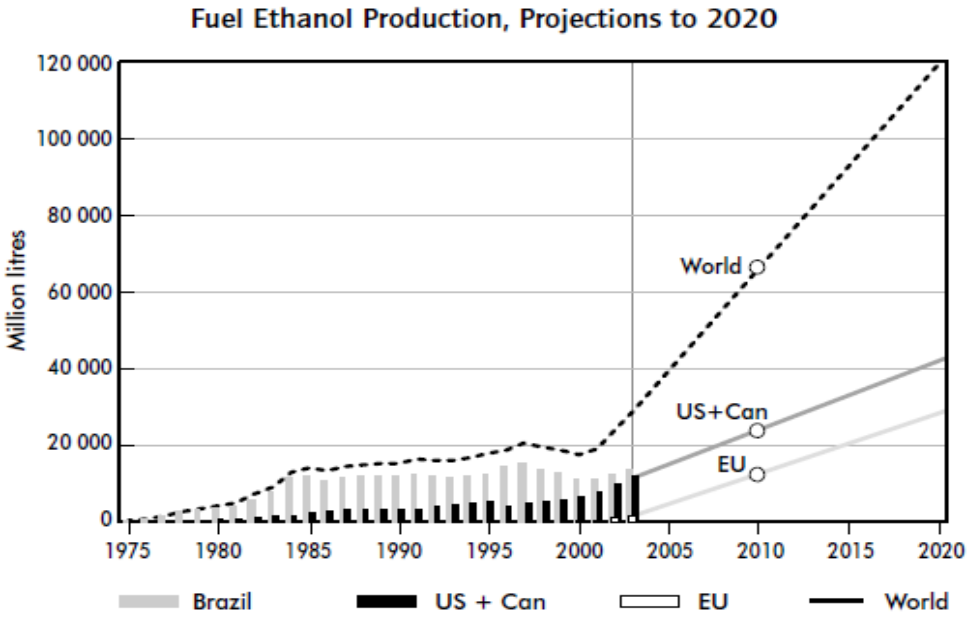
2010 Production Capacity

COUNTRY	'000 TONNES*
Austria	560
Belgium	670
Bulgaria	425
Cyprus	20
Czech Republic	427
Denmark	250
Estonia	135
Finland*	340
France	2,505
Germany	4,933

Greece	662
Hungary	158
Ireland*	76
Italy*	2,375
Latvia	156
Lithuania	147
Luxemburg	0
Malta	5
The Netherlands	1,036
Poland	710
Portugal	468
Romania	307
Slovakia	156
Slovenia	105
Spain	4,100
Sweden	212
UK	609
TOTAL	**21,904**
Calculation based on 330 working days per year, per plant. The above figures represent an overall picture of the EU-27 biodiesel capacity on July 1, 2009.	

Source: http://epp.eurostat.ec.europa.eu/statistics.

Reliable information on cropland and conversion efficiencies is needed to estimate the potential for global biofuels production. Optimally, one would need to know on what type of land various feedstocks can be grown and how much of that land is available, after taking into account various other required uses for that land. It would also be useful to know the extent to which these feedstocks could be dedicated to biofuels production (as opposed to food, clothing and other materials production, and production of other types of energy such as electricity) and the efficiency of biofuels production per unit land area (taking into account crop production efficiency and biofuels conversion efficiency).



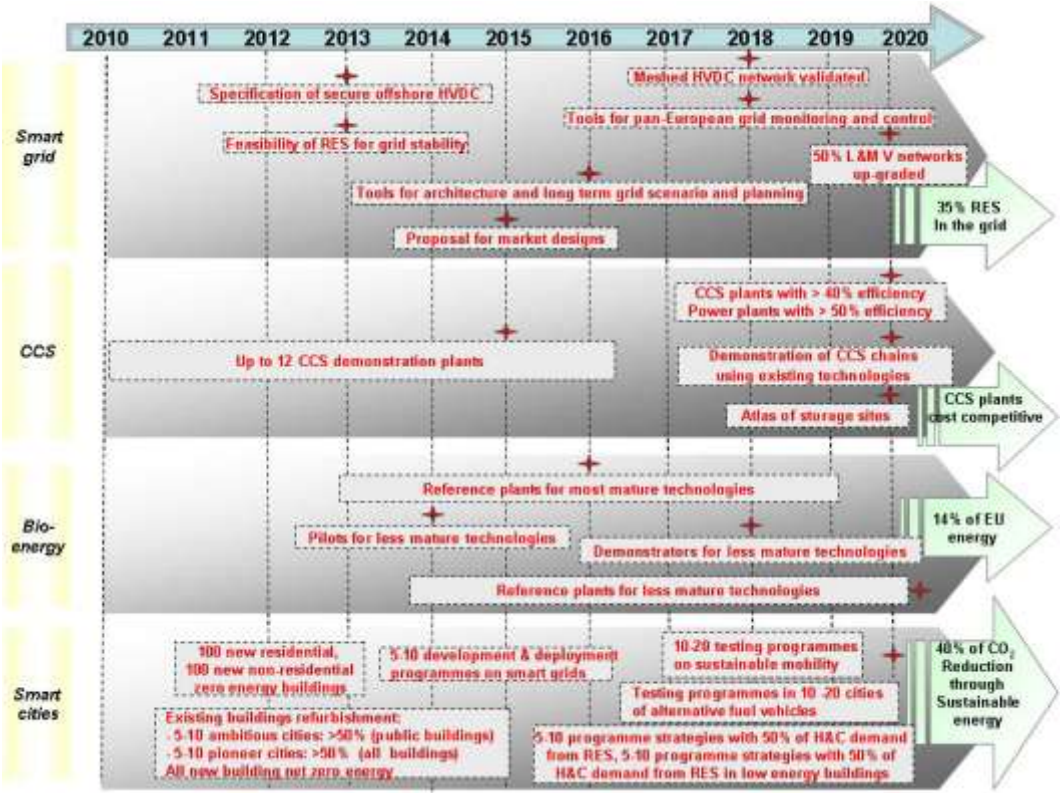
Source: http://epp.eurostat.ec.europa.eu/statistics.

The EII proposes to carry out an ambitious demonstration programmed of different bio-energy pathways at a scale appropriate to the level of their maturity – pilot plants, pre-commercial demonstration or full industrial scale. Up to about 30 such plants will be built and operated across Europe to take full account of differing geographical and climate conditions and logistical constraints. A longer term research programme will support the bio-energy industry development beyond 2020. The cost of such a European programmed is estimated at €9 billion over the next ten years.

The expansion of biofuels production should rest on four pillars:

- innovation,
- capacity expansion,
- infrastructure;
- building of a global market.

It is suggested that a fifth pillar is equally relevant: biofuels production should be predicated on institutional settings and production models capable of inducing a new cycle of rural development, aimed at creating a fair amount of opportunities for decent work. These would include the production and processing of biomass for fuel, productive uses of by-products and waste, as well as technical services and transport. As for innovations required, they ought to be knowledge and labour intensive, yet land, water and capital saving.



Source: http://epp.eurostat.ec.europa.eu/statistics.

To ensure at least 10% biofuels in the EU energy mix by 2020, and at the same time to guarantee GHG emission savings of 60% for bio-fuels and bio-liquids under the sustainability criteria it's necessary to bring to commercial maturity the currently most promising technologies and value-chains through the development and optimization of feedstock-flexible thermo chemical pathways and biochemical pathways, in order to promote large-scale, sustainable production of advanced biofuels and highly efficient heat & power from biomass. This will require scaling up and optimization of process integration, with focus on the improvement of feedstock flexibility, energy and carbon efficiency, capex efficiency, reliability and maintenance of plants; to contribute to a set of activities in the field of biomass feedstock availability assessment, production, management and harvesting in support of the up-scaling of promising technologies. Biomass availability, production and harvesting are not specific to the bio energy use of biomass and are to be addressed in a coherent effort shared with relevant stakeholders and initiatives and to develop a longer term R&D programme to support the Bio energy industry development beyond 2020.

Optimization of the most promising value chains within thermo-chemical (characterized by the use of high temperature transformations) and biochemical (characterized by the use of biological and chemical processes) pathways. Several technology options have shown promising performances at pilot scale, these calls for a collaborative programme of demonstration and first-of-this-kind industrial-size plants depending on the level of maturity of each specific value chain.

Activities will include the optimized use of advanced catalysts and the improvement of gas cleaning technologies and quality/stability of bioliquids.

Production of synthesis gas (syngas) as an intermediary to create liquid fuels (e.g. gasoline, naphtha, kerosene or diesel fuel) and chemicals; production of bio-methane and other bio-synthetics gaseous fuels through gasification; optimization of syngas combustion to produce heat and electrical power; optimization of the production of bio energy carriers such as bio-oil and solid intermediates; co-processing of biomass and bio-energy carriers with petroleum oil.

Within the biochemical pathways, the following three value chains will be optimized for the production of gas and liquids from biomass, including the optimization of feedstock pre-treatment and downstream processing and the optimized use of advanced enzymes, ensuring the optimum production of valuable co-products where possible.

While increased crop demand may trigger an increase in crop prices, as well as in other related markets, there are also important potential "macro" benefits from increasing the domestic production of biofuels.

The full benefits are difficult to measure, requiring general equilibrium modelling and assumptions regarding the costs and risks of oil import dependence, such as the risk of supply disruption or sudden spikes in prices.

Biofuels production in developing countries can also have a positive impact on agricultural labour employment and rural development, particularly when conversion facilities are smaller-scale and are located near crop sources in rural districts. In Brazil for example, it is estimated that 700 000 jobs have been created in rural areas to support the additional sugar cane and bioethanol industry. The development of multi-product "bio refineries" could further spur the development of related secondary Industries. In addition to employment benefits, domestic biofuels production enhances the security of national energy supply and improves the balance of trade, since many countries spend large percentages of their foreign currency reserves on oil imports.

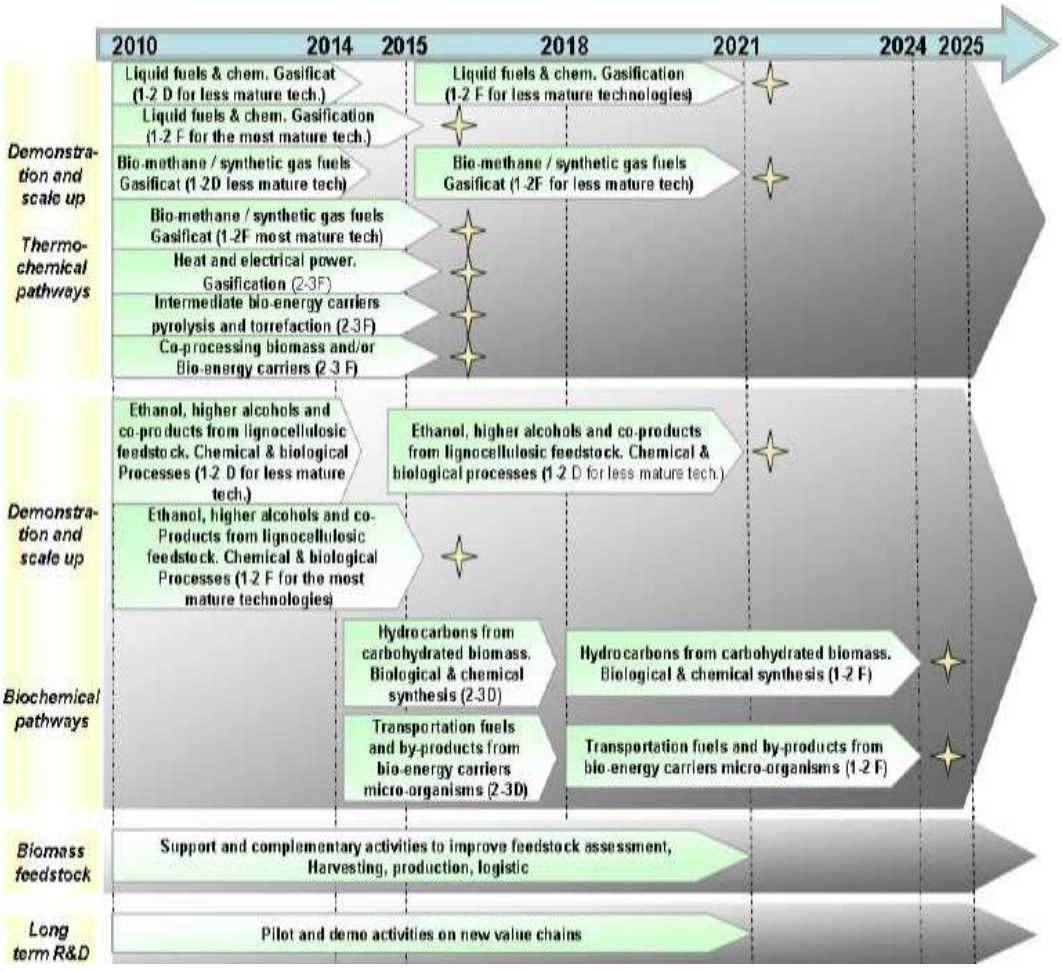
The potential economic benefits from developing biofuels must be weighed against the costs of producing the biofuels, and the negative economic impact these higher costs have on government budgets and economic growth. Such effects must be carefully assessed before the broader macroeconomic benefits are used as justification for biofuels production.

Biofuels production

– Biofuel production cost < 0.6 € /litre gasoline equivalent

– Capital investment and operation costs in line with fossil industry refinery costs

Indicative costs (2010-2020).



Source: http://epp.eurostat.ec.europa.eu/statistics.

4. Conclusions

Biofuels may well play a part in expanding the range of energy sources available in the future. The extent of their penetration will be limited by the opportunity cost of biofuels feedstock's being applied to competing end uses, and the extent to which second-generation technologies can significantly lower the costs of production.

Organizing the international markets for biofuels by:

• fostering the dialogue among all the stakeholders for an orderly transition from the oil age to a less carbon intensive era;

• developing guidelines for long term contracts between producers and consumers of biofuels, with special reference to cooperatives acting on both sides (fair trade);

• promoting non-discriminatory social and environmental certification at the international level; and

• simplifying the procedures for the emission of in accessing carbon credits linked with carbon reductions achieved with biofuels projects.

Finally, steps must be taken for the organization of the emerging international markets of ethanol and biodiesel. The world economy is entering a long transition from the oil to the post-oil age, likely to extend itself for many decades. All the efforts ought to be made to make it as orderly as possible, seeking the cooperation of all the protagonists, including oil producers.

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THE ECONOMIC IMPACT OF INTRODUCING OF THE INFORMATION AND COMMUNICATION TECHNOLOGY UPON THE RAILWAY TRANSPORT IN ROMANIA

Mariana BĂLAN, CS II[*], Gheorghe-Stelian BĂLAN[**]

Abstract. *The technological progress over the past decades allowed for the emergence of new multimedia services and telematic applications. The development of new means of communication and information technology is an important factor for increasing the economic agents' competitiveness, opening new perspectives for a better organization of work and for creating new jobs.*

Transports are a key of success in achieving the single market in the European Union, because they contribute to concretize two of its fundamental objectives: free movement of persons and free movement of goods. Among the existing transport modes, the railway transport is still of great interest due to certain benefits arising from the fact that it is the least polluting and the most environmentally friendly.

The Intelligent Transport Systems require the application of information and communication technologies (ICT) in transport. The railway networks are gradually introducing the European system of railway traffic management (European Rail Traffic Management System – ERTMS) and telematic applications for freight transport (Telematic Applications for Freight – TAF). The aims of implementing the ERTMS are to replace the national command and control systems for trains, to create a unitary European railway system and to increase the competitiveness of the European railways.

The paper proposes a brief analysis of the economic implications of implementing the information and telecommunications technology in the Romanian railway transport. It analyzes the economic benefits arising from the capacity and performance improvement, but also from the reduction in re-signaling costs. The increase in the number of passengers carried by railway will require increase in the number of trains, and in train service costs, but they are assumed in estimating the benefits of ERTMS deployment. Economic benefits from ERTMS implementation are also arising for the railway users by cutting the crowding and delays, as well as for the road users by taking over a part of the passenger/freight transported by road.

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Keywords: *economic impact, ICT in Romanian railways transport, economic benefits from ERTMS implementation, JEL Classification: L16, L62, L63, L92, L96.*

1. Introduction

Transport is one of the keys for achieving success in the EU Single Market, as it contributes to the realization of two of its fundamental objectives: the free movement of persons and free movement of goods.

Among today's existing transport modes, rail transportation remains of great interest because of certain advantages which derive from the fact that it is the least polluting and more environmentally friendly. These are just some of the reasons why, in recent years by the European Union try to develop strategies and implement programs to revive rail transport in the Community and to attract increased traffic to this type of transport.

The European Union advocates the exploitation of existing infrastructure and transport more environmentally friendly. Ensuring environmental sustainability of European transport and energy is a goal that can not be attained only by combining several policies that support and complement each other and involving a growing number of actors, representatives of the transport sector, the government and public citizens.

Since transport is a complex system that depends on multiple factors, including patterns of human settlements and consumption, the organization of production and facilities available for intervention in this sector must be based on a long term vision on mobility sustainable for people and property.

European Economic and Social Committee believes that competitive transport, reliable, cost-effective fluid and a prerequisite for economic prosperity of Europe and the free movement of persons and goods is one of the fundamental freedoms of the European Union. In this context, transport should contribute greatly to achieving the objectives of Strategy 2020.

Advanced information and communication technologies can contribute significantly to achieving competitive and reliable transport, improving infrastructure, traffic and fleet, by facilitating better monitoring and traceability of assets along the transmission and print better networking of enterprises and administrations.

2. Rail transport in the European Union

Transport is an essential component of the European economy, generating about 7% of GDP and more than 5% of total employments in

the EU. European Transport Policy (ETP) has contributed to a comparable mobility system, the efficiency and effectiveness with those of the regions most economically advanced in the world. Also, ETP has stimulated economic and social cohesion and promoting competitiveness of European industry, thus contributing to a significant extent, the implementation of the Lisbon Agenda for growth and jobs [11-12].

European Community is seeking to create conditions for improving the railway sector and its adaptation to the requirements of the Single Market. In this respect, proposed the introduction of an operating license to provide uniform access to infrastructure and established a system for the allocation of infrastructure capacity on a non-discriminatory basis, users paying the actual cost of the facilities they use.

Rail transport in Europe registered an alarming decline in recent decades, particularly in freight transportation. The share of rail freight declined from 32.6% in 1970 (EU-15) to 10.7% in 2007 in the EU-27. In absolute terms, taking into account the quantity of goods carried and distance flown, rail freight activity (EU-15) fell between 1970 and 2006, about 1%, while road freight grew by more than three times in the same period.

As regard the passenger rail traffic, it also decreased, but not as dramatically (in 1970 (EU-15), the share of passenger rail travel was over 10%, but decreased to 6.1 % in 2007 in the EU-27). The main cause of this situation is that the rail sector is not as competitive as a road.

Rail transport is less safe than the road in terms of delivery, which are less predictable for railways. In the recent years, one some international routes, terms of delivery (very important for many sectors) have doubled or even tripled. This is mainly caused by very long stops along the way, because other trains (especially passenger service) have priority and border procedures are complicated (train crews and locomotives must be changed due to differences in signalling and traction systems from one country to another etc.).

However, Railways have unique advantages: a safe and clean transport's mode and a train can carry the load of 50-60 trucks. Rail infrastructure covers much territory and is generally in good condition, but no longer matches with the customer requirements.

In the last fifteen years, the European Community has developed a rail policy designed to create a new dynamics for this sector and halting the decline of rail freight transport in relation to the road, to build a solid single market, based on a sustainable transport system. In this context and actions are part of the freight market opening from 2007 and identification of

priority axes eligible for Community support, both in financial terms (was created a budget for achieving trans-European Transport Network (TEN-T) 8 billion for 2007-2013, much of this amount being for rail infrastructure) and in terms of coordination among the various Member States crossed by each axis.

Internationally, the rail freight faces three major difficulties:

i) the slowing of traffic on the bottlenecks (generally near urban agglomerations);

ii) loss of time at border crossings due to administrative or technical duties;

iii) the terms of access to rail services (terminals, sorting stations). These difficulties significantly affect the average commercial speed and can be considered the same constraints that are affecting the infrastructure, limited capacity and reliability of freight.

2.1. Intelligent Transport Systems in rail transport

Technological innovation will be a major contributor to the solution of the transport problems. Rail traffic management systems can optimize network utilization and improve safety [4].

"Intelligent Transport Systems" require the application of TIC in transport. These applications are developed for different modes of transport, but also to promote interaction between them (including hubs).

If air transport, SESAR will be the framework for implementation of a new generation air traffic management systems, and hinterland waterways are the River information services are available (RIS) for managing the use of waterways and freight and passengers transport, inside the railway network is gradually introducing the European Rail Traffic Management System (European Rail Traffic Management System – ERTMS) and telematics applications for freight (Telematic Applications for Freight-TAF).

The European rail transport management ERTMS is a major industrial project developed by six members of the association UNIFEM (the Association of the European Rail Industry): Alstom Transport, Ansaldo STS, Bombardier Transportation, Invensys Rail Group, Siemens Mobility and Thales, in close cooperation with EU bodies concerned with rail and GSM-R industry.

ERTMS system has two basic components (ETCS + GSM-R = ERTMS);

ETCS – European Train Control System, which is the system of automatic train protection (ATP Automatic Train Protection System), used to replace existing national ATP systems;

GSM-R – radio system for providing voice and data communications between rail and train based on the GSM standard that uses special frequencies reserved for railway applications, with specific and advanced functions.

The purpose of the ERTMS system implementing is to replace the national command and control systems for trains and creating a single European rail system that leads to increased competitiveness of European railway.

Currently, in the European Union there are more than 20 train control systems. Each train used by the national railway company must be equipped with at least one system, but sometimes more, so that traffic can be safely held in that country.

Each system is independently and non-interoperable, and thus require extensive integration, engineering effort and increasing total cost of delivery for cross-border traffic. This is but an obstacle to the competitiveness of European rail compared with road transport, creating technical barriers to international travel. For example, Thalys speed trains running between Paris-Brussels-Cologne and Amsterdam, must be equipped with seven different types of train control systems, which involve significant costs.

As a unique European Train Control System, ERTMS is designed to replace the existing systems compatible throughout Europe. This will bring considerable benefits for the rail sector, which will lead to the strengthening of international freight and passengers transport.

Also, ERTMS is the most powerful train control system existing in the world and brings significant advantages in terms of maintenance costs, safety, reliability, punctuality and traffic capacity. This explains the fact that ERTMS is increasingly used outside of Europe and becomes the train control system in countries like China, India, Taiwan, South Korea and Saudi Arabia.

ERTMS contribute, thus increasing the competitiveness of rail, which makes this system can compete with other modes of transport such as road.

ERTMS system will enable interoperability across the European railway network.

Compatible across Europe, ERTMS allows the creation of a single rail system, allowing, for example, trains running from Barcelona to Warsaw

would no longer be faced with technical problems related to specific signals that go through each area.

ERTMS also presents other advantages. Designed to implement the trains with the best control systems in the world, so the system brings considerable benefits in addition to interoperability, including:

- increase capacity of existing lines through strict management of the intervals between trains and the ability to cope with rising demand for transport;
- achieve higher speeds: ERTMS allows a maximum movement speed to 500 km/h;
- achieve higher reliability rates: ERTMS can significantly increase the reliability and punctuality, which are essential both for passengers and for freight transport;
- reducing production costs: as a harmonized system is easier to install and maintain and manufacture of railway systems become more competitive;
- obtaining low maintenance costs;
- creating an open market offer: customers will be able to purchase equipments for installation anywhere in Europe and all providers will be able to bid for any opportunity. Railway lines and equipment on board can be purchased from any of the six ERTMS suppliers, which makes the supply market become more competitive;
- reduced supply contracts as a result of significant reduction in process engineering;
- simplifying the approval and certification process in Europe, which has greatly reduced the costs associated, traditionally, to the introduction of new systems;
- improve the safety of passengers, employees and freight.

Economic considerations for the implementation of ERTMS system derives from three main reasons:

- increase rail capacity and performance by taking a volume of passenger and freight transport by road, thus eliminating bottlenecks, reducing at the same time, the complexity of track systems and costs caused by road accidents and traffic delays;
- Interoperability, which will allow trains to operate safely and effectively in control systems supplied in part or whole by different companies. This leads to greater mobility for trains across Europe and beyond, the competitive procurement;

- Safety-ERTMS is a system that provides automatic train protection, reduce the incidence and consequences of signals passed at danger (SPADs). Even if the installation of Protection and Prevention System for trains (Train Protection and Warning System-TPWS) significantly mitigates risk by implementing ERTMS system to, it provides an additional signal in the train cab, which is an important step forward for train drivers, especially at high speeds in bad weather. ERTMS is actually a requirement for trains to travel at 200 km/h. This is a safety requirement, but ERTMS also allows obtain commercial benefits in this area. Higher levels of ERTMS will facilitate better management of "possession" for track work and track requires less infrastructure, leading to reduced risks for workers in this sector.

The assessment of the investment required to implement ERTMS, requires consideration of the following objectives:

- Economical – to identify the optimal solution for the implementation of ERTMS, cost-benefit analysis and, especially the economic benefits of the capacity and improve performance and reduce costs by re-flashing. Increasing the number of passengers transported by train will require increase in number of trains, with train service costs, but they are assumed in estimating the benefits of ERTMS implementation. Economic benefits through the implementation of ERTMS are for rail users by cutting settlement time (crowding) and delays, and benefits to road users by taking on the part of rail passengers/cargo to be transported by road [6-8].
- Compliance with EC directives on interoperability [2-3];
- Safety – a means of providing more ATP to reduce the incidence and consequences of signals passed at danger (SPADs).

3. Rail transport in Romania

Romania now has a national transport system (infrastructure, vehicles, carriers etc.) situated largely in terms of both functional structure and the services rendered to media standards conventional transport systems in Europe, able to cope the current needs of domestic and international users.

Overall, the network of public transport infrastructure (roads, railways, waterways, fairways, sea and river ports, airports) ensure achievement of all localities in the country connected to the national transport and international transport systems.

Although major changes made so far, the transport system in Romania is still indebted "the old" system has been designed and built. Restructuring it in a manner required by the principles of the common transport policy takes time, resources and "amputations" sometimes very painful.

Romania's location at the intersection of numerous roads connecting Western and Eastern Europe as the North and South Europe and transit country location on routes between Europe and Asia, is a benchmark for determining transport policy.

Romanian Railways have a duty to integrate national railway infrastructure in the technical and operational parameters of European standard to be compatible and interoperable part of the future Trans-European railway network.

Interoperability of the conventional rail network (TEN-T and TEN-T out) with the European rail network will be achieved by placing in the track and rolling stock engine board the elements necessary surveillance system ETCS, upgrading of railway stations centralization through the introduction of electronic railway interlocking, developing the information system for all railway stations located on interoperable rail network in Romania, the development of the telecommunications network to provide data transmission support and implementation of railway information systems in all railway stations located on the interoperable railway infrastructure in Romania, the implementation of the National Centre for centralized control of rail traffic in Romania, retrofitting energy-supply facilities of the contact line.

These actions will lead to better market coverage and better transport accessibility to major transportation routes for passengers through their interconnection to the regional services and increased passenger wagon's load on the main and regional routes.

3.1. Implementation of ERTMS / ETCS in Romania and the economic effects generated by this

Develop national plan for implementation in Romania of the system ERTMS / ETCS started from the strategy in signalling, based on current features and future upgrades, the allocated funds for this area [1].

Thus, for large stations was considered necessary to introduce electronic interlocking installations (W-SIEMENS SIMIS types and L90 ESTW EN-ALCATEL compatible for connecting in the system ERTMS /

ETCS), and for small stations have developed two variants of computerization of operating stations of the electrodynamics centralized facilities (CED).

Because the equipment developments is more spectacular, and the pressure to reduce maintenance costs is more powerful, National Railway Company CFR SA has included in its strategy an project of an electronic interlocking equipment for small and medium-sized stations [9]. Through this project are kept outside upgraded equipment (point machine, signals, track circuits, installation of automatic signalling level crossings), relays interfaces for external elements and other subsystems, respectively automatic line block (BLA), barrier automatic level crossing (BAT), signal level crossing without automatic half-barriers (SAT) etc., but they replaced the logic of the contact safety relay with safety logic based computing. In this way, performing a hybrid system that benefits facilities for electronic interlocking equipment, but kept outside equipments of the station, reducing in turn the large proportion that the number of relays and maintenance costs.

Implementation of ERTMS/ETCS is based on a range of specific requirements of each railway administration, for Romania requirements can be classified as:

- higher requirements, covering essential needs for the ERTMS / ETCS system;
- operational requirements, which describe the necessity of ERTMS / ETCS in terms of operations that are performed on the railway;
- functional requirements of the system ERTMS / ETCS system;

Among the requirements imposed centralize facilities in Romania may be mentioned:

- general requirements: the facility must ensure interlocking/locked the reciprocal of points and signals;
- particular requirements of the electronic interlocking plant: are those governing the safety philosophy of the Romanian railways.

Regarding the introduction of ETCS train protection type, Romania has opted for ETCS Level 1 on the Bucharest Nord-Ploiesti West, ETCS Level 2 on the Bucharest Nord-Constanta facility while maintaining point control of train speed (INDUSI).

Within the concept of transition from national INDUSI to ETCS level 1, the system keeps in track and INDUSI for freight and passenger trains that are not equipped with ETCS.

For reasons of cost and given the size of railway stations, in Romania shall be equipped with ETCS, the first stage, only the direct lines stations and the BLA blocks.

The introduction of ETCS Level 1 provides a number of important advantages: interoperability, increase safety, increases the comfort of the passenger transport by optimizing braking, power consumption reduction of specific thrust, reducing brake wear.

The selected configuration option must be a balance between costs and increased safety performance and availability.

Modular design of the system hardware and software, combined with the media through standardized protocols, allows economic adaptation to changing circumstances, so that modules can be placed next to each other to form an integrated solution.

The system allows the integration of new features by adding software or hardware modules, thus allowing the extension in line with growing needs, without sacrificing the original investment.

Important advantages related to the implementation of electronic interlocking installations are:

- achievement of all possible paths of movement and manoeuvres for a given configuration of the station, which gives greater flexibility traffic management;
- providing opportunities for changes and adjustments during operation, without requiring significant time period in which the system is turned off;
- increase the safety of rail traffic;
- ensure a maximum level of the installation reliability, to allow, thus reducing maintenance activity and costs;
- effective preventive and corrective maintenance activities by assisting computer, including the functions of diagnosis and fault location;
- decrease in operating costs by reducing the system components that require periodic adjustments, such as relays;
- technical support for the development of rail traffic management by incorporating centralized facility as a subsystem in ERTMS / ETCS.

3.2. Other's implementation of TIC in the Romanian railway transport and economic implications arising from this

As a result of the project "Modernization of the SNCFR telecommunications systems", financed from BIRD loan (36.7 million USD), and in

addition the state budget through the Ministry of Transport (21.9 million USD) were made:

i) installation in the cadastral area of railway of 3530 km of 20 single-mode optical fibre cables and extensions;
ii) synchronous digital transmission network, structurally organized in five rings and seven branches;
iii) the provision to users, large data transmission capacity ranging from 155 Mbit/s and 2.5 Gbit/s and lower transport capacity data between 64 kbit/s and 34 Mbit/s, on the 550 access points in railway stations;
iv) integrated service network that includes 224 digital telephone exchanges, 40 knots international switching and switching node;
v) asynchronous digital transmission network based on ATM switches, with data transmission speeds of 622 Mbit/s network backbone providing railway information systems;
vi) network synchronization, which is based on a clock generated by the Cesium atomic clock and 8 GPS points located in major railway hubs;
vii) videoconference network that connects the eight regional offices, located in the Palace CFR and conference room complex Snagov.

Offer variety of railway telecommunications services allows user's easy access to new communications technologies found in constant development in asynchronous transmission network (ATM) and network synchronization, which is, technically speaking, among the most successful networks in Europe.

The upgrading of rail communications program has included and integrated project of information technology for operations management in Romanian Railways-IRIS [5].

The IRIS (Integrated Railway Information System) is a component of the Railway Rehabilitation Program funded by the BIRD, the latter wishing to increase the competitiveness of the Romanian railways system in the context of free access to European railways.

The main objectives of the project were to optimize and automate a number of key activities in rail and construction of an information infrastructure capable to supporting further development. The first phase of the IRIS project, designed to cover the applications and information systems vital activities of the entire railway system was completed in 2003 and included four major components: the application of railway infrastructure management, application management of railway vehicles;

application freight transport management, application for monitoring the movement of trains.

Thus, IRIS provides an integrated solution for information technology, including advanced hardware for databases and software applications, connected into a national network with two levels – WAN and LAN.

In Romania, IRIS-RSMA –Rolling Stock Management application is already implemented in 14 pilot locations in the area, and of these, it is only operational in seven locations SNTF Passengers and three locations C.F.R. Freight.

For timetable planning it use solution IRIS-ATLAS. This allows you to create train paths and a program of movement. Existing paths are shown, as highlighted opportunities for the rapid creation of some additional paths for special trains.

Application for passenger and freight transport management IRIS-ARGUS contains records for all freight and passenger wagons, locomotives stationed, or which are in circulation on the track, including foreign cars entering/leaving the border stations.

For commercial freight subsystem was carried IRIS MERCURY application that allows creation and use of consignment notes for calculating tariffs and accessories due to transportation charges. It maintains constant data files on the stations, customers, costs, distances, etc. and the percentage of VAT applicable, that the amount of charges to be fully and correctly calculated in accordance with the conditions of transport.

XSELL project is an upgrade of the electronic sale of travel tickets and booking of seats on passenger trains. Implementation of the solution made by S.C. Railway Information S.A. offers a series of economic and procedural advantages for customers: it's cheaper than an imported solution, is already proven in service, specific requirements in Romania and works for any passenger rail carriers.

Among the advantages of implementing this system can be listed: the doubling of passenger ship, high quality service to passengers, fair pricing, secure booking, ticket issuing standardized on the European level, with clear information, financial management, safe and quick, a major reduction manual effort, to obtain various statistics that support effective decision making, modelling processes specific CFR, comfortable use, 100% availability, ensure security and confidentiality of data in the system.

Pilot system, installed in Bucharest North Station (SELL) since 1993, is an improved response to real business needs and existing technology processes developed with latest technology in the field. Hardware and software architecture provides an availability of over 99.3% of the system,

over 80% of tickets issued in Bucharest complex requiring an average serving time of an application for 40 seconds.

Since 2008, S.N.T.F. C.F.R. Travel S.A. started more purchasing programs for the coaches or the service of upgrading the fleet of cars to comply with the limits imposed by current transport requirements and Regulation (EC) no. 1371/2007 of the European Parliament on the rights and obligations of rail passengers transport [10].

Conclusions

Romanian railway system began to revive shy steps after the start of accession of Romania to the European Union, a process that continued more intensely after accession in order to align it with the standards of European railways. From the actual moment started the rehabilitation of the Romanian railway infrastructure.

As investment in infrastructure, the implementation of the EURO – Interlocking project was intended mainly to reduce costs of procuring, installing and commissioning related facilities.

Putting into use of three electronic interlocking systems in the Bucharest-Constanta section (implemented Dorobanțu, Saligny and Borcea stations) will bring CFR benefits of proven technologies, in accordance with international safety standards. The implemented solution allows C.F.R. to increase transport efficiency and to reduce transmission costs.

Implementation of ETCS – Level 1 in Romania decrease in operating costs by reducing the system components that require periodic adjustment, gives greater flexibility traffic management, increase safety of railway traffic, ensuring the highest level of reliability of the plant thus enabling reduction maintenance activity, but also preventive and corrective maintenance efficiency by assisting the computer, including the diagnosis functions and fault location;

All telecommunications networks and computer systems were expanded in 2004 with 1200 km, and in 2007 all railway lines, and thus interoperable rail network is Romanian.

Current dimensioning of telecommunications networks services digital railway but does not provide the necessary infrastructure entirely domestic rail operators and economic operators working in the railway field.

Development of transport infrastructure will play an important role in integrating the internal market and will help enhance the geographical position of Romania as a transit area, located at the intersection of

Pan-European Transport Corridor IV and Pan-European Transport Corridor IX. Romania's location at the intersection of numerous roads connecting Western Europe with the East, and North with the South, and location of the axes of transit country between Europe and Asia, is a benchmark for determining the strategic options development and modernization of transport infrastructure, the opportunity created by the Danube-Black Sea channel and the Danube, can play a key role in attracting international flows of goods, the relations between Europe and other continents.

Romanian Railways have a duty to integrate national railway infrastructure on the technical and operational parameters of European standard, to be compatible and interoperable part of the future Trans-European railway network.

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CONSIDERATIONS FOR COMPUTERIZED LOGISTIC SYSTEM IMPLEMENTATION

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Abstract. *In order to create and implement a computer-assisted logistic system, it is necessary to understand the basic elements of the method of organization and management of a computer-assisted logistic system, at the same time with the knowledge and application of useful techniques of investigation of logistic processes. After an organization defines its logistic strategy and determines its performance objectives for the entities to which it addresses (the markets it serves), the next stage is to develop the logistic systems necessary for the implementation of the strategy. Often, the existing systems require improvement or new systems need to be created.*

Keywords: *logistic system, computer, informatics, principles, management*.

1. Introduction

We mention from the very beginning that the aspects related to the organization of a project make the object of study of a distinctive subject – "Project Management". We will not get into details about the method of conception, carrying out, implementation and control of a project because it is not the objective of this chapter. In exchange, we will try to present the particularities of a project that aims at the creation of a logistic system (infrastructures) in a company/ organization.

In view of creating a computer-assisted logistic system, it is necessary to go through two stages:

– Designing the system;

– Creation/building the system.

Each stage has a certain period of time and a budget that should be allotted for this purpose (Swaminathan, J. M.; Smith, S. F.; Sadeh, N. M., 1998). From this point of view, the organization and management of the project must be accomplished so that the necessary work in each stage should be done in the context of integration in the limits of time and budget.

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2. Principles

There is a series of principles that has to be used to carry out a project. If these principles are consistently applied, the probability of success of the project is very high. If any of these principles is ignored (or is paid a lesser importance), special precaution measures must be taken to compensate it. If two or several principles are violated, it is almost certain that the project will fail. These principles are:

a. *Any project needs a leader that must be present all the time, with global responsibility and competent authority (Project Manager).*

There should be only one person responsible for the success of the project and focused entirely on the fulfilment of the missions. This person must also have the authority of making decisions and acting. It is best to have a coordination committee or a management supervision group to which the project manager reports, but such a committee cannot make decisions in due course. If there is no person in this role, then the progress and cost of the project will reflect it. The progress will be slow or inexistent and the costs will be high.

b. *Definition of a set of measurable objectives that should not overlap, they are necessary and sufficient to accomplish the objective or the mission of the project.*

It is essential that in the project the objectives are clearly defined so that the persons that were assigned the responsibility of achieving these objectives should know what is expected from them. It is very important that the limits of these objectives do not overlap because if they do, the overlapping will cause confusion and conflicts between the teams that are asked to achieve these overlapped objectives. Moreover, it is necessary to perform a careful analysis of the objectives proposed so that it is certain that each of them is absolutely necessary for the realization of the purpose of the project. You must not follow an objective only for the assumption that "it looks like a good idea". Eventually, you must get in the situation in which if every objective is achieved, then the mission was accomplished. The objectives must cover everything that is supposed to happen.

c. *Assigning the objectives of the project to teams of two to seven persons, with team leaders involved and holding the proper combination of technical and economic competences.*

In the carrying out of the project it is necessary to form a project team made of two to seven persons who, in the manager's opinion, have the

competence and the technical and economic experience necessary to tackle the problems that will appear in reaching the set objectives. A team is a group of persons with complementary competences, which organizes so that all the team members can contribute with their strengths without being underprivileged or without under-privileging the team by their weaknesses. Each team member focuses on the aspects related to the design and building of the logistic system at which they are good and/or in which they are the most interested. For most of them, nobody is obliged to do things in which he has no interest or at which he is not good. In a team, the operative word is "we" not "I". The whole team must be rewarded for success and takes the responsibility for mistakes. The highlighting of the heroes or scapegoats undermines the moral and performance of the team.

d. *The Manager has to tell the teams WHAT to do, not HOW to do it.*

During the carrying out of the project, the Project Manager has to guide the project team in the good direction, by offering them a well-defined project objective; the Project Manager also has to clearly identify the objectives of the project for which they are responsible. The objectives define the things they should do to have success. The purpose of the project and the objectives that are assigned to a team define the game that the manager wants the team to play. To support this principle, it is noteworthy to present the observation of General Patton, who said "tell the people what you want, but don't tell them how – and you will be surprised by their ingeniousness in the fulfilment of the tasks". The teams can make changes or additions to the given objectives, if the Project Manager agrees that the changed objectives are necessary and sufficient to realize the mission of the project.

e. *Division of the project activities in tasks for each week (or for a lower interval of time) based on which one can appreciate the degree of fulfilment of an objective every 30 or 90 days.*

The Project Manager must encourage the project teams to structure their plans within the project so that the individual tasks should be for a week or less. Each task must have a well established result. At the same time, the Project Manager must follow these tasks, whether they are at the beginning, are delayed or are concluded. What matters is if the result of the mission was produced and, if not, when it is produced. The Project Manager must be able to follow the progress of the task given at detail level in order to understand what is really going on and to hold

accurate time and cost forecasts until completion for each of the objectives of the project.

For the tasks for several weeks, the progress is more difficult to evaluate and they will cause excess of costs and confusion. The tasks for several weeks, reported by the completion percentage method, usually seem to make progress and then, in the last week, it turns out that you do not know how close/far to completion they are and that they need a few more weeks to be concluded. In order to avoid this situation, the Project Manager has to divide the big tasks into a set of smaller tasks that take a week or less to be completed. These tasks will be combined to present the results every 30 or 90 days. This way there is the possibility to check if the project is on the right or wrong track. Moreover, it is likely to have concrete results that can be used even before the whole project is completely finished and on this basis, you can begin to recover the cost of the project.

f. *Each project needs office staff designated for the project (secretariat of the project), who works with the Project Manager and the team leaders to update plans and budgets.*

The project plan and the budget are similar to the profit and loss statements of a company. They must be always and precisely updated to give the persons that carry out the project the information they need to make optimal decisions. There is a common, but wrong notion that the Project Manager and the team leaders should be those who take care of updating plans. This perception is similar to the perception according to which the President of a Company and his managers (in general sense, top management) should spend their time updating the registers of that company. The Project Manager and the team leaders are responsible for creating the initial plan and budget, but afterwards they have to dedicate all their energies to transpose the plan into reality. Just as there is an accounting department to keep the records of a company, the same way, there should be a design office to handle the updating of the plans of the project and budgets. The staff of the design office reports to the Project Manager and works with the team leaders on weekly basis to revise and update the plans and budgets associated to the objectives of each team. That way, the Project Manager can monitor precisely the progress of the project and the team leaders are able to focus on the management of their teams and not on the completion of reports.

3. Stage of design of the computer-assisted logistic system

The purpose of this design stage is to materialize the conceptual project of the logistic system and to create its detailed specifications. This stage also creates the detailed project plan and the necessary budget to build the logistic system. Depending on how complex the logistic system designed is (comprising supply, sale, internal transport processes, informational and human flows, etc. – Frazelle E., 2001), now is the time when the persons who will work on the project get to know what the top management wants and to imagine how they will do it. Now is the time when you make the adjustment and finishing of the objectives of the project because the persons that will build the logistic system take into consideration the realities of the work in front of them. Usually, until the end of the design stage, it is likely to predict the success of failure of the project. If the persons involved in the project end this stage, having a clear set of specifications of design of the logistic system and trust in their capacity to build it according to these specifications, the project will be a success. But, if the opposite happens, the design specifications are vague, incomplete or hard to understand and if the people are undetermined or unsatisfied about their chances of success, the project will fail. The stage begins with the revision of the objective of the project by the Project Manager. The work group is made of technical and economic experts that hold the necessary combination of business competence, technique and experience to elaborate the detailed project of the logistic system. It is important that the persons understand the intentions of top management and the purpose of the project. The specific aspects related to the objectives of the project and the budget can be investigated during this stage. If necessary, you can make adjustments in the light of the observations deriving from this stage. Once the persons from the work groups of the project understand the purpose and objectives, they will participate with the Project Manager in the set-up of a detailed plan of work for this stage. There are two main things that need to be done in the design stage:

1. Creation of detailed diagrams of processes for the new computer-assisted logistic system (Anderson, Barbara V. 1996);

2. Construction and testing of the prototype of the system (for instance, user interface and technical architecture, if it is about a computer-assisted logistic system).

In this respect, the Project Manager can use the technique called "time boxing" (time limits) to set up a work schedule and do the works

according to that schedule. At the same time, the Project Manager has to divide the time allotted to the whole design stage between the two main activities of the project. Thus, he has to divide each activity into a set of tasks. Then, he must allot each task an interval of time necessary for the execution of operations in conditions of quality. In this stage, one must avoid the temptation to consume additional time to make an excess of analysis and checking and double-checking of results from each activity. Depending on the degree of complexity of the logistic system, the design stage should last between one and three months. For the largest part, the volume of work for each of the two aspects mentioned above can be done simultaneously or "in parallel". In some cases, the work can be done in less than a month. It is not at all wise for this work to last more than three months. If the design works last more than three months, this indicates a lack of concentration or the lack of an effective organization (or both) in the project.

4. Analysis of logistic process

The project team has to analyze the performance criteria of the logistic system designed. The criteria will be a combination of the performance objectives regarding the four categories:

a. Customer Service
b. Internal Efficiency
c. Flexibility of Demand
d. Product Development.

Before starting to sketch the detailed flows of the process of the new system, the Project Manager has to lead the teams in discussion sessions regarding the means of fulfilling these criteria (Zadeh, L. 1973). The Project Manager has to encourage a free flow of ideas and help the project group avoid falling in the trap of a premature critic spirit, insisting on the reasons which prevent things from working, instead of focusing on the means by which things can be done (from this point of view, a brainstorming session is welcome). Thus, the Project Manager and the work group must generate as many ideas as possible about the way in which these performance criteria can be achieved. These ideas are the raw materials with which they will work and which will combine to create models of processes for the new computer-assisted logistic system.

5. Creation of the prototype for the new computer-assisted logistic system

After the design of the new process flows, the creation of a prototype of the system represents a technique to be used in the design of a new computer-assisted logistic system which effectively supports these new processes. The diagrams of decomposition of the process offer the processing logic and sequences that should be used and indicate the types and volume of data that the new system has to process. There are two types of system prototypes: user interface prototypes and technical architecture prototypes. We can make an analogy if we think of the design of a building. If we make an analogy with the field of constructions, we can speak of two types of projects for the construction of a building. The first project is the construction itself and the façade of the building in order to show what the building will look like. The second one is the project of structural, electric components and water and sewerage pipe installations necessary to support the carrying out of the activity in the building. In the design of the logistic systems, the user interface can be thought of as the construction itself and the façade of the building because it shows what the system will look like. The technical architecture prototype is the equivalent of the project of structural, electric components and all the installations for a building.

Both the user interface and the concept of technical architecture are created in parallel. It is an iterative process which makes compromises between the user interface, the functionality of the system and the technical architecture at the base. The purpose is to conceive an overall project which offers a good balance between the functionality of the system and the easiness in use. The Project Manager must look for means of reducing the complexity of the technical architecture that lies at the base of the functionality of the system. The key is to find the means of using relatively simple architectures from the technical point of view to creatively support a wide variety of user interfaces and characteristics of the system.

a. User Interface Prototype in the System

A lot was written and said about the design of user interfaces for software systems (not necessarily in the logistic field). One of the most important concepts is that the user interface should be “intuitively obvious”. This means that a person who already knows how to perform the activity that the software system is conceived to support should observe that it can decipher the basic elements of use of the new software system in

about 20 minutes in which it turns the system upside down and tries all kinds of things. The better designed a system interface is, the more reduced is the training that a person needs to be able to use the system (Winston, W.L., 1994). We present below an example of logical scheme and the corresponding user interface:

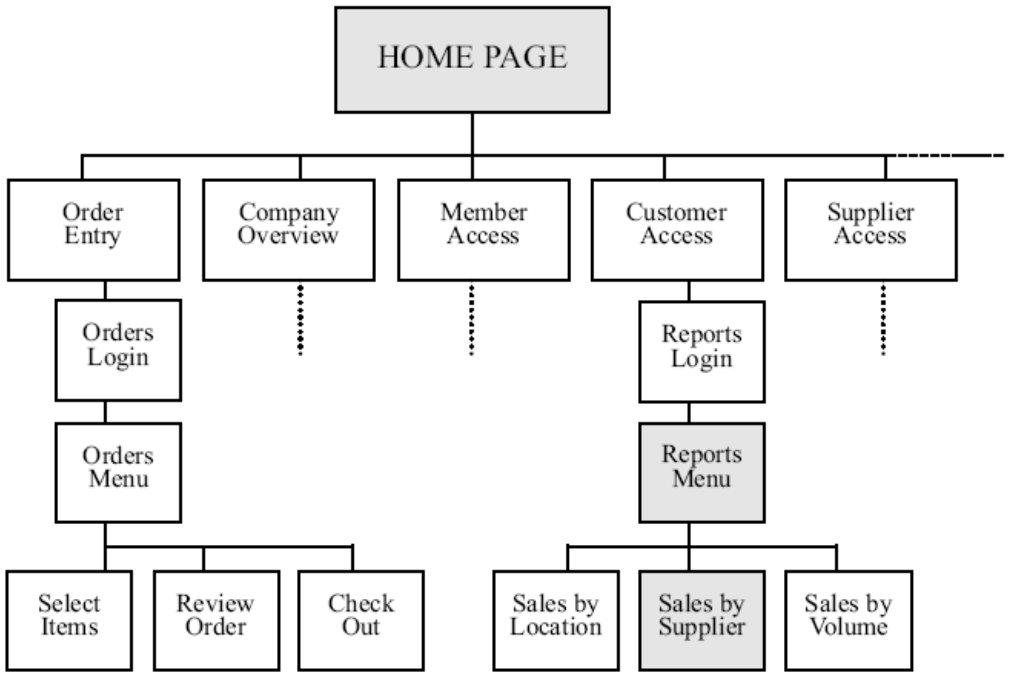

Figure 1. Logical scheme of user interface for a website of a Company in the logistic field.

The Project Manager has to create a prototype of user interface based on the work done to define the process flows. The diagrams of decomposition of processes need to help him from the point of view of determining the succession of activities that must be carried out, in what order and what data is required as support of these activities (Oakshott, L., 1997). The project sequences displayed on the computer closely map the process flows and allow the user to manipulate the data involved in these processes.

b. Creation of the Prototype of Technical Architecture of the System

As the user interface project advances, an effort is being carried out in parallel for the selection and testing of the technical components that will

be used to build the system. All these components must be assembled in a test environment and must be checked to observe if they function as predicted. From the informatics point of view, until a technical component has not been used for at least two years, it is not recommended that the performance statistics published are taken into consideration at nominal value. That is why the technicians from a design team must do their own checks to see if all the components can work together. This means that different performance tests are conceived and run to generate evaluation/calibration data. If certain components turn out to be incapable of fulfilling the tasks and objectives desired, the technical design team must make changes in the selection of components or even change the design of the technical architecture.

The database must be installed from the hardware point of view on the platform of the operating system on which it is designed to run. It is essential to install any software package (software application) that will be used. Then, the test data must be downloaded in the database and you will perform the performance studies to test the functioning of the whole architecture. A simple code must be written to send data from one component to another, in order to test the data interfaces and the speed of LAN, WAN and Internet connections. By the end of the prototype activities, the technical architecture has to indicate that it functions at the performance requirements of the new computer-assisted logistic system it will support. If you cannot create a prototype that operates well, it is no use trying to create a production version of the system by using the same technical architecture.

The first part of the design stage should be consumed in session during which businessmen and technicians should explore different process models. This is the time when the persons involved should think in a nonconformist way, get aware and rally to generate as many ideas as possible. Then the team selects the most useful ideas and harmonizes them to form a coherent and detailed map of the method of organization of work and how the operations will be carried out in the new flow of activities.

As soon as the process flows are sketched, the design sessions can start to focus on the way in which the technology will be used to support this process. The design team starts to define the way in which the persons involved will interact with the process support technology. The Project Manager has to identify means of automation of the routine work and repetitive operations; at the same time, he has to identify the methods of delegation of responsibilities regarding the resolution of different problems

in the process of making various decisions. Usually people do not like routine and repetitive work because it is boring, but they like to solve problems and make decisions because it is a creative act and involves the interaction with other people.

We often make a mistake in making computers solve problems and execute the activities of making decisions. In order to avoid it, the Project Manager must take into consideration the following aspects/requirements:

— People and not the computers are the spark that animates the activities;
— The systems resulted must represent experiences full of satisfactions for people;
— People and not the computers must be at command of systems;
— The persons involved must have access to information so that they can solve the problems faster and of course, make optimal decisions;
— Computers are those that should do the routine and repetitive work (in fact, this is what computers do best);
— If you make the decision of using a package of software applications, then this package has to be installed in a test environment. You must write realistic scenarios of use. The databases used by the software package must be loaded with samples of real data. The persons that will use and support the package have to evaluate it afterwards, operating by scenarios of use.

6. Creation of the detailed project plan

At the end of the design stage, as detailed design specifications are produced, all those involved will get a clear image of the work they have to do and how long this work will take in the construction stage. The Project Manager is now capable to supervise the creation of a detailed project plan and of the budget for the construction of the logistic system. The project teams are assigned responsibilities for certain objectives and the persons from these teams can plan the sequences of tasks they will do to achieve each objective assigned. Each activity is assigned restrictions of time and resources, so you can calculate a cost for each individual task. In this stage the Project Manager will let each team decide in what way they will perform their tasks and how long the fulfilment of the tasks will take. The Project Manager will also challenge the teams set ambitious, but achievable deadlines. The teams should also be encouraged to divide their

activity in separate tasks that last a week or less, because the week is the standard unit of time in business and the teams have to make efforts to accomplish valuable and especially quantifiable aspects every week. If a certain task lasts more than a week, it has to be divided into sub-tasks. In order to identify these sub-tasks, apply the technique of decomposition of process.

A project plan that clearly determines for each person what each person must accomplish every week is a valuable instrument for the coordination and monitoring of construction works of the logistic system desired. A plan at this detail level is also the best method of observance of a correct and realistic budget project. Because the design teams create separate specific plans of tasks in the achievement of objectives assigned, the Project Manager will harmonize all these plans, thus creating the general plan of the project. In a process that is somewhat similar to the way in which a general plans a campaign, the Project Manager plans the succession of the activities that will lead to the success of the campaign and the running of the system that the respective stage of design specified.

In order to achieve this objective, the Project Manager has to segment the project plan by objectives and dedicate a section of the project plan for each objective. The Manager establishes the succession necessary for achieving the objectives of the project and structures the project plan to reflect it. The design teams allotted for each objective have already created detailed plans for what they have to do.

For the purpose of reducing the time consumption, the Project Manager has to identify opportunities for carrying out certain activities in parallel. The more the activities that can be carried out simultaneously, the more flexible the project will be. When the activities are run in succession, a delay in a single activity causes a wave effect, which delays all the other activities pending. When the activities are run in parallel, a delay in an activity does not affect the other activities. The activities have to create results which, combining in the end, achieve the objective. The key point is that the carrying out of activities in parallel allows you to conclude an activity and then move the resources to support another activity, which could be delayed. In a project, the delays are inevitable. A plan that does not take into account the delays and does not offer the necessary flexibility to treat them effectively is a plan whose calendar and budget will be quickly outrun, which increases the probability of failure.

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INTERMODAL TRANSPORT

Eduard ARMEANU*

Abstract. *Competition between the different means of transport has led to the segmentation of systems of transport that, until recently, seemed impossible to integrate. Each means of transport tries to stand out on the market by way of the advantages it offers in terms of costs, services, availability and safety. The present paper analyzes the intermodal transport issues in an integrative vision.*

Keywords: *transports, interconnection, efficiency, components.*

1. Introduction

Along with the fierce competition between operators, the lack of integration of the different means of transport has in certain cases been emphasized by the nature of state monopoly of certain means of transport such as the railway, which has discouraged various companies from investing money in infrastructure and fixed assets. However, in the last forty years, constant efforts have been put in worldwide towards integrating the means of transport.

The key factors that have turned fragmented systems into integrated transport systems by way of intermodalism are[1]:

1. *The spontaneous cooperation of the various means of transport*, to increase economic efficiency in the field. Since ancient times, water transport has been extended by land transport, in terms of the technique available at the time.

With the emergence and development of railways, land intermodal transport spontaneously appeared and developed, due to the lack of accessibility of the railway means of transport.

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2. *The geographical area of operation of transport.*

Whenever a waterway got in the way of land transport, the need to continue the transport imposed intermodal transport. Thus, ships designed for carrying railway and road means of transport arose and developed.

3. *The need for cooperation between road and railway transport.*

In 1930, in the economically developed countries, railway transport had the "monopoly" over land transport, since cars came to be 55 years after the railroads. 50 years after their appearance, due to technical refinements that were made and addressed their capacity, speed, operational safety and economy, cars become a formidable competitor of railways, by attracting a growing part of traffic.

As railways are a national objective, attempts were made to solve the problem of road transport competition by making the same voluntarily use railway infrastructure through the development of intermodal car – railway transport technologies using road semi-trailers. Thus, intermodal transport procedures appeared such as U.F.R., Kangourou – in France, piggyback – in the U.S., Huckepackverkehr – in Germany etc. These transport techniques combined the advantages of railroads – the cost efficiency of long-distance transport, traffic safety and regularity – with those of road transport – the cost efficiency of short-distance transport, high availability and the possibility to serve *door to door*. This cooperation led to lower transport costs and increased logistics efficiency.

4. Door-to-door serving.

It is the most important factor in terms of logistics. For the beneficiaries, this factor is reflected in lower packaging costs on transport, decreased losses and damages, merchandise thefts, lower numbers of handlers and transhipments and, implicitly, default costs. For the carriers, this factor mainly causes a better use of the means of transport by reducing the loading – unloading time.

Clearly, in the case of direct road transport or railway transport between beneficiaries with industrial lines, the much required *door-to-door* serving is performed. However, in practice, in many cases, direct road transport is not suitable because the *economic distance* is exceeded and *door-to-door* railway transport cannot be achieved because the beneficiaries – both or only one of them – are not connected to the railway network. In order for *door-to-door* transport to be performed in these cases, too, without transhipment, the use of *intermodal transport units (ITU)* has been initiated.

The intermodal transport unit means: transcontainers, special containers, euro-containers, mobile boxes, road semi-trailers, detachable boxes and the likes.

All this ensures the continuity of the transport process, and the connection in transhipment terminals between a means of transport and another means of transport and streamlines their coordination.

5. *Technological progress.*

New means of container transport have been built such as *Post-Panamax*[2] ships or lowered platform cars – which can carry two superposed 40' containers – at the same time as developing high capacity equipment and machinery, able to successfully respond to increased numbers of merchandise handling and transhipment cases.

Information technology also decisively contributes to increasing the degree of control over the logistics processes especially towards optimizing and monitoring transport and managing the group or fleet of means of transport.

6. *Capital investments.*

Freight transport is a highly capitalized sector, with high initial investment costs, especially in the fields of naval and railway transport. The depreciation of the means of transport and the transport infrastructure, especially the terminals, covers an extended period of time, usually over ten years, which involves some risk taking on part of potential investors who are reluctant to invest in this direction. In order to solve this problem, the governments of various countries carry out joint infrastructure investment projects such as public-private partnerships.

The sector of freight transport is dominated by private companies that need to turn to capital markets to finance their investment approaches. However, through very good coordination with other elements of logistics, the safety of these investments is guaranteed, and the expenses incurred on fixed assets can be reduced and recovered in a rather short period of time by way of intermodal transport projects that have very low potential venture capital.

7. *Globalization.*

This phenomenon has allowed the emergence of new production structures known as *global production networks* or *a global chain of goods*, which implies a high level of organization and coordination. Likewise, the increased development of these networks will require a

[2] A large ship that cannot cross the Panama Canal

similar distribution structure, which, in turn, will require organization and coordination at optimal parameters between the different means and systems of transport. In these conditions, the transport demand will increase, leading to a more thorough integration of the transport systems, and, thereby, an *integrated transport demand*.

8. *The consolidation and interconnection of transport networks.*

Integrated transport systems are based on the strengths of each individual network. Although these networks are expensive in terms of construction and operation, by way of interconnection, the efficiency of their use and the degree of control can increase. From a holistic perspective, one can consider this a multiplying effect, whereby the efficiency of the entire intermodal transport network is higher than the sum of the efficiencies of each means of transport making up the network.

2. Main functions of the intermodal transports

Intermodal transport is defined by four major functions (Fig. 1):

1. *Collection* is the process of receipt, assembly and consolidation of the merchandise in an intermodal interface terminal, belonging to the local/regional transport system or the national/international transport system. Merchandise batches come from various shippers or the logistics centres where they were gathered and are then moved using large capacity means of transport such as railway cars or ships. Logistics activities such as packaging and storage are included in the collection process, and are also closely related to the production function.
2. *Connection* involves a consolidated modal flow, like a set of trains, a motorcade or a container ship moving between two terminals belonging to a national or international transport system. The efficiency of a connection mainly results from the economy of scale given by the placement of the merchandise in containers.
3. *Transhipment* is a major function of intermodal transport. This function belongs to the transport terminal which, by way of the access and transhipment capabilities, determines the effectiveness and continuity of the supply chain. Terminals are nodes belonging to national or international transport networks, and ports are one of the most conclusive examples.
4. *Dispersion*. Once the merchandise arrives at the end terminal, the batches are divided and moved through the local/regional transport network to various recipients. This function is closely related to

the consumption function and involves complex logistics activities especially in large urban areas.

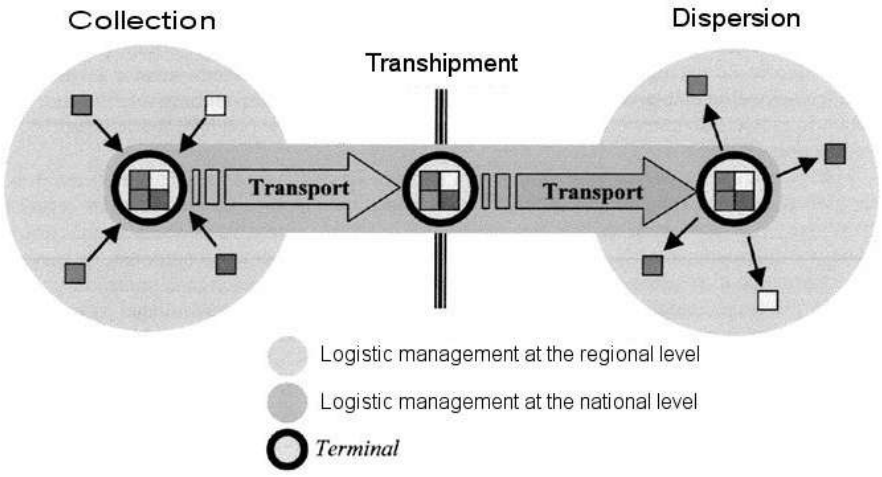

Figure 1. Tthe intermodal transport chain.

The intermodal transport chain enhances the economic performance of the logistics chain, using the component means of transport thereof, in the most productive manner. Thus, for example, the railway, by way of its high transport capacity, can highlight the economic effects across long distances and via the loading onto platform cars of the trucks with merchandise from local and regional logistic systems. This example justifies the holistic perspective discussed above, as it represents a movement as a whole and not a series of individual movements, requiring specific technical operations, and separate shipping documents and fees, respectively.

From a structural point of view, intermodal transport appears under two forms:

I. *Combined intermodal transport* - which involves the movement of merchandise set up as load units using a main means of transport – railway and sea transport – and a secondary means of transport, usually road transport. The secondary means of transportation refers to the transport that ensures the connection with the loading/unloading points, along the shortest road path possible.

II. *Container intermodal transport* – which involves the movement of merchandise in an intermodal transport unit, successively using at least two means of transport.

In both forms of intermodal transport, a single transport document is used from the point of origin to the destination. Container intermodal transport can be performed using all the means of transport and given its importance it is tackled in a separate chapter

The logistics system must be managed so as to primarily ensure a uniform flow of products and materials to determine improved company performance. One of the directions of action oriented towards the upgrade of transport is the *optimization of volume of freight transport*. Regardless of the manner of organization of the company, logistics managers should know the almost exact cost of freight transport, the level of stocks in transit and the number of shipments made, all of these comprised in a global schedule. Beyond these basic issues, these managers must turn their attention to factors that may lead to optimizing both the transport of products and materials and the relationships with the providers of such services, and the relationships with different customers or markets.

The choice of transport is a fundamental part of logistics management and should be carefully considered because of its impact on operational efficiency. The choice of an inappropriate means of transport may cause higher costs than necessary and, therefore, a low degree of customer service.

The decision to choose the means of transport is extremely complex due to the wide variety of options available and due to the various possible methods of examination and assessment. The means of transport vary considerably depending on factors such as the type of products, the size of the order, the service level requested by the customer and the alternative methods of transport available. Along with these, the details of the necessary equipment, the method of funding and operating techniques to be used should be determined

The complexity of the choice increases when we consider the impact of potential changes as the operating macro-environment is dynamic and, therefore, the very basic requirements of the means of transport can change over time, making it impossible to determine how appropriate it is for longer periods of time.

The decrease in the number of carrier companies used can be an effective way to unify the volume of products and materials to be carried. Following this process, strategic regional alliances can be concluded, and the manufacturer thus has a major role in the merger of several previously used carriers, with beneficial consequences for both parties.

In a globalising economy, it is increasingly difficult for a company, regardless of its size, not to get involved in supplying merchandise to other

countries, in producing or distributing materials in foreign territories. The performance of international transport operations faces a number of issues related to national statutory regulations, the requirements for the acceptance of goods at customs, the packaging and pricing standards, the conversion of currency, tire control and political restrictions, etc. With the enlargement of the European Union, these barriers will be eliminated, which involves a change in the structure of transport networks by adding new transnational connections which will, implicitly, change product and material flows between countries (Fig. 2). In some cases, the national flows may go into a relative decline as compared to transnational flows (Fig. 3). This is also the case of Romanian transport companies which, since January 2007, with the accession to the European Union, have had to face fierce competition from Western companies that are better organized and developed. Several companies have resorted to introducing innovative practices in logistics that might set them apart from their competitors. They use logistics optimization to get the competitive upper hand on the global markets. An established method of obtaining such an advantage is the creation of joint ventures, partnerships, strategic alliances or holdings. Via the proliferation of such alliances, it is becoming increasingly difficult to identify the location of manufacture of a product. American and Japanese companies annually form alliances in the most diverse fields such as metallurgy, cars, computers, pharmaceuticals, telecommunications and electronics.

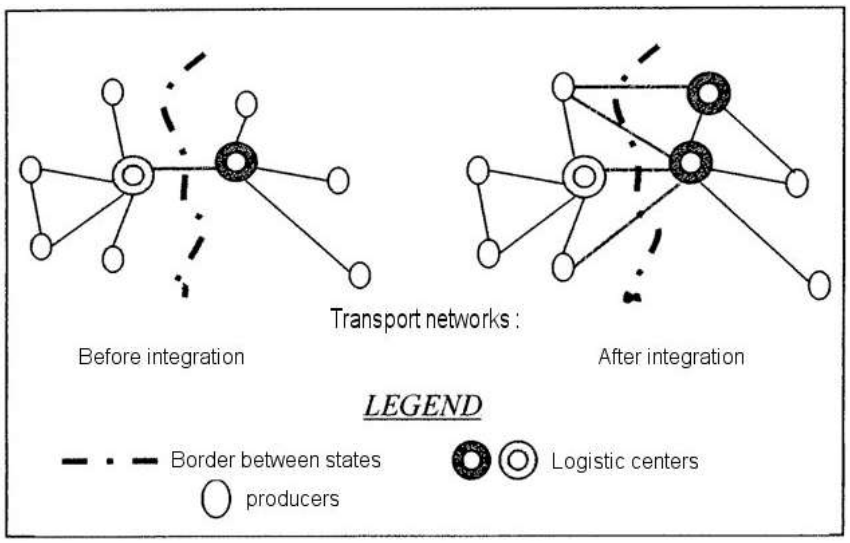

Figure 2. The evolution of the configuration of transport networks.

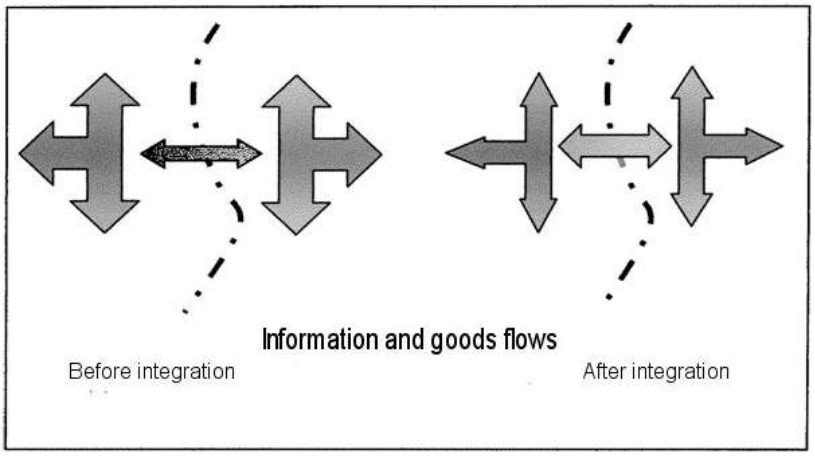

Figure 3. The evolution of information and merchandise flows.

The concept of third company or company contracting logistics services has become very popular in recent years. At least in Europe, it has become common practice for companies to contract third parties for the provision of supply, transport, storage services etc. Regardless of who provides the logistics services, the practice of optimizing the volume and flow of products and materials will boom because we are in an increasingly global economy that requires companies to conduct an increasingly careful planning, organization, coordination and assessment of their logistics services to stay competitive. Logistics managers must obtain information, measure and monitor the volume of products and materials ordered, transported and handled in-house, in an integrated manner. Thus, information is collected about the full range of products and materials that goes through the value supply chain – from the supplier to the beneficiary – beyond organization limits.

With these influences, logistics managers can optimize the logistics and implement creative options by: dividing the load into units, improving the connections with the carriers, efficiently coordinating the receipts and shipments of products and materials, investing in efficient infrastructure and equipment, increasing the stock turnover, resorting to third parties for services with a high degree of specialization or establishing joint ventures.

The ability to optimize the volume of products and materials determines cost savings, improved profitability and gaining a competitive advantage. In this context, product and material transport from the supplier to the beneficiary creates value. In the past, transport was considered a *commodity*. According to this view, the best form of transport was the one

that brought the products and materials to the consumer at the lowest possible cost. Nowadays, this view has changed, and transport is considered a service the value of which is influenced by the consumer and the circumstances that arise. This is one of the explanations for the rapid development of *express* transport, as the customer is prepared to pay an additional sum of money, for quick and safe transport.

However, the efficiency and effectiveness of the transport activity depend largely on how the movement of merchandise is scheduled to meet each supply order and how the route of each means of transport is determined between the point of shipping and the destination.

In order to achieve a rational system of travel routes, one should take into account the specific features of merchandise distribution, including:

— The need to ensure rhythmic supplies to meet the requirements of the beneficiaries in terms of both time and full volume;

— The implications of small batches of goods, which include increased difficulties in preparing the orders, repeated handling, stopping of the means of transport and many employees involved in their selection and establishment;

— Urban outlet facilities, which are generally traditional constructions, with narrow handling spaces and warehouses with insufficient areas. These deficiencies can often be found in new constructions, too, for which the architecture conception prevails over the functional one, and thus issues of the access of the means of transport for the supply of merchandise, for potential shipments or disposal of packaging are neglected;

— The changes in the volume/weight ratio, depending on the nature of the product, limiting the rational use of means of transport;

— The great diversity of packaging for the merchandise in terms of size, shape, materials it is made of, stacking resistance, etc.;

— The traffic limitations in force or that come into effect along various urban or suburban routes;

— The operating hours of the outlets or stores, and so on.

Another course of action is the *automation* and *mechanization of merchandise loading and unloading operations* the main consequence of which is increased economic efficiency of transport. The mechanization and automation of merchandise loading and unloading operations ensures:

– An optimized flow of goods and enhanced labour productivity;

– Increased merchandise turnover;

– The maintenance of quality and the integrity of the merchandise from the supplier to the beneficiary;

– Shorter periods of occupation of the loading and unloading front;

– The rational use of means of transport and a maximal return of the same;

– Reduced human consumption, as the staff can be used in other sectors.

However, even given the mechanization of the loading and unloading operations, a large number of workers are involved in a multitude of preparatory or concluding activities for such operations, such as[3]:

– The attachment or detachment of the load;

– The manual cleaning of merchandise residues;

– The standardisation of the load carried in bulk;

– The weighing and potential redoing of the load;

– The securing of the load unit onto the means of transport;

– The closing and opening of the shutters, unloading flaps, the covering with tarps and other specific operations determined by the nature of the merchandise, the type of equipment or the means of transport.

It is therefore necessary to resort to modern methods of preventing damages to the merchandise or the packaging thereof, which may occur as a result of improper or negligent handling by the specialized staff, and to identify those responsible for such erroneous operations, respectively, in order to recover the damages. To that effect, data collectors can be used as labels placed on the merchandise packaging such as shock or rollover sensors. They change colour when the parcels are subjected to improper treatment, thus warning the recipient of any irregularities.

Likewise, in order to reduce individual merchandise handling operations, the extensive use of pallets, containers and road semi-trailers is required. In the same context, one must emphasize the importance of upgrading the terminals, which are genuine nodes connecting the flows of merchandise. Equipping them with computer document processing systems, communications systems and merchandise movement monitoring systems or high capacity machinery and equipment, tailored to the structure of the goods handled, should be a priority of the logistics specialists.

Particular attention should be paid to *ensuring the quantity and quality integrity of the merchandise* during transport. The protection against corrosion using paper or packaging foil impregnated with *volatile corrosion inhibitors* is an extremely effective method that aims at creating a protective microclimate for the products and materials by reducing the relative humidity of the air inside the means of transport or inside the

[3] Coyle, John J., Bardi, J., Novack R., *Transportation,* 5th Edition, South-Western Publishing Company, Cincinnati, 2000.

container. This method is mainly designed for the protection of metal products, spare parts, machines etc.

The use of labels for monitoring and recording the temperature and humidity of the compartments inside the means of transport is also a very useful method. These devices are true databases that store information on the parameters associated with the environment where the merchandise was transported or handled. Their memory can be then transferred to the computer and then subjected to processing the results of which can underlie further analysis. Thus, in order to modernize transport, the efforts of logistics specialists should focus in particular on:

– Using the means of transport to the maximum of their capacity and avoiding making trips when not full;

– Ensuring preventive maintenance work on the means of transport in order to reduce the time during which they are inactive and in repairs;

– Wisely distributing the deliveries in time and space;

– Adapting the means of transport to the specific traffic;

– Ensuring a sufficient number of positions for loading and unloading operations in order to increase operating speed;

– Computerizing technical and administrative operations;

– The rhythmic scheduling of the means of transport at the loading and unloading ramps;

– Mechanizing the merchandise handling operations;

– Extensively using innovative fleet management systems, modern communications systems and highly practical software products.

3. Conclusions

The creation of a rational and economical transportation system is subject to the collaboration that must exist between the participants in the flow of goods, which implies a concept of unitary logistics, designed to integrate all the courses of action in order to achieve high economic efficiency.

The transport of merchandise is the most important component of logistics and that is why the experts in the field have to pay it particular attention. The constant improvement of transport methods and technologies, the upgrading of the means and systems used, the optimization of the flows of merchandise and information, the constant tailoring of the logistics system to market demands are key priorities on the agenda of every logistics manager.

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ROMANIAN REGIONAL POLICY AND THE NEW PATTERN OF EUROPEAN COHESION POLICY

Gabriela MARCHIS[*]

Abstract. *The critical consequences over the interregional disparities at EU level due to the complexity of the European economic integration process may be attenuated only by some adequate measures of regional policy. Researchers like: Fujita, Krugman and Venable, demonstrate that: "the economies of different states are characterized by heterogeneity and, as a consequence, the economic relation among them, needs to be viewed in the context of diversity" („New Economic Geography", 1999).*

Thus, it is recommended that regional instruments ensemble to serve the national economic policy of each member state of EU, in the sight of reducing the existing inequalities between EU citizens' standards of living. On the other hand, the process of European integration, by removing the commercial obstacles, ensuring the free movement of production factors and by the eliminating the state aids procedures, is contributing to stumping the boundary line among member states; this idea being emphasised by Krugman in 1991, when he demonstrated that "the more unified is the European market, the much higher is the mobility of capital or labour factor and there is no point in approaching trade relations among member states in terms of international trade, rather that dealing with interregional trade".

In this context, "developing the regional policy in an enlarged Union may not be viewed only by national perspective, without taking into consideration the existing connections among national regional politics, European regional policy and the EU competition policy" (Batchler J. Wishlade F., Yuill D., 2003).

This paper intends to reveal the dynamics of European integration process, revealing the main effect of this process, economic divergence (Mangrini, 1999) or economic convergence (Krugman, 1991; Romer 1986 and 1990). The Romanian regional policy is presented in relation with European Union regional policy, in the perspective of catching-up process, the modernisation on the whole economy, through a mimetic behaviour.

Regional convergence between Romania and EU implies an extensive jump from the existing status of "poor" country of the community (the Nord-Est region – RO21 has the lowest level of GDP/inhabitant, being the poorest region of EU) through the EU medium level of welfare. This may be

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achieved only when Romania will learn the European lesson, that "the integration can't be a substitute for a strategy of economic development" (Rodrik, 2000).

Keywords**:** *economic integration; cohesion; regional convergence; enlargement.*

1. Introduction

European economic integration may be approach from three different perspectives [10]: "*deepening* (of its economic liberalisation, common regulation and policies, and of its commitments and prohibitions of the Member States), *widening* (of the scope of its economic and other powers) and *enlargement* (of membership). However, it should be noted that the rapid development of the European Union has led to some economic and/or political inadvertences between *deepening* and *widening* and between *deepening* and *enlargement*.

A careful analysis of European Union history show a cyclical trend, characterized by successive ups and downs, the boom periods alternating with the crisis, this evolution being generated by the fact that political integration has priority over economic integration.

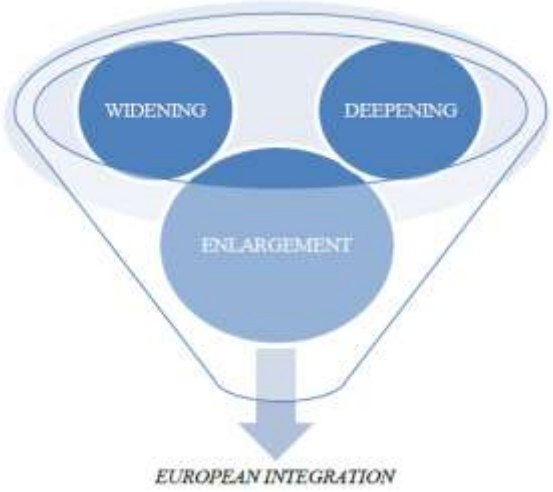

Figure 1. Economic integration process into EU – trivalent approach.

Also, fragile stages of integration generated by the complexity of EU historical evolution, made that *deepening*, *widening* and *enlargement* of the European Union cannot be achieved **simultaneously**, **continuously** and at **the same level of intensity**. Thus, the trivalent approach of European integration process can be summarised as follows:

– EU *deepening* manifested in different ways: the revisions of the EEC Treaty (Single European Act, Maastricht Treaty, Amsterdam Treaty, Nice Treaty, and Lisbon Treaty), the achievement of full customs, and historical evolution of European Court decisions regarding economic integration;

– *Widening* is a recurrent phenomenon in EU history, especially regarding the rules and economic policies and can be exemplified by: the Common Agricultural Policy, Economic and Monetary Union, Transport Policy, European Research and Technological Development Policy, Schengen Agreement, European Social Charter etc..;

– *Enlargement* has created significant adverse reactions in EU socio-economic life, always representing a challenge in achieving the fundamental objective of economic and social cohesion, being the promoter element of EU reforms.

2. European cohesion policy

"Cohesion policy can be viewed as a tool for deepening integration, which is not only an economic project, but also social, cultural and political". [11]

Economic and social cohesion is a basic component of the European model of economic and social development, together with economic growth and political freedom. Therefore, the European model is presented as "one who wants to spread prosperity from the hard core to emerging areas". [9]

But, the evolution of cohesion policy can be explained only in correlation with the *enlargement* of the European Union. Thus, in 1973, with the UK's EU accession, it began the gradual development of European cohesion policy, the United Kingdom being the state that supported the creation of the European Regional Development Fund, which materialized two years later, in 1975. The importance of cohesion policy on EU agenda widened with the accession of Greece (1980), then Spain and Portugal, in 1986, a time when the *deepening* of the EU, could endanger, at the very beginning, the position of less developed regions in the European single market competition.

"The signing of the Maastricht Treaty strengthens the link between economic integration and deepening of economic and social cohesion [...] cohesion being regarded as one of the three major objectives of the EU, together with Single Market and Economic and Monetary Union". [11]

Also, the eastward enlargement of the EU in 2004, and the second wave of enlargement in 2007 led to a drastic restructuring of European cohesion strategy, which not only translated into a mere reshuffling of funds.

"Regional cohesion and European integration are two sides of same coin". [8]

The literature offers mixed signals in terms of *real convergence* in the EU. Unequal growth rhythm of economic activity that characterizes the EU Member States and differences between regions in terms of economic, social and geographical conditions led to the emergence of significant regional disparities regarding GDP per capita, labour productivity and employment both within a Member State and at interstate level. Therefore, real convergence can be observed between Member States, but at the regional level, an increase of gaps is more evident, the less developed regions are not able to catch up with developed regions or shows delays in development and even are lagging behind.

Besides the three fundamental processes of European integration – *deepening*, *widening* and *enlargement* – integration includes another set of processes, *membership*, aimed at the progressive adoption of EU specific model by candidate countries. Fulfilling "Copenhagen criteria" (1993), which define the conditions necessary to achieve real and structural convergence of eastern and central Europe economies, is in fact the compatibility of a candidate country with specific standards of European Union. "*Real convergence defines the adjustment of economic structures and building institutional and legal framework.*" [9]

Most commonly, real convergence is addressed in conjunction with economic development. In other words, it refers to the process of "*catching-up*" of poor countries in terms of income per capita, the target level being set in comparison with a reference country or being calculated as an average of income per capita in different countries. But the "*catching-up*" is not done automatically; it depends largely on the rhythm of economic reforms, the implementation of the acquis communautaire and as well as, the level of economic development.

Some authors argue that there is no real convergence or divergence in the EU, perhaps a convergence of growth rates of the Member States, convergence that excludes the idea of "*catching-up*" in the less developed regions. There are views that the convergence is caused and accelerated by the process of spatial diffusion of technology, capital, foreign invest-

ment, employment information and labour, as well as by the international trade. [12]

EU *enlargement* to 27 members led not only to increasing economic disparities between EU regions but also the emergence of a new model of territorial distribution of wealth.

Thus, new growth poles are represented by the Dublin, Madrid, Helsinki and Stockholm, and Warsaw, Prague, Bratislava and Budapest.
Under the Fourth Report on Economic and Social Cohesion (2007), the European Union area, following the accession of Romania and Bulgaria has increased by about 8.6%, the population increased by over 6.3% while, GDP per capita measured at purchasing power parity, fell by almost 4%. Regional inequalities have evolved so that the relationship between the most developed and the poorest regions of the Union has changed permanently from 5 in EU-15 to 9 in EU-25 and 8 for the EU-27. So, the centre of gravity of economic policy went into Eastern Europe.

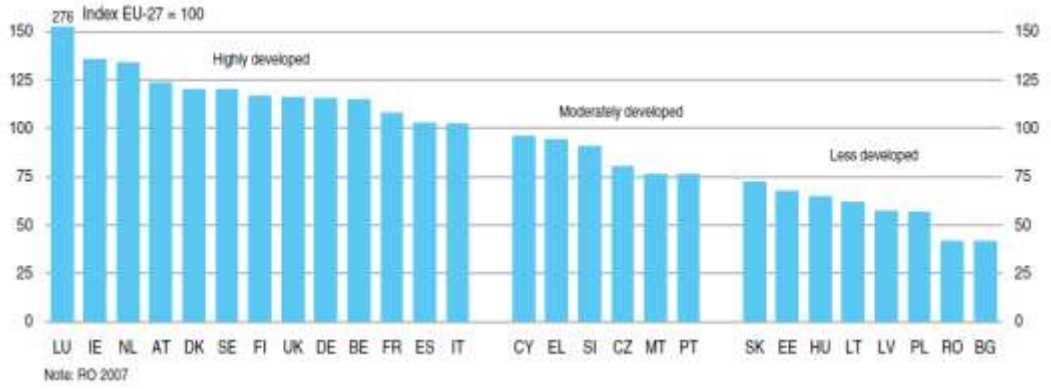

Figure 2. GDP per head (PPS), 2008.

Source: *European Commission (2010) Investing in Europe's Future, Fifth report on economic, social and territorial cohesion, Luxembourg, Publications Office of the European Union, p. 38.*

Regarding the effects of cohesion policy, they felt on *short-term*, during the programming period, but also on *long-term*, long after the cessation of Community assistance. Both effects are extremely important in ensuring the convergence of member states, but strength and form of their expression differs from one Member State to another, being strongly influenced by both the *level of Community assistance* and *national economic structure*, but also *the types of investment* chosen by member governments as a priority.

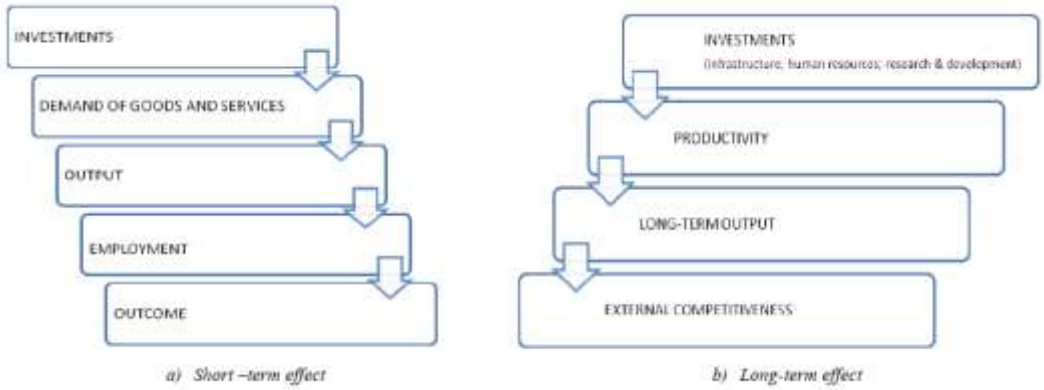

Figure 3. Cohesion policy effects.

Lessons learned from previous programming periods (1988-1993, 1994-1999, 2000-2006), but from the current one as well (2007-2013) which was strongly affected by global economic crisis demonstrates once again the need that during the next programming period (2014-2020) cohesion policy must be designed in a more *integrated vision*, characterized by *strong* and *pragmatic regional and national coordination.*

According to the Fifth Cohesion Report, convergence trends among EU regions can be also observed in the decline of regional differences in terms of GDP per head.

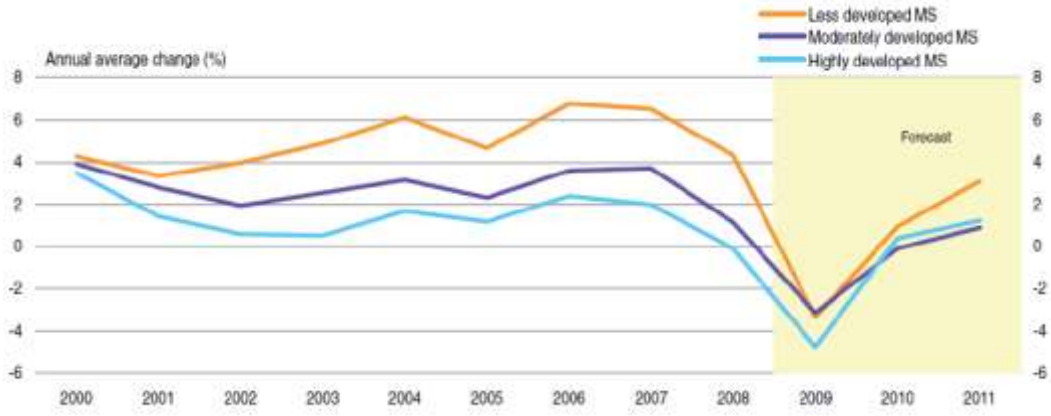

Figure 4. Growth of GDP per head in real terms, 2000-2011.

Source: *European Commission (2010) Investing in Europe's Future, Fifth report on economic, social and territorial cohesion, Luxembourg, Publications Office of the European Union, p. 38.*

Even if GDP per head measures economic development and growth and is a good indicator for making comparisons across countries and regions in terms of economic performance, it is not good enough for well-being measurement, because the increase in GDP is rarely equally distributed across the population or across the regions. The well-being, life expectancy, health perception and happiness of European citizens cannot be measured only by GDP. So, the impact of cohesion policy on Europeans is very difficult to account.

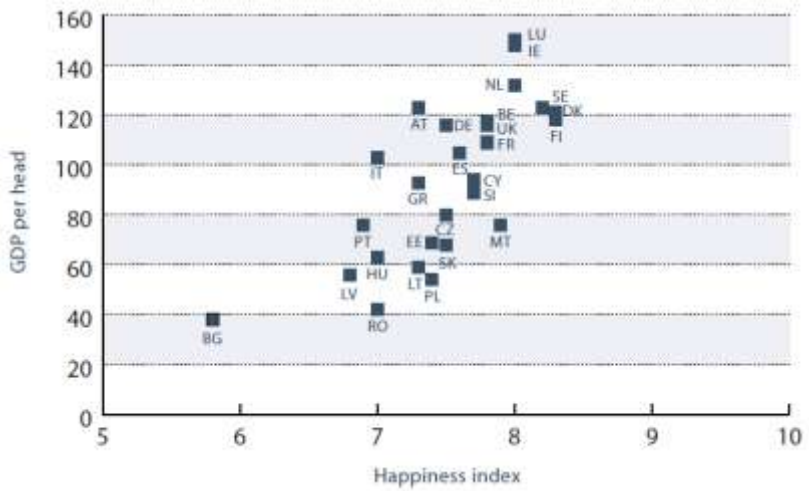

Figure 5. Relation between happiness and GDP per head, 2007.

Source: European Union (2010) Delivering smart, sustainable and inclusive growth in *Panorama InfoRegio no36*, winter 2010/2011, p. 23.

According to a study produced by the Directorate –General for Regional Policy, regarding the Regional Lisbon Index, which measures how far regions are from eight Lisbon targets1, during 2000-2007 EU regions improved their score by 10 units. Among forehead list regions

[1] The Lisbon Index shows how close an EU region is to eight derived Lisbon 2010 targets:

- 85% for employment rate among men aged 15-54
- 64% for employment rate among women aged 15-54
- 50% employment rate for people aged 55-64
- 10% of early school leavers aged 18-24
- 85% of secondary education attainment for people aged 20-24
- 12.5% of lifelong learning participation of people aged 25-64
- 2% for business expenditure in R&D as % of GDP
- 1% for government, higher education and non-profit expenditure in R&D as % of GDP

were: Corse in France, Comunidad Foral de Navarra, País Vasco, Cantabria, Extremadura, Galicia, La Rioja and Comunidad de Madrid in Spain, Kärnten in Austria and Liguria in Italy. All these improved their index by 25 points or more. In 2007, the top ten Lisbon regions contain three Finnish, four Swedish and three UK regions, scoring between 94 and 100. The bottom ten contains four Southern Italian regions, the two Portuguese island regions, Malta, Corse in France, South-Est in Romania and Észak-Magyarország in Hungary all scoring less than 20. Capital regions tend to score higher than the other regions in a country. This is clearly the case in France, Italy, the Czech Republic, Slovakia, Hungary, Romania and Bulgaria. In Belgium and the UK, the score of the regions surrounding the capital region is higher than that of the capital region itself. This is partially due to commuting, as the three employment rates and participation in lifelong learning are measured at the place of residence and not the place of work.

Overall, the rate of convergence in the EU increased from 57 units in 2000 to 69 units in 2007 and to 75 units in 2010.

In this context, it remains essential the role of cohesion policy in achieving balanced and equitable development of EU regions and, in particular, in reducing disparities to a more acceptable level, in a reasonable period of time.

3. Romanian cohesion policy

Romania's regional development policy emerged in the process of preparing for EU funds management as candidate country, in the accession negotiations. Association Process for integration into the European Union took place in an institutional framework, from 1st of February 1993, the date of signing the Agreement of Association of our country to the EU (European Agreement)[2].

On 22 June 1995, Romania has officially filed for membership and in December the same year, our country has presented a detailed strategy on the adoption of the acquis communautaire, the first assessment meeting the accession criteria being made by Agenda 2000 – the document adopted in July 1997. A milestone in the relations Romania – EU was the Helsinki European Council in December 1999 when it was decided to start accession negotiations with Romania, a process started on 15 February 2000 and officially ended on 17 December 2004 at the European Council

[2] European Agreement came into force two years later, on February 1, 1995.

in Brussels. Treaty of Romanian Accession into EU was signed on 25 April 2005, and the accession took place on 1st of January 2007.

In this context, one can say that Romania's regional development policy has a relatively recent history, 1998 marking the establishment of legal framework of regional development policy in Romania by Law 151/1998, which was repealed and replaced by Law 315/2004, which sets the objectives, institutions and instruments of Romanian regional policy as EU member state.

Romania, a country with no tradition of regional development, had to take and adapt specific instruments of regional policy, in line with European requirements.

European regional policy implementation is achieved mainly through programming tools, aimed at implementing the economic and social development strategies and enabling European financial instruments to maximize the benefits of European cohesion policy, in synergy with the national ones. Following the European model, based on the programming documents, the national development priorities are established, mainly compatible with the interventions of structural instruments. Financing of regional development in Romania was a time of great change and trans-formation as it was made the transition from pre-accession instruments, specific to the 2000-2006 programming period, to the structural tools for current programming periods (2007-2013), which operates by rules entirely new.

Table 1

Financial instruments of Romanian regional development policy

2000-2006	2007-2013
Pre-accession instruments: • Phare • ISPA • SAPARD	Transition Facility (2007-2010) Post-accession instruments: • European Regional Development Fund • European Social Fund • Cohesion Fund

Implementation of national regional development policy is made in accordance with the general development objectives and priorities of Romania and with the EU economic and social cohesion objectives, Romania hovering over a period of assimilation of the European model. The speed of full understanding, adaptation and implementation of the

European model determines the pace of real convergence between Romania and the EU.

4. Conclusions

The dynamics and multi-dimensionality of the integration process have determined over time EU cohesion policy to transform and to adapt continuously to the new challenges posed by *deepening*, *widening* and *enlargement* of the Community.

Figure 6. EU Multiannual Financial Framework over time.

Future cohesion policy for the next programming period (2014-2020) will be designed in accordance with EU 2020 Strategy.

Also, more striking is the need to address cohesion through a *macro-level strategy*, more clot and coordinated, so that the 27 EU member states can act together in an *unitary* manner, through their 27 specific National Policy Cohesion Programs, in this way, being achieved the common objectives of the EU 2020 strategy, instead of 27 different specific outcomes in tone with the 2020 EU's strategy.

EU motto "*unity in diversity*" must be applied in the case of cohesion policy, unity meaning the EU *common voice*, but also the *common language* of putting into practice the various national cohesion programs.

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