Faculty of Operation and Economics of Transport and Communications
University of Žilina
Žilina, Slovakia

TRANSPORT AND COMMUNICATIONS

Scientific journal

tac.uniza.sk

I/2015

ISSN 1339-5130

TRANSPORT AND COMMUNICATIONS

Scientific journal intended to combine theory and practice in the field transport and communications and thus advancement of transport and communications sciences

DOI: 10.26552/tac.J.2015.1
ISSN 1339-5130

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Transport and Communications, 2015; Vol. I.
ISSN: 1339-5130

Low-Cost Carriers – Business Model Development

Antonín Kazda[1], Mária Mrázová[2]

[1]Air Transport Department, University of Žilina, Žilina, 010 26, Slovakia
[2]Air Transport Department, University of Žilina, Žilina, 010 26, Slovakia

Abstract This paper deals with low-cost airline business model that has overwhelmingly been the favoured mode of the airline. Fast-changing aviation industry forces low-cost carriers to transform their initial business model and therefore, author stresses further opportunities for the expansion of these models to another direction with more concentration on customer´s needs as well as company´s operational and financial benefits. One of the most important partial results is analysis of existing low-cost carrier's business models, describe their historical evolution and propose future modifications to stay competitive and profitable.

Keywords Low-cost carriers, business model, unit costs, unit revenues.

JEL L93

1. Introduction

Since the introduction of Southwest Airlines' low-cost model in the USA in 1971 and the deregulation process of American airline industry in 1978lead towards the entrance of new business model – low-cost carriers – that has changed patterns, thinking and position of legacy carriers on aviation market. Deregulation process caused that airlines had adopted new strategies and consumers had been experiencing a new market and it helped to financial benefits to the air travellers could not pay high flight ticket prices due to the legacy carrier's monopoly position on airline market.

Despite, unpredictable and unstable airline industry is still forcing airlines to restructure and create new, more flexible strategies that will be able to adapt in constantly changing environment. Since 1990, when low-cost carriers appeared in Europe following Southwest business model we can see their success further. According to Amadeus database low-cost carriers represent about 19%percent of the total air traffic in Asia, 38% in Europe and more than 30% in North America.

Moreover, measured by revenue, the industry has doubled over the past decade, from 370 billion euros in 2004 to 747 billion euros in 2014 according to IATA. Also, most of that growth has been driven by low-cost carriers which at the moment have a control of 25% of the worldwide market and they also have been expanding rapidly in emerging markets.
In spite of that fact, for instance European market is still highly saturated in order to small opportunities for further expansion across new routes, mainly in Western Europe [1].

In addition, many airlines have acknowledged the need to restructure with the ultimate goal of staying alive due to the unstable industry that forces them to think ahead. Though, they suddenly skip one significant factor that plays important role in business plan of any air transport carrier - flexibility – is the key element that ensures the success.

Also, we cannot forget at the carrier's mission that should reflect three basic features: *who you are what do you do and for whom and what are your uniqueness?* If the company is able to answer those questions, after that it can help them to communicate with passengers. It is also the tool for leadership because it gives the airline a clear position to take when working wills allies and promoting the airline with the public.

Therefore, the author also highlights the fact another important thing that is necessary to take a look - more advanced customer analytics that will provide the overview of the services that are needed, required and inevitable to satisfy customer's needs and which will lead towards positive image of the airline that cares about their people. Mentioned features are supported by a questionnaire that the author created in order to cover this specifications and in way to achieve ancillary revenues, and mainly loyal customers on other side because airlines must not cut costs in areas such as safety, reputation, and branding or customer value.

2. The Purpose of the Paper

The purpose of this paper is based on the illustration of historical low-cost business model development through its evolution since 1978 until present. According to the case studies that were analysed, author found out that all low-cost contemporary models are mostly based on the Southwest

airlines business model. Therefore, author feels the need to create new concept of business model that will be different as Southwest one and which will cover basic things that are necessary to be successful – it should cover customer and company values together. Rapidly changing environment has caused that low-cost carriers cannot sustain and new features are needed to keep airlines competitive and profitable. This problem is related to the saturation of the market and as a result of this many airlines have no possibility for further expansion, such as Ryanair that was the most profitable low-cost carrier in 2014 but also they suffer from limited possibilities for further growth.

An achievement of the mentioned goal is possible just in the case when analysis of existed business models will be provided. All research is linked with the finding of the concept that will be able as nearest as possible to combine features that will lead towards getting ability to stay competitive and profitable on one side, and also attract new customers and also will raise the segment of the customers.

The research is executed through following methods, such as typological analysis, historical and statistical research method. One of the essential ways of doing research is based on gathering information in order to gain theoretical perspective of the problem that will be supported by practical suggestions of the possible ways where to direct the LCC's business model. Firstly, for the purpose of the achieving goal related to the development of low-cost airline business models, author uses historical method to get all information from the entire enter of low-cost airlines on aviation market. It is followed by their subsequent development until today's position on worldwide market.

The creation of new concept of business model is linked with its economic and operational point of view. In order to work with a big amount of statistic's data it is necessary to use methods that will make them more understandable. Therefore, author uses two-dimensional symbolic data presentation by different types of diagrams. Also, the statistical procedures are interpreted by the Product and Organisational Architecture Tool that are helpful for the classification and relation of the key elements that are typical for the airline business models.

Author also uses typological analysis in order to divide the features that are typical for researched low-cost models and later they will be located in business model structure in way that allows making comparisons and estimating whether the data are consistent with appropriate theories.

3. Current Status of the Problem

Until 1978 when deregulation process started, air transport was available just for rich class due to high flight ticket prices. After that the monopoly of airline industry had to face another different competition based on the airline that offer cheaper flights and made the boom in airline industry. It begun with Southwest airlines that introduced new business model called low-cost airline business model

As can be seen in Figure 1 below, in 2004-2009 time period it is noticeable that many low-cost carriers failed – red line (19 airlines) while in the most successful year (2003) we could observe an entrance of 13 new low-cost carriers on European market (blue line). Moreover, in 2008-2009 we can observe lower low-cost carriers traffic operations in order to financial crisis that influenced all industries [2].

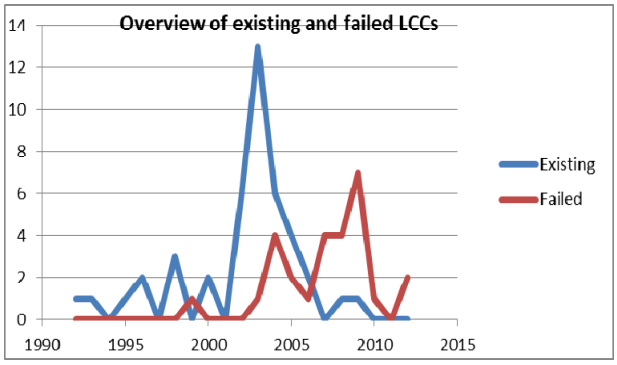

Figure 1. Illustration of existing and failed low-cost carriers [authors]

In addition, we can describe content of 4 categories that are related to low-cost carrier's airline business model, as can be seen in Figure 2 below.

Following mentioned Figure 2 in spite the fact that market conditions was tough for entrance of new carriers and mainly influenced by strong position of monopoly legacy carriers, many low-cost carriers operations started to show their position in more industrialised and economically prosperous countries of northwest Europe before their spread to south and east to the Central and Eastern Europe in 2000s. European aviation market showed strong position in 2013 despite economic crisis in many countries or due to the slow recovery from this situation. The results of the Association of European Airlines report that in 2013 they carried about 0.2% more passengers in comparison with previous year. In addition, members of the ELFAA reported a 6.7% passenger's increase in the same time period (2013). Also, European airlines have remarked growth of 5.8% in international Revenue per Kilometres (RPK), as can be seen in Figure 3 [4].

DOI: 10.26552/tac.C.2015.1.1

Establishment of Southwest Airlines – 1971 – inspiration for European airlines			
Classification	**Year**	**No**	**Founded Airlines**
Pioneer	1992-1998	8	*Ryanair, Norwegian, EasyJet,*Deboanair, Virgin Express, *Air Berlin*, Color Air, GoFly
Early adopted	1999-2002	8	Basiq Air, Buzz, Bmibaby, *Germanwings*, Goodjet, HLX, MyTravLite, SkyEurope
Mainstream LCCs	2003-2006	25	Air Polonia, Air Scotland, dba, EU Jet, FlyGlobespan, Flying Finn, Germania Express, Get Jet, Iceland Express, Jet2, Snowflake, V Bird, WindJet, FlyMe, FlyNordic, MyAir, *Thomson-Fly.com*, *Vueling,WizzAir,* Air Turquoise, CentralWings, Sterling, *Transavia.com*, Click Air, Zoom UK
Late adopters	2007-2012	2	Volare Web, Star1

Figure 2. Chronolgy of low-cost carriers pioneers [3]

Moreover, according to the Amadeus database, we can see significant impact related to the changing LCC's passenger demand. Low-cost carriers represents just 19% of total air traffic in Asia, 38% in Europe and over 30% in North America (related to 2013 time period). In addition, market share of low-cost carriers in Asian continent grew by 2% (from 16.5% to 18.5%) during 2011-2012 time periods and it was also the highest value in comparison with other regions worldwide.

Nowadays, in Europe we can still observe the highest concentration of low-cost airline carriers and during 2012 time period it increased about 1.5% while in Asia, Middle East and South West Pacific we can see just small increase (about 1%).

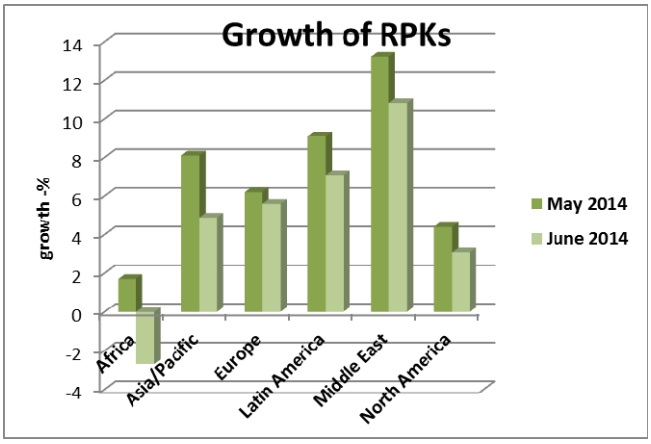

Figure 3. Comparison of PAX´s growth in RPKs [4]

Current status of low-cost carrier's market share (2013 time period) is illustrated in Figure 4 below.

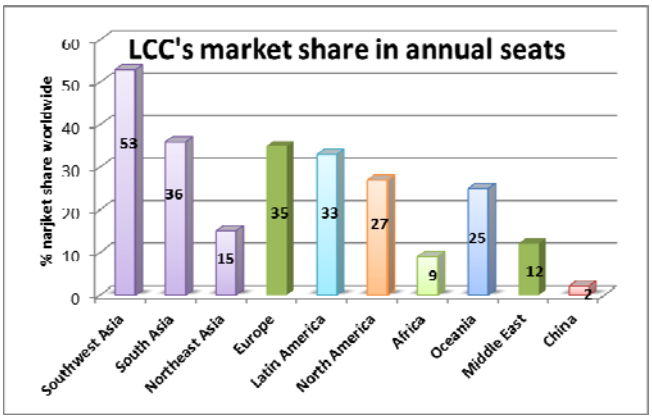

Figure 4. Illustration of LCC´s market share in 2013 time period [4]

Moreover, departing flights in the first half of 2013 to the same period in 2012 has shown that in Asia low-cost carriers seats grew by 6.8% worldwide across the same period. In the Middle East it grew at a fast rate of 17.7%. In comparison with European and American continent, capacity grew as well, but at a more modest rate: just 0.8% for Europe and 1.5% for North America [4].

Briefly, although low-cost carriers have found a position of dominance and have a robust growth, it should be known that airports are also facing increasing competition and therefore it is necessary to be able to analyse multiple data to ensure that opportunities will be identified and also ensure avoiding all possible risks.

4. The Results and Discussion

Firstly, author created an overview of the case studies that were related to the low-cost airline business.

Consequently, according to the available materials, author divided case studies following groups such as:

1. Case studies related to low-cost airlines business model development

(They were related to the factors that encouraged the spatial and temporal spread of low-cost carriers and they also offer an overview of the business model strategies).

2. Hybridisation process related to the low-cost carriers

(These case studies were based on hybridisation process on European and American continent).

3. Entrance of the LCCs on European market

(These case studies illustrated the entrance of low-cost carriers on European market and it also explained differences between legacy and low-cost carriers).

4. Last group is related to the network structure and their spreading through European continent

(These case studies represented differences between type of services between legacy and low-cost carriers and it also covered different conditions for low-cost carriers operations on European, American and Asian continent).

Secondly, author created compendious overview of airline business models in general with the sequent concentration on low-cost airline business model. According to the available classifications of the business model, one classification was missing, therefore author created new typology related to the level of offered services by concrete low-cost airlines.

Thirdly, analysis of the current low-cost carriers' position was done. Author compared the conditions on the market during last years and nowadays. All this facts leads towards the conclusion, that many carriers still face an extremely hard macroeconomic environment.

Lately, author created questionnaire that represents customer's preferences related to the customer's profile. This will be evaluated and consequently it will offer the requirements of the customers that should be part of the services of low-cost carrier's business model. It is based on the findings which factors are crucial to influence customer's decision to fly by low-cost airlines, such as price, seat comfort, flight's punctuality, etc. Also, author highlights services that could be important for current or future customer, such as flight entertainment, interline services, Wi-Fi on-board, etc. Moreover, last section of questionnaire is related to the customer's willingness to suggest the price that they are available to pay (it is limited that the value has to be higher than 5 euros for each service).

The results of this questionnaire will be the base for the confrontation of an expert's opinion to suggested services in future concept of low-cost airline business model. Later, author will assess the possible opportunities and will make inevitable calculations related to economic and operations model development.

5. Future Work

According to available data we will make financial calculations that will emerge from average values of selected economic indicators related to low-cost carriers on European continent and consequently it will cover combination of values related to the legacy carriers. After achievement of this data we will combine the most convenient values to ensure customer willingness for paying related fees and also it will cover all economic and operational values, indeed. Also, new concept of business model will include Frequent Flyer Programme - FFP (despite this way of customer's loyalty is more typical for legacy carriers). The reason why the author decides to suggest this programme into the concept of new business model is based on the fact that flyer programme focuses on ancillary revenues on one side and also this programme will be simple and understandable for customers.

As was mentioned in previous chapters, concept of new business model will be based on features that are illustrated in Figure 3 below.

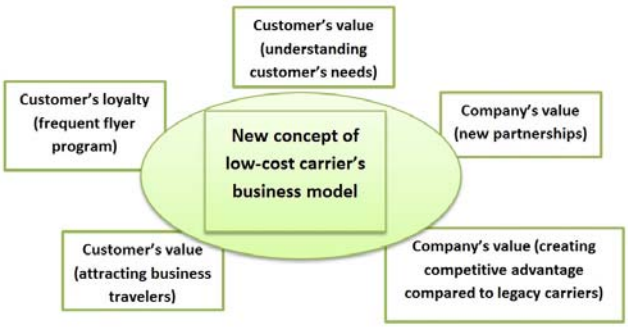

Figure 5. Features related to the concept of new business model [authors]

In addition, the author also highlights the fact that it is necessary to identify key indicators related to product and organisational architecture. Therefore we have to define the product architecture – that should be oriented on customer's needs and organisational architecture – how to manage the airline to ensure financial profits and airline's position on the low-cost carriers market where the product architecture is supported by Questionnaire on customer opinion on low-cost airline product that will suggest the services that are needed from the customer's point of view. The Organisational architecture will be supported by indicators related to the calculations of revenue, cost, profitability, comfort and convenience indexes. Combination of the Product and Organisational architecture will help to define business plan of new concept of low-cost carrier's model.

DOI: 10.26552/tac.C.2015.1.1

6. Conclusions

This paper offers an overview of current situation related to the low-cost airline business model development that is supported by its historical review since 1978 when South-west airlines had started its business, through description of the selected research methods and their application on the researched problem. Moreover, this paper introduces new typology of the low-cost carriers business model that was never used before – typology based on the quality level of the services – that is important mainly from the customer's need to respect their requirements and expectations.

Another practical contributed is based on the illustration of possible ways through enhancements in organisational structure that will lead towards another cost reduction that is the main goal of the LCC's model and also, the author stresses the fact related to the customers – it is necessary get to know your customers better in each way, e.g. through loyalty programs. Another problem related to the low-cost carriers is that many carriers try to reduce expenses in way that is not really effective. Due to this inappropriate tactic the author helps to find the right balance between making investments to improve the experience which they offer and also maintaining their cost advantage. This was supported by questionnaire that reflects customer's willingness to pay for extra services on-board and also it offers an overview of the services that are missing or that are insufficient.

According to the economic results that will emerged from mentioned questionnaire, author will create concept of possible low-cost carrier business model that will be given to the airline experts and which will cover the ability or non-ability to reach customer's expectations in way that will satisfy customers and their expected level of services on one side, and also economic and operations' business plan on another side.

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Operator – Pilot Learning Success With Aviation Ergatic System Control

Pavol Kurdel[1], Tobiáš Lazar[2], Alena Novák Sedláčková[3]

[1]Department of Avionics, Faculty of Aeronautics, Technical university of Košice, Košice, 041 21, Slovak republic
[2] Department of Avionics, Faculty of Aeronautics, Technical university of Košice, Košice, 041 21, Slovak republic
[3]Department of Air Transport, Faculty of Operation and Economics of Transport and Communications, University of Žilina, Žilina, 010 26, Slovak republic

Abstract The unique mission of operator – pilot during the performed flight lies in the responsibility for selected aircraft position doctrine along determine flight trajectory determined by programme. The mutuality of the relationship of the operator - pilot (OP) and the aircraft completes the image of an ergatic system [7] in which the OP is bound to the object (aircraft), makes decisions in complex flight situations, optimises the transfer of the aircraft into a regular flight. OP also decides about the change to manual aircraft control, which is the main feature of a selective method of flight ergatic system along determined flight trajectory control. The paper shows a method of determination and evaluation of operator – pilot with the aim to obtain quality in successful fulfilment of aviation ergatic system.

Keywords operator – pilot (OP), AES aviation ergatic system, asymptotic estimation

JEL L93

1. Introduction

The process of the operator – pilot learning has been standardised by European conventions and the flight schools are obliged to comply with them. The aim of aviation faculties is not only to comply with the learning processes but also to perform research in the areas which lead to increased quality of education by the application of new knowledge and technologies a finally to the increase of aviation safety according to the rule that the higher education quality means the higher quality of the student (operator – pilot). Also educational institutions in Slovak republic follow this way, University of Žilina and Technical University of Košice. The researches performed in the conditions of those universities are devoted mainly to the development of new technological processes which are implemented in the educational process which reflects in the upbringing of young specialists in the area of air transport who will later be able to utilise new approaches to the development of the air transport. This is how the importance of air transport will grow on both national and international levels. Technological approaches to increase the effectiveness of flights and air operation safety which have been found by research have been used by the form of knowledge transfer and the development into practical conditions of air transport. The developed technological processes enable their use in the cooperation with the practice to develop and support specialist education of young research workers on higher level of quality within practical specialist education, mainly on the third (PhD.) level of university study. The research described in the paper can also build foundation for the estimation of the feasibility of future professionals´ listing into the process of asymptotic learning how to control an aircraft.

Asymptotic learning is a process of gradual stabilisation of operator – pilot aviation ergatic system according to predetermined conditions, which determine the estimation of AES quality together with the influence of defined final progression of stimuli necessary for learning in the process of aircraft control and keeping it within flight envelope [4]. The operator – pilot performs the functions of ergatic complex, presents the generator of stimuli together with aircraft control. The difference in the metasystem values and immediate state of ergatic complex is the stimulus sASSce. The difference estimation evokes the control subject (operator – pilot and aircraft assistance system), which performs gradual steps and converges the metasystem of aircraft in a limit way with the ergatic system space-time. The running process of required concord is connected with the adaptive asymptotic learning (i.e. gradually along the exponent line). Repetition of control abilities and obtained experience, which is the result of AES state observation output confrontation and leads towards permanent refinement of operator - pilot. Realised skill in aircraft control in connection with knowledge of character, intellectual features of the object are the AES quality demonstration AES. [2]

DOI: 10.26552/tac.C.2015.1.2

In intellectual control of complex aircraft complexes, the skill, when it is possible to perform the activity in the control process in the most suitable way and the least possible effort on the base of acquired knowledge and previous practical activity, is important. [1]

2. Level of Skill of OP Estimation during asymptotic Learning

From the viewpoint of asymptotic learning it is possible to interpret skill as an open recurrent progression, which enables to follow the dynamics of the variable yi, when i = 1,2,3, --- within the range of j –time cycle (j = 1....N) of the ergatic process. In given case it is suitable to visualise the asymptotic learning by a recurrent relationship in the shape, which is described in [1] as:

$$y((i)) = a\,y(i-1) + (1-a)\,q((i)), \quad 0 < a < 1 \qquad (1)$$

Where:

yi – is the estimation of asymptotic learning success

q(i) – is the success of obtaining of the determined metasystem (solution aim), which is below marked by the symbol ASS (area of successful solution)

Where: q(i) = 1, then obtaining ASS is a success

q (i) =0, then obtaining ASS is a failure

a – constant, which determines the mutuality of the features of operator – pilot and further on, the range ($0.5 \leq a < 1$) is considered

From the above mentioned if follows that the estimation can be characterised as follows:

$y(i) = ay(i-1) + (1-a)$, if $q(i) = 1$

$y(i) = ay(i-1)$, if $q(i) = 0$

$y(i) = ay(i-1)$, if $q(i) = y(i-1)$

AES control characteristics are the input into the solution of differential equation (1). For the need of AES features comparison (i.e. OP and the object - aircraft), ASS characteristic types (i.e. type functions), which express mutuality features, have been selected. [6], [3]

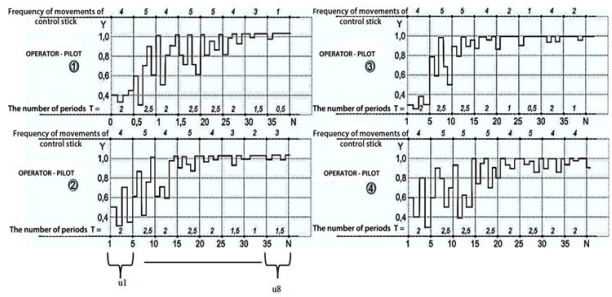

Figure 1. Representation of skills of different operator – pilots in AES control mode [7]

As it follows from Figure 1, the skill, [5] which has been illustrated for concrete cases by the calculation of mean values of AES control lever variation, is decisive for control. It is obvious that the form of the above mentioned characteristic is exponential. Movement of aircraft flight control stick gradually decreases in the mentioned characteristics, which shows the quality of operator - control skills to control the aircraft. Characteristic features (i.e. two types) of two learning OP´s have been illustrated. AES mathematical models, which contain considered characteristics and object, have been made for this purpose.

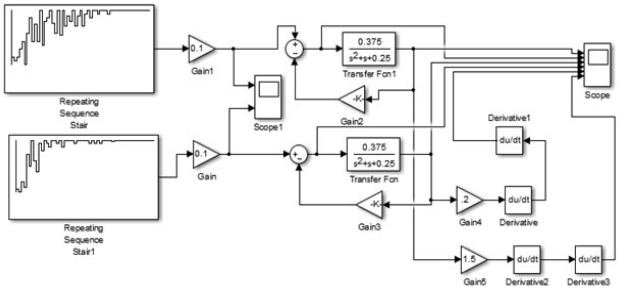

Figure 2. Scheme of AES features simulation with type characteristics of two operators - pilots

Legend:

1 – simulation model of OP1, OP3 characteristics (Fig.1),

2 – simulation model of object features

3 – oscilloscope – AES dynamics observation

Simulated outputs:

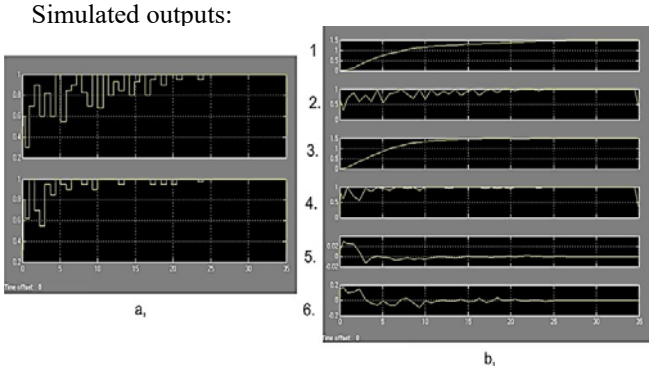

Figure 3. Outputs of AES simulation for OP manual control

a, inputs OP1, OP3. b, 1 – dynamics of the change angle-off attack evoked by movement the control stick OP1, 2 – control and feedback difference parameter, 3 - dynamics of the change angle-off attack evoked by movement the control stick OP3, 4 - dynamics of the change angle-off attack evoked by movement the control stick OP1, 5 – dynamics of AES acceleration evoked by OP3, 6 – dynamics of AES acceleration evoked by OP1

If the AES acceleration characteristics quality criterion is determined, then aircraft control learning process for OP3 can be evaluated by the value a = 1. OP1 can be integrated into the class with value = 0.5 (this evaluation means the expression of OP instructor experience, who is characterised by " i ", high degree of knowledge in control and obtained skill, which presents the connection of theory with practice).[7]

Next, it is possible to highlight the eligibility of such claims and the sensibility in OP integration into classes.

In researching OP skills it is suitable to select a type method of internal structure evaluation of control stick movement in the observed asymptotic learning cycle [1],[2]. The method of research accepts the programme environment Matlab, which enable the availability of task solving by the determination of mean values of movement control stick, Fig. 1. The progression of the programme of mean values calculation follows:

OP mean values

OP1 = [0.4 0.35 0.4 0.5 0.6 0.3 0.7 0.9 0.6 0.82 0.6 1.0 0.55 0.85 0.9 1.0 0.83 0.7 1.0 0.68 1.0 0.8 0.93 0.85 1.0 0.8 0.93 1.0 0.8 0.95 1.0 0.9 1.0 1.0 0.95]';

t=([1:4:36])'; %time of AES cycle control

y1=[0.4 0.5 0.9 1.0 1.0 0.68 0.93 0.85 1.0]'; %random selection of control stick movement by OP1, according to object control cycle

[t';y1']; %control lever movement check and table construction

figure(1), plot (t',y1'), hold on, %representation of control stick movement in AES control for OP1

OP3=[0.3 0.25 0.34 0.32 0.8 0.62 1.0 0.7 0.55 0.95 0.85 1.0 0.95 0.9 1.0 1.0 0.95 1.0 0.9 1.0 1.0 1.0 1.0 0.95 1.0 1.0 1.0 1.0 1.0 0.95 1.0 0.95 1.0 0.95 1.0 1.0 1.0 1.0 0.98 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0]';

%selection according to OP1 criteria concord:

y3=[0.3 0.32 0.7 1.0 1.0 1.0 0.95 1.0 0.95]';

[t';y3'];

plot(t',y3'),

plot(t',y3','r'),

ans = 1.0000 5.0000 9.0000 13.0000 17.0000 21.0000 25.0000 29.0000 33.0000

0.4000 0.5000 0.9000 1.0000 1.0000 0.6800 0.9300 0.8500 1.0000

ans = 1.0000 5.0000 9.0000 13.0000 17.0000 21.0000 25.0000 29.0000 33.0000

0.3000 0.3200 0.7000 1.0000 1.0000 1.0000 0.9500 1.0000 0.9500

title ('Movement of control stick in AES control'),

xlabel('Time progression in control stick movement'),

ylabel('Control stick movement values ')

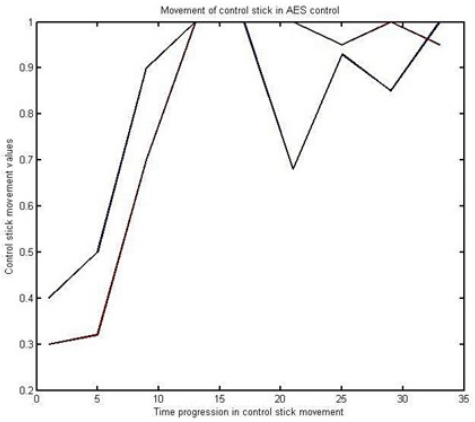

Figure 4. Control lever movement measurement during AES control Outputs of AES simulation for OP manual control

2.1. Partial conclusion

According to Fig. 2 and the simulation results, according to Fig. 3, (control stick movement - Fig. 4) it is possible to estimate the skill for each OP in an expert way. It is possible to guess that the skill OP3 > OP1. The correctness of intuition decision is possible to be confirmed by the calculation of mean values of skill measurement, which can be performed in the environment MATALAB in the following way.

3. OP Skill Quality Measurement

The simulation of operators - pilots (OP1, OP3) has been performed according to a programme algorithm respecting the following orders:

%Numeric integration of differential equation (1) of estimation variable is listed in MATLAB environment (see Numerical %Estimation of Pi Using Message Passing) and required adjustment to the following form

%yF=@(tau)1/T0/(2.718^(T/T0))(2.718.^(tau/T0)*q(tau)=1/T0(atan(b)-atan(a))=1.% integral differential equation*

% a,b;[a,b]- upper, bottom limit (gradually) of integral yF.

%For the estimation of operators quality (skills) it is sufficient to determine variable standard which accepts the principle of its asymptotic growth. The selected standard is:

*%T0=n*T, where: N=(observed section(u)/number of control inputs(r)).Then: T0=u/r*T.*

%T-number of period control inputs

%After substituting parameters into integral equation the following form is obtained

*%yF=@(tau)(r/u*T)/(2.718^(r/u))*(2.718.^(tau*(r/u*T))*q(tau).*

DOI: 10.26552/tac.C.2015.1.2


```
%Skill estimation by equation yF requires the application of the following orders
%[a, b];integral limits
%P>> myIntegral = quadl(yF, a, b). P-sequence number of sections of OP inputs.
%The above mentioned method is applied on the control skill (quality) estimation of both OP1 and OP3 operators – pilots whose control inputs are illustrated in Fig (1).
% Graph description:
%Graph Y(N) of each OP presents the function of approximation process into ASS along an exponent line.
% N-number of observed sections „u“ in which control inputs with the number or „r“ are recorded.
%Final aim of control is the state Y(N)=1.Therefore q(tau)=1 – success.
%First control input in section recording: first vertical recording. End of recording is on vertical line of the following section.
%First operator skill estimation is marked:
% OP1.
% First section u1(fig.1) P11.
r=4;u=5;T=2;
yF=@(tau)(r/(u*T))/(2.718^(r/u))*(2.718.^(tau*(r/u*T)))
a=0.36;b=0.44;[a,b];
myIntegral=quadl(yF,a,b),
% P12.
r=5;u=5;T=2.5;
yF=@(tau)(r/(u*T))/(2.718^(r/u))*(2.718.^(tau*(r/u*T)))
a=0.36;b=1;[a,b];
myIntegral=quadl(yF,a,b),
% P13.
r=4;u=5;T=2;
yF=@(tau)(r/(u*T))/(2.718^(r/u))*(2.718.^(tau*(r/u*T)))
a=0.5;b=1;[a,b];
myIntegral=quadl(yF,a,b),
% P14.
r=5;u=5;T=2.5;
yF=@(tau)(r/(u*T))/(2.718^(r/u))*(2.718.^(tau*(r/u*T));
a=0.6;b=1;[a,b];
myIntegral=quadl(yF,a,b),
% P15.
r=5;u=5;T=2.5;
yF=@(tau)(r/(u*T))/(2.718^(r/u))*(2.718.^(tau*(r/u*T));
a=0.8;b=1;[a,b];
myIntegral=quadl(yF,a,b),
% P16.
r=4;u=5;T=2;
yF=@(tau)(r/(u*T))/(2.718^(r/u))*(2.718.^(tau*(r/u*T));
a=0.8;b=1;[a,b];
myIntegral=quadl(yF,a,b),
% P17.
r=3;u=5;T=1.5;
yF=@(tau)(r/(u*T))/(2.718^(r/u))*(2.718.^(tau*(r/u*T));
a=0.97;b=1;[a,b];
myIntegral=quadl(yF,a,b)
% P18.
r=1;u=5;T=0.5;
yF=@(tau)(r/(u*T))/(2.718^(r/u))*(2.718.^(tau*(r/u*T)))
a=0.95;b=1;[a,b]
myIntegral=quadl(yF,a,b),
% Independent values of sections:
N=[1 5:5:35],
%Function:
YN1=[0.0273 0.5722 0.3064 0.4532 0.2851 0.1524 0.0160 0.018];
%Obtained skill estimation is:
OZ1=1-YN1,
%Graf OZ1:
plot(N,OZ1,'bo-'),hold on,
title(' OPERATOR-PILOT SKILL ESTIMATION'),
xlabel('Observation sections '),ylabel('Skill estimation values'),
%Equally the following have been calculated:
% OP3.
N=[1 5:5:35];
YN3=[0.2225 0.4338 0.4598 0.0823 0.0392 0.0360 0.0345 0.0119];
OZ3=1-YN3;
plot(N,OZ3,'k'),hold on,
t=([1 5:5:35])',
y=[0.0273 0.5722 0.3064 0.4532 0.2851 0.1524 0.0160 0.018]',
plot(t,y,'bo-'), hold on, h = plot(t,y,'b'), hold off,
title('Input data'); ylim([0 0.45])
%y = C(1)*exp(-lambda(1)*t) + C(2)*exp(-lambda(2)*t),
type fitfun
start = [0;.0261];
outputFcn = @(x,optimvalues,state) fitoutputfun(x,optimvalues,state,t,y,h),
options = optimset('OutputFcn',outputFcn,'TolX',0.1),
estimated_lambda = fminsearch(@(x)fitfun(x,t,y),start,options)
hold on,
t=([1 5:5:35])',y=[0.2225 0.4338 0.4598 0.0823 0.0392 0.0360 0.0345 0.0119]';
plot(t,y,'go'), hold on, h = plot(t,y,'g'), hold off,
title('Input data'); ylim([0 0.45]),
xlabel(' observation sections '),ylabel(' skill estimation mean '),
type fitfun
start = [0;.018];
outputFcn = @(x,optimvalues,state) fitoutputfun(x,optimvalues,state,t,y,h),
options = optimset('OutputFcn',outputFcn,'TolX',0.1);
estimated_lambda = fminsearch(@(x)fitfun(x,t,y),start,options)
hold on
```

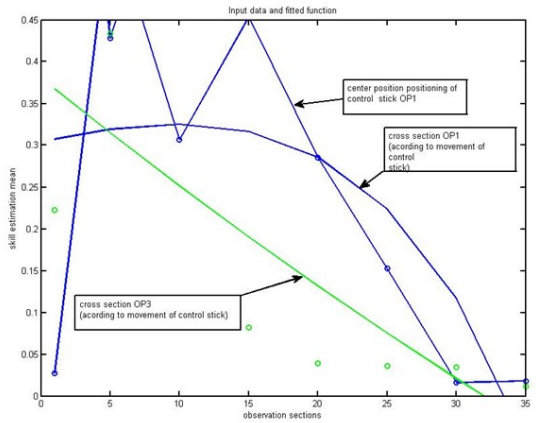

Figure 5. Output reliability characteristics of OP and object mutuality.

4. Conclusions

The defined conditions of mutuality research expressed by the character of operator – pilot and the object can be quantified only on the base of experiences which are inserted into the solution by a subjective judgement of an expert. Mutuality quantification in the paper is presented by the parameter „ a “, which indirectly enables the realisation of algorithms which have been confronted with the possibilities offered by MATLAB. The simulation of object mathematical models and later OP simulation through the term „skill“ uncovers manifested dependence, which can be used to estimate the reliability of object control by the operator - pilot. The method presented in the paper demonstrates its flexibility to the variants of the control of object control by OP. Appertaining influence of the skill, which is evaluated by movement the aircraft control stick against its mean position in the paper, creates a good prerequisite for the creation of supplementary classification classes which show OP quality and its use for concrete flight tasks solutions. The four used OP characteristics serve as type functions which can create a base for the qualification of the suitability of professionals selection into the process of asymptotic learning to control aircraft in relevant educational environment.

ACKNOWLEDGEMENTS

This paper has been created following the project in the process of solution which has been co-financed by the EU sources entitled Implementation of scientific research knowledge to the Air Transport -ITMS 26220220010.

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Transport and Communications, 2015; Vol. I.
ISSN: 1339-5130
DOI: 10.26552/tac.C.2015.1.3

Comparison of R&D within the Visegrad countries

Radovan Madleňák[1], Mário Al Kassiri[2]

[1,2] Department of communications, Faculty of Operation and Economics of Transport and Communications, University of Žilina, Žilina, 010 26, Slovak republic

Abstract Knowledge is learning, as short explanation meaning. Knowledge is gained by long-term experience, continual learning, as well as by finding the right solutions for the issue. The longer we take the time for solving and analysing the issue the better given solution can be obtained. Knowledge is very closely linked with creativity, as Einstein had mentioned, Creativity has no boundaries, but it is a process that requires knowledge of the problem and longer term experience according to research. The knowledge economy is very important for growing economies. Countries which are rich of raw material resources yet don't need to be countries which are part of developed countries. This might be caused by not supporting the ideas of innovations, education, or research and development. Simply we can say that growing economics is based on knowledge.

JEL O10, H52

1. Introduction

Economists continue to search for the foundations of economic growth. Traditional "production functions" focus on labour, capital, materials and energy; knowledge and technology are external influences on production. Investments in knowledge can increase the productive capacity of the other factors of production as well as transform them into new products and processes. It is not a new idea that knowledge plays an important role in the economy. [1]

Slovakia is a small open economic dependent on exports and foreign investment. Its competitiveness now stands primarily on the comparative advantage of the relatively low cost of work. Slovakia is a small open economy dependent on exports and foreign investment. Its competitiveness now stands primarily on the comparative advantage of the relatively low cost of work. The following period, however, competitiveness will increasingly make the usage of knowledge on innovative processes as an important factor.

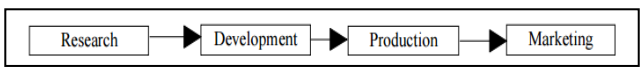

Figure 1. The linear model of innovation

The traditional theory held that innovation is a process of discovery which proceeds via a fixed and linear sequence of phases. In this view, innovation begins with new scientific research, progresses sequentially through stages of product development, production and marketing, and terminates with the successful sale of new products, processes and services. [1]

2. Theoretical background

Typical examples of knowledge-intensive services include research and development (R&D), management consulting, information and communication services, human resources management and employment services, legal services (including those related to intellectual property rights) accounting, transportation, financing, and marketing-related services activities etc. [2].

In importance particularly in the context of the Lisbon strategy, the aim of which was to create a presumption of intensifying competition based on knowledge, quality and innovation and other related documents. Currently, the most important is the Europe 2020. [3]

Five targets for the EU by 2020

1. Rate of employment increase by the population aged 20-64 years to 75%.
2. To increase the level of investment into research and development to 3% of GDP.
3. Climate change and energy sustainability of reducing greenhouse gas emissions by 20% (or providing a broader global agreement by 30%) compared to 1990 levels of 20% of renewable energy to reach 20% increase efficiency in energy use.
4. Reduction of early school leaving to below 10% at least 40% of the population aged 30-34 years should complete the university education.
5. Reduction of a number of people at risk and underprivileged people by at least 20 million. [4]

Research and development is a national priority in the knowledge-economy and has been placed on 2nd place in the objectives of the EU by 2020.

2.1. The characteristics of the economic activity

Service sector by knowledge intensity is divided into knowledge-intensive services:

- knowledge-intensive services - high technology:
  - post and telecommunications,
  - computer and related services,
  - research and development.
- knowledge-intensive market services (excluding financial services and high technology)
  - water and air transport,
  - real estate activities,
- knowledge-intensive financial services:
  - financial intermediation without insurance
- other knowledge-intensive services:
  - education,
- knowledge-demanding market services:
  - trade in vehicles and fuels,
  - wholesale etc., [5]

3. Comparison of selected indicators

Table 1. Research and development expenditure, by sectors of performance in % of GDP in the business enterprise

Year	Slovakia	Poland	Hungary	Czech Republic
2002	0,36	0,11	0,35	0,67
2003	0,31	0,15	0,34	0,7
2004	0,25	0,16	0,36	0,72
2005	0,25	0,18	0,4	0,69
2006	0,21	0,17	0,48	0,74
2007	0,18	0,17	0,49	0,77
2008	0,2	0,19	0,52	0,73
2009	0,2	0,19	0,65	0,73
2010	0,26	0,19	0,69	0,77
2011	0,25	0,23	0,75	0,86
2012	0,34	0,33	0,84	0,96
2013	0,38	0,38	0,98	1,03
Average	**0,27**	**0,2**	**0,57**	**0,78**

In table no. 1 are compared Visegrad countries from 2002 to 2013 in research and development expenditure, by sectors of performance in %. Results were then compared and averaged in order to show which out of four countries has the largest expenditure on R&D. In this case, table 1 shows that the Czech Republic has the largest expenditure on research and development. Thus, the sequence would be as follows; the Czech Republic, followed by Hungary, Slovakia and the least spending on R&D is Poland. Poland is more concentrated on quantitative production then the production based on innovation.

Table 2. Research and development expenditure, by sectors of performance in % of GDP government

Year	Slovakia	Poland	Hungary	Czech Republic
2002	0,15	0,25	0,32	0,25
2003	0,18	0,22	0,29	0,27
2004	0,15	0,22	0,26	0,26
2005	0,15	0,21	0,26	0,26
2006	0,16	0,2	0,25	0,27
2007	0,16	0,2	0,23	0,3
2008	0,15	0,21	0,23	0,28
2009	0,16	0,23	0,23	0,3
2010	0,19	0,26	0,21	0,29
2011	0,18	0,26	0,19	0,31
2012	0,2	0,25	0,18	0,33
2013	0,17	0,23	0,21	0,35
Average	**0,17**	**0,23**	**0,24**	**0,29**

Table 2 shows R&D expenditure, by sectors of performance in % of GDP government. Based on calculation average of shown data we came out with the following result: Czech Republic (0,29%), Hungary (0,24%), Poland (0,23%) and the least is Slovak Republic (0,17%). We of course, must consider into account the population, the GDP growth in the country and other macroeconomic indicators that may have an impact on the overall output of R&D. It is believed that the greater costs on R&D the greater the share of the output produced during the period.

Table 3. Research and development personnel, by sectors of performance (% of the labour force) business sector environment

Year	Poland	Slovakia	Hungary	Czech Republic
2002	0,05	0,17	0,18	0,25
2003	0,07	0,14	0,17	0,27
2004	0,08	0,13	0,16	0,29
2005	0,08	0,13	0,18	0,42
2006	0,08	0,12	0,22	0,46
2007	0,09	0,1	0,24	0,49
2008	0,08	0,1	0,27	0,5
2009	0,08	0,1	0,31	0,49
2010	0,11	0,12	0,35	0,51
2011	0,11	0,12	0,4	0,57
2012	0,15	0,14	0,46	0,61
2013	0,17	0,13	0,51	0,64
Average	**0,096**	**0,125**	**0,288**	**0,458**

Based on table 3 we can determine the number of employees in the business sector since 2002-2013. Average of years studied indicates the country with the highest number of researchers in the business sector as following an order

DOI: 10.26552/tac.C.2015.1.1

from highest into the least: Czech Republic, Hungary, Slovakia and Poland. The outcome is based on the assumption of the costs incurred in R&D. We can also foresee an increased total output from the research according to expenditures spent on R&D.

Table 4. Research and development personnel, by sectors of performance (% of the labour force) by Government

Year	Poland	Slovakia	Hungary	Czech Republic
2002	0,14	0,15	0,19	0,14
2003	0,12	0,15	0,19	0,16
2004	0,12	0,13	0,18	0,15
2005	0,1	0,14	0,18	0,2
2006	0,1	0,14	0,19	0,21
2007	0,1	0,16	0,18	0,22
2008	0,11	0,16	0,19	0,22
2009	0,11	0,15	0,2	0,21
2010	0,12	0,16	0,19	0,21
2011	0,12	0,15	0,2	0,21
2012	0,13	0,15	0,17	0,22
2013	0,13	0,13	0,18	0,22
Average	**0,115**	**0,148**	**0,187**	**0,198**

Table 4 indicates the status of employees in R&D. According to calculated average, from the following years 2002-2013 we came to the result, that country with the highest number of employees according to order from highest are as following: Czech republic, Hungary, Slovakia and Poland. We must consider the factors such the growth of HDP, population and other factors which can influence the number of employees in R&D mainly in the government sector. Increased employment in R&D government sectors may also cause the reduction in competition. The economic growth is considered in particular on GDP growth. GDP growth affects the qualitative and quantitative growth factor. Quantitate methods are mainly on the volume of production in the country, the use of technology and techniques. Assuming that the country which supports R&D supports overall economic growth.

3.1. Government projects supporting R&D

"Support for projects involving basic research, applied research and experimental development,

- support for technical feasibility studies,
- support for small and medium enterprises in intellectual properties,
- supporting technology transfer,
- supporting innovative enterprises,
- support for process innovation and organizational innovation in services,
- support of counselling in services for innovation,
- encouraging mobility of highly skilled workers in small and medium-sized enterprises
- supporting the creation of innovation networks. "[3]

4. Conclusion

A country which supports R&D simply supports economic growth. Economic growth is the result of increasing employment, innovation, production, and motivation for foreign investors. The most important consideration is the know-how of the best uses of our raw materials. Knowledge is contracted in development and examination based on the information received. Today, many economists agree that one of the primary factors for economic growth is knowledge. It is a wealth that can be transformed into the country's wealth. Countries which have mineral resources are mostly countries with weak economies. These countries don't consider the importance of innovation and knowledge. In simple way to say, that money can be spent whereas knowledge can be transferred into a meaningful source. This is probably due to the fact that countries with raw materials rely on their resources and not based on innovation and a growing economy. Countries such Germany, France, are countries which don't belong to countries with mineral sources, but they fully support innovation, R&D and knowledge. This is probably due to the fact that countries with raw materials rely on their resources and not based on innovation and a growing economy. Civilization must learn and obtain knowledge and experience which can then be converted into an inexhaustible source.

ACKNOWLEDGEMENTS

VEGA – 1/0515/15 Endogenous factors of the IPR intensive Industries in the regional enterprise environment in Slovak Republic

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Transport and Communications, 2015; Vol. I.
ISSN: 1339-5130
DOI: 10.26552/tac.C.2015.1.4

Providing Transport Services Based on the Gross Cost and Net Cost Contracts

Miloš Poliak[1], Štefánia Semanová[2], Peter Varjan[3], Lenka Komačková[4]

[1]Department of Road and Urban Transport, Faculty of Operation and Economics of Transport and Communications, University of Zilina in Zilina, Univerzitná 1, Zilina, 010 26, Slovak Republic (University of Zilina in Zilina)
[2]Department of Road and Urban Transport, Faculty of Operation and Economics of Transport and Communications, University of Zilina in Zilina, Univerzitná 1, Zilina, 010 26, Slovak Republic (University of Zilina in Zilina)
[3]Department of Road and Urban Transport, Faculty of Operation and Economics of Transport and Communications, University of Zilina in Zilina, Univerzitná 1, Zilina, 010 26, Slovak Republic (University of Zilina in Zilina)
[4]Department of Road and Urban Transport, Faculty of Operation and Economics of Transport and Communications, University of Zilina in Zilina, Univerzitná 1, Zilina, 010 26, Slovak Republic (University of Zilina in Zilina)

Abstract The paper deals with an issue of the impact of a contract form choice on providing public transport services and its influence on a scope of transport services. The first part of the paper describes the current situation in selected countries and then various contract forms. It also analyses the existing risks and possibilities for their allocation between the contracting parties in the field of public transport provision. Further part of the paper describes an approach of public service operators to net cost contracts and gross costs contracts.

Keywords contract, transport, service, risk, responsibility

JEL

1. Introduction

Within Member States of the European Union, the majority of public passenger transport services cannot be provided on a commercial basis. Public authorities must ensure providing transport services even in times of low demand, particularly in the evenings and at the weekends. The aim of transport serviceability is to provide inhabitants with the satisfaction of their basic transport needs such as travelling to work, schools or health care facilities. Furthermore, it is necessary to provide public transport services with regard to social and environmental factors and to provide special tariff conditions for particular groups of passengers such as students and pensioners (Regulation (EC) No 1370/2007) who have no other options of transport than public passenger transport.

In 2007, a new Regulation (EC) No. 1370/2007 came into force and it is currently valid throughout the European Union. It regulates the conditions of providing public transport services in EU Member States. According to this regulation, it is possible to ensure providing public transport services through a direct award in rail and road transport only in the case that a public service operator is owned by the public authority, or the subject of contractual relationship between the operator and authority is providing public transport services with maximum annual performance of 300 000 km or a maximum price of performance is 1 million €/year (van de Velde, 2008). The direct award is also possible for the operator who operates not more than 23 buses with maximum annual performance of 600 000 km and a maximum performance price of 2 million €/year. In all other cases, the public authority is obligated to ensure providing transport services through a competitive tendering.

In Slovak regions and cities up to 2009, any public transport services were ensured without a competitive tendering. Contracts were awarded directly to particular operators. The most common contract form was gross cost contract where a part of cost risks are transferred to a public authority. The form of such contracts is similar to management contracts under which the authority assumes all risks (revenue and cost risks) associated with providing public transport services. According to the existing contracts, the authorities award the exclusive rights to a particular operator and this enables the operator to provide public transport services. Moreover, authorities grant a financial compensation to the operator in the case that fare revenue does not cover the operator's costs. In addition to reimbursement of costs, the operator is entitled to a reasonable profit. A similar system of contracts exists also in other countries of Central Europe (e.g. the Czech Republic, Hungary, and Poland). Under the contracts between

* Miloš Poliak: milos.poliak@fpedas.uniza.sk

authorities and operators in mentioned countries, the authorities are obligated to assume all economically justified costs calculated by the operators. However, it is problematic for authorities to control eligibility of individual cost items. Under contractual relationship, the operator is entitled to the reasonable profit in addition to cost recovery. In accordance with applicable legislation regulating contracting for public interest services (Act No. 56/2012 coll.), the reasonable profit in terms of methodology for its determination is a matter of an agreement between contractual parties – the public authority (self-governing region or city) and the operator. In all contracts made in the SR up to 2012, the reasonable profit is determined in the range from 3.5 to 5.0 % of the economically justified costs[1]. A similar approach can also be found in some other EU Member States, despite the fact that determination of the reasonable profit as a percentage of the costs is not economically correct procedure (Poliak, 2013). For example in Hungary, the public service contract between the operator and public authority (the city of Budapest) contains provisions under which a level of the reasonable profit is maximum 4 % of economically justified costs[2].On the other hand in the Czech Republic, a new Decree No 296/2010 was adopted in 2010 and it stipulates a level of the reasonable profit at a maximum level of 7.5 % of operating assets per year. Deficiencies of such determined reasonable profit are discussed in detail by Poliak (2013), Fendeková and Fendek (2010).

The public authorities in the SR have problems with the financial resources to cover the demonstrable loss of operators. Therefore, the mechanisms for reducing financial resources of providing public transport services from the authorities' position without a quality reduction are being sought. Requirements of quality assurance in providing public transport services are elaborated in detail by Konečný (2011). One of the possibilities is to transfer a part of the risks to operators. There is also an option to transfer all risks associated with providing public transport services to operators and enter into the contract under the net costs (net cost contracts). The aim of this paper is to analyse the risks related to providing public transport services and the risks which arise from concluding gross cost contracts and net cost contracts.

2. The Risks and Possibilities of Contracting in Providing Public Passenger Transport Services

Financing public transport services cannot be assessed independently without an analysis of the risk which is borne by an operator in providing public transport services. Existing risks can be categorised into (Valach, 2001), (Fotr, 1992):

- Systematic risks – such risks include political risks (government decisions, changes in government policy, etc.), international risks (changes in foreign exchange rates, etc.), economic risks (price development, population purchasing power, etc.), interest rate changes, the inflation risk, and the risk of unforeseen events.
- Unsystematic risks are the risks associated with the revenue of company and its ability to cover liabilities. These risks may be influenced by an investment project quality, deployment environment, qualified management, etc.

Regarding to providing public transport services, van de Velde (2008) deals with the risk analysis and he divides the risks into:

- Cost risk: the risk related to an incorrectly predicted level of operating costs and the incorrectly determined residual value of investment costs at the end of a contract period.
- Revenue risk: the risk related to a revenue decrease due to the decline in demand for public transport services and the passenger structure changes.

2.1 The Operational Cost Risks

The cost risks are characterised as the risks arising from the difference between the calculated (predicted) costs and the actual costs after the performance realization. In other words, the risk associated with the payment allocation of the difference to the person who bears the risk. If the operating costs are higher/lower than those predicted in the contract, it will be necessary to determine an entity that will be responsible for potential losses.
The cost risks can be further divided:

- External cost risks: the risk that cannot be influenced by operators at all (e.g. cost increasing due to flooding streets in the event of natural disasters). This group can also include the risk which can be influenced by operators indirectly or only in small extent (e.g. changes in energy prices during the contract period, change of employees' costs, etc.)
- Internal cost risks: the risk that can be influenced by operator, e.g. the costs of maintaining of vehicle fleet (the operator can decide on the maintenance process in order to avoid failure of vehicle and higher costs). (Kilianová, 2012).

2.2 Investment Cost Risks

In this case, it is basically determination of the asset residual value at the end of a contract period. In other words, it is the determination of the risk liability associated with the property and asset value (infrastructure, stations, vehicle, etc. in the case of public passenger transport).

2.3 Revenue Risks

The revenue risk is characterised as the risk of a

[1] e.g. Public service contract for urban bus transport in the city of Bardejov – the reasonable profit is 5 % during the contract period (the contract is valid until 31.12.2018)

[2] Public service contract in urban transport between BKV operator and city of Budapest; 2008

DOI: 10.26552/tac.C.2015.1.4

decrease/increase in expected revenue. This represents determining responsibility in the case that the revenue is lower than that anticipated in the contract. This risk can be borne by public authority as well as operator. The revenue risk can be divided as follows:

- Revenue risk associated with a decrease in demand - it is a risk related to the changes in number of passengers carried when providing public passenger transport. In the case that the authority (self-governing region or city) bears the revenue risk, it is necessary to appropriately involve the operator in compliance with required quality because the amount of the compensation in this case does not depend on the number of passengers carried.

  In the SR, this risk is very significant because the demand for public passenger transport expressed in passenger-kilometres (pskm) is decreasing annually in road and railway transport.

  While the performance of regular bus transport was at the level of 8.4 billion pskm in 2000; in 2013, it was at the level of only 4.388 billion pskm (Table 1). It represents a performance decrease by about 48 %. A similar development can be also observed in railway transport where the performance was at the level of 2.87 billion pskm in 2000. In 2013, performance of railway transport achieved the value of only 2.485 billion pskm. This represents a performance decrease by about 13.4 % (Table 1). Table 1 shows data from the whole SR, however, the performance decrease is not the same throughout the territory of the SR. Therefore, when it comes to the revenue risk associated with a decrease in demand, it is necessary to distinguish territories in which the transport services are operated.

Table 1. Performance Development (in million pskm)

Kind of Transport	2000	2005	2008	2009	2010	2011	2012	2013
Railway Passenger Transport	2 870	2 182	2 296	2 264	2 309	2 431	2 459	2 485
Regular Bus Service	8 435	7 525	6 446	4 538	4 436	4 611	4 584	4 388
Urban Transport	1 173	1 399	1 370	1 127	1 119	1 172	1 137	1 145

Source: authors based on [8]

  The development of number of passengers carried depends to some extent on the interventions of public authorities which can indirectly influence the number of passengers carried through fulfilling their strategic objectives. The strategic objectives of public authorities can be divided into (Stanley and van de Velde, 2008):
  - *economic* - maximizing the effectiveness and efficiency of resource use (e.g. limitations of unused connections, fare increase for less used connections, taxation of passenger cars as a source of compensation for losses of public passenger transport, etc.);
  - *environmental* - minimizing the impact of transport in the served area (e.g. limiting access of cars at defined time intervals in the serviced territory);
  - *social* - ensuring possibility of mobility for all people, particularly for vulnerable groups of passengers (discounted fares for students, pensioners, etc.);
  - *public* - planning transport policy and other policies in a region (e.g. deployment of schools raises a demand for carriage, etc.).
- Revenue risk associated with a change of passenger structure – it is the risk of revenue change because of a change of passenger structure. For example, when the selected groups of passengers (students, pensioners) travel with special fares, an increase in number of those passengers while keeping the total number of passengers causes a decrease in total revenue for providing transport services. The good solution is setting an appropriate pricing policy of transport services. However, it is important to monitor the impact of price changes on the demand, which varies considerably for particular groups of passengers (Gnap et al., 2006). In the SR, the discounted fares known as saver tickets (half price of the full fare ticket) are for young people aged from 6 to 15 and students to 26, and fares known as "other fares" are for :
  - senior citizens over 70 (€ 0.20 per every 50 km),
  - severely disabled people (half price of the full fare ticket),
  - parents travelling to visit their physically or mentally disabled, chronically ill children nourished in special facilities in the SR (half price of the full fare ticket).

The public passenger transport fare is regulated by public authorities that decide which specific groups of passengers will be entitled to the reduced fares; and, therefore, the revenue risk associated with the change in passenger structure can be classified as the risks associated with interventions by public authorities.

Based on the above analysis, it can be stated that the most passengers leaving public passenger transport system are those who have an option of other means of transport, mainly a passenger car. This group consists of the passengers travelling for full fare. Students who usually do not have the option of travelling by a passenger car, and they are subjected to compulsory school attendance, remain as the users of public passenger transport. Similarly in case of pensioners, the transition to individual motoring is limited at present. Therefore, the need for increasing public funding can be expected because the current trend of increases in number of passengers travelling with special fares persists and these fares bring lower income for operators in comparison with the full fares.

The contract between authorities and operators must be concluded according to the risk allocation between contracting parties. There are following contract forms (van de Velde, 2008):

- The operator bears no risk: in principle, it is called a management contract according to which the authority

bears the cost as well as revenue risk and thus operator bears no risk.
- The operator bears cost risk: so-called a gross cost contract. In this case, the operator bears the production cost risk and the authority assumes revenue risk.
- The operator bears both risks (cost and revenue risk): so-called a net cost contract where the operator assumes both types of mentioned risks and the authority bears no risks.

Table 2 shows the cities in which operators bear the cost risk (authorities assume the revenue risk) or operators bear both risks.

The risk is also possible to allocate between the contracting parties in a certain share (no matter whether cost or revenue risk):
- Full allocation of the risk to one of the contracting parties (the risk from difference between anticipated costs and actual costs spent as well as difference between anticipated revenue and revenue actually achieved).
- Shared allocation of the risk from difference between anticipated and actual level of costs or revenue. A certain percentage of the risk is allocated to each party, for example, in ratio 50/50.
- Pro rata risk allocation to a certain limit (e.g. the operator bears revenue risk up to the level of € 100 000 and the risk above that level is divided proportionally – 50 % to each party (van de Velde, 2008).

Table 2. Allocation of Cost and Revenue Risk to the Operator

Operator Bears	**Cost Risks**	Krakow, Innsbruck, Rome, Dublin, Gifhorn, London, Oviedo, Elmshorn, Frankfurt, Halmstad, Munich, Stockholm, Warsaw
	Cost And Revenue Risks	Amsterdam, Barcelona, Brussels, Budapest, Dijon, Gifhorn, London, Lyon, Parla, Porto, Santiago, Trieste, Grenland, Haarlem, Manchester, Sondrio, Sundsvall, Wittenberg

Source: van de Velde (2008) and Poliak et al. (2012)

3. Approach of Operators to Various Contract Forms

From the position of public authorities that plan funds for providing public transport services, the net cost contracts appear to be the most advantageous. Under this contract form, all the risks, cost and revenue, are borne by operators. The authority pays to the operator a financial amount that is fixed determined at the beginning of a contract period and stated in the contract. In this case, the public transport services in a given area are provided only by the selected operator through a license. The operator has the option to set the level of fares because he also assumes revenue risks.

The gross cost contract is advantageous for operators because they do not bear the risk of revenue decreases which is usually associated with the factors that cannot be influenced by operators.

Based on mathematical modelling of a price regulation and determination of the business reasonable profit in network industries, Fendeková, E and Fendek, M (2010), they mathematically model an approach of the enterprise in a regulated sector and they define two approaches that can be applied in providing public transport services:
- Approach of the enterprise applying return on investment – the approach encourages the enterprise to use a high volume of capital in order to achieve the maximum permitted reasonable profit. The enterprise has no incentive to use more efficient combination of inputs, e.g. supporting employment in comparison with an end in itself investment in facilities.
- Approach of the enterprise applying increasing the volume of outputs – in this case, if the authority does not have the possibility or manpower for verifying effectiveness of providing public transport service, the operator will seek to realise also inefficient performance.

The mathematical cost modelling applicable to providing public transport services can be also found in the studies of Zhanbirov and Kenzhegulova (2012), and Sharma and Swami (2012).

3.1 Approach of Operators to Gross Cost Contracts

Operators assume all cost risks under gross cost contracts in providing public transport services, whereas, authorities bear revenue risks related to a decrease in the number of passengers. Documents for optimization of public transport services are available for the operator and in case that the authority does not have sufficient access to the data about the number of passengers on particular bus routes he is not able to optimise public transport services. It is necessary to continuously optimise providing public transport services when the number of passengers decreases. In terms of business interest, the operator who bears no revenue risk is willing to operate also the buses without any demand because the authority bears the risk that bus will not be used by passengers. For example, if there was abolition of a production plant into which the operator provided transport services for employees and the authority did not change a transport license, the operator would continue in providing transport services because a decrease in revenue (in this case to the zero level) would be compensate by the public authority assuming revenue risk.

This approach assumes that a fare level is also determined in the public service contract. The deficiencies of such contracts may be addressed by a contractual clause based on which the authorities have an access to the electronic data on the number of passengers in real time and thus they can obtain materials to optimise the transport services.

3.2 Approach of Operators to Net Cost Contracts

Under these contracts, the operators assume not only cost risk but also revenue risk related to providing transport services. The authority grants a license for providing public

DOI: 10.26552/tac.C.2015.1.4

transport services to the operator that is then entitled to provide public transport services in the given served area with an exclusion of other operators (during the license period). As follows from the analysis processed by van de Velde (2008), the net cost contracts are rarely awarded as route contracts because the operator determines a fare level and he becomes a monopoly for providing public transport services in a given served area during the licence period. The following mathematical model defines a procedure of such operator in relation to providing transport services.

Assume that the operator is a company that aims to make a profit. Based on the license and the public service contract – net cost contract, the operator provides a range of transport services bounded by demand of q. Start from a general assumption which is acceptable in any type of a market structure, the consumption of a product offered in the market is described by a price – demand function that expresses willingness of a consumer to buy q units of services provided at given price - p.

$$p = p(q) \tag{1}$$

Technological conditions of the operator are expressed through the real cost function

$$n = n(q) \tag{2}$$

The equation presents the amount of minimum costs of n which are spent by a producer in the production of q units of goods, while it is assumed that the price – demand function $p(q)$ is continuous and a twice differentiable real function. It is also envisaged that the price – demand function of the consumer is constructed in order to clearly motivate the consumer to buy q units of services at market price – p because the consumer feels the maximum rate of usefulness from consumer strategy realization in this combination of price and demand. Analogously, the cost function describes a process of providing services by the operator so that quantifies the minimum of total production costs – n for an optimal combination of production factors required to produce q units of provided services.

While optimal consumer behaviour is described by the price – demand function $p(q)$, the optimal operator's behaviour is described by a profit function $\pi(q)$ which is formulated as the difference between revenue and costs of company corresponding to a certain production volume of q:

$$\pi(q) = r(q) - n(q) \tag{3}$$

where a continuous and twice differentiable real function of company revenue $r(q)$ is defined as the product of price and supply volume, i.e. :

$$r(q) = p.\ q = p(q).q \tag{4}$$

A company operating in every type of a market structure (a competitive company as well as a monopoly) seeks in a decision-making process such a combination of price and supply of its product that guarantees a maximum level of the profit. This means that the operator also provides transport services in such a way that ensures the maximum profit. Analytically, this approach can be expressed as follows:

$$\pi(q) = r(q) - n(q) = p(q).q - n(q) \tag{5}$$

For optimizing the profit function, it is necessary that the function would reach its maximum at a certain point of supply - q, i.e. that the first derivative of the profit function at this point is zero:

$$d\pi(q)/dq = d(r(q) - n(q))/dq = rm(q) - nm(q) = 0 \tag{6}$$

In the equation (6), $rm(q)$ is a marginal revenue function of the operator and $nm(q)$ is a marginal cost function. Based on (6), it can be seen that a company generally achieves the maximum profit for a volume of q when the marginal revenue equal to marginal costs, i.e. a solution to the equation:

$$rm(q) = nm(q) \tag{7}$$

Then, it is possible to calculate such a price - p_p that maximises profit of the operator at the optimal level of supply q_p

$$p_p = p(q_p) \tag{8}$$

In the case of the operator who operates in a non-regulated sector (e.g. long-distance transport), where the competition exists, the approach described in previous relationships (equations) cannot be applied. The operator accepts the price - p_K at the level of his marginal costs and he offers the production volume - q_K at that price (Fendekova and Fendek, 2010). This means that the following relationship applies:

$$p_K = nm(q_K) \tag{9}$$

On the other hand, a monopoly due to its dominant position in the market can influence the price of its product so that to achieve higher profit in comparison with competing companies. The monopoly determines an optimal price - p_M based on the optimization solution (5) and based on relationships (7), (8), that is:

$$p_M = p(q_M) \tag{10}$$

Based on above mentioned, the operator operating in a monopoly position can provide fewer services at a higher price compared to competitors. The approach is shown in Figure 1 based on which the following applies:

$$p_M > p_K \wedge q_M < q_K \tag{11}$$

It can be concluded based on Figure 1 that the operator operating in a competitive market would provide services in a volume of q_K at the price - p_K. If the average unit costs per unit of provided services are defined as:

$$n_j(q) = n(q)/q,\ q > 0 \tag{12}$$

then the price of provided services will not cover even the average costs of the operator because:

$$n_j(q) > pK \tag{13}$$

If the operator provides public transport services in such a case, the loss of operator will be at the level of (according to the equation (5)):

$$\pi_K = r_K - n_K = p_K\ .\ q_K - n_{jK}\ .\ q_K = \\ = (p_K - n_{jK}).\ q_K, \quad n_{jK} > p_K \tag{14}$$

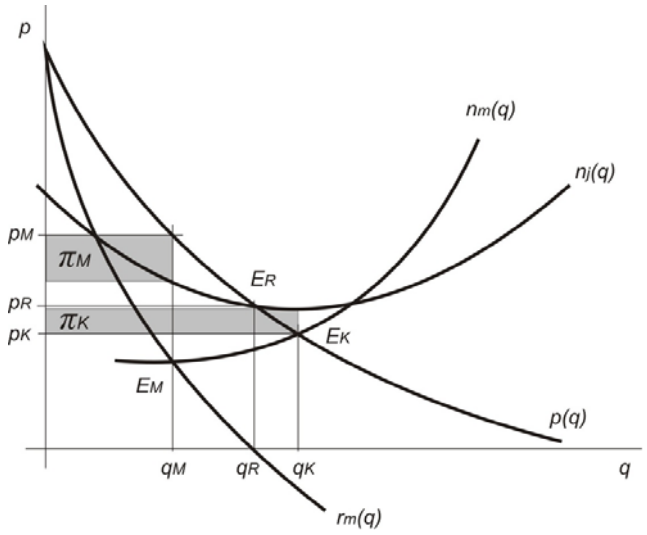

Figure 1 Monopoly and competitive company; *Source: processing by authors*

If the operator acted as a monopoly in the same market, he would provide public transport services at the level of q_M at price - p_M and he would achieve, under these conditions, a profit - π_M at the level (Figure1):

$$\pi_M = r_M - n_M = p_M \,.\, q_M - n_{jM} \,.\, q_M = (p_M - n_{jM}).\, q_M \qquad (15)$$

because the following applies for the monopoly:

$$p_M > n_{jM} \qquad (16)$$

4. Conclusion

The authors conclude that while providing public transport services the operator in a monopoly position achieves higher profit in comparison with the operator who operates in the market of perfect competition. If the public authority decides on a net cost contract, according to which the providing transport services is in the competence of the operator, there will be the risk of lower quality or the risk of lower performance than in comparison with the case of a gross cost contract.

The public authorities tend to issue a license for one operator to provide public transport services for whole served area and consequently to conclude a net cost contract. Under this contract, the decision on an organization of public transport service including pricing is in the competence of the operator. However, it is important to note that this procedure can lead to reducing quality of providing services.

ACKNOWLEDGMENT

This paper has been developed under support of project: MŠVVŠ SR - VEGA č. 1/0320/14 POLIAK, M.: Zvyšovanie bezpečnosti cestnej dopravy prostredníctvom podpory hromadnej prepravy cestujúcich.

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NOTES

Note 1. Public service contract for urban bus transport in city of Bardejov – the reasonable profit is 5 % during a contract period (the contract is valid until 31.12.2018).

Note 2. Public service contract in urban transport between BKV operator and city of Budapest; 2008.

Development of courier services in Poland

Ewelina Porębska, Jacek Caban, Mateusz Sopoćko[1]

[1]Faculty of Production Engineering, University of Life Sciences in Lublin, Lublin, 20-612, 28 Głęboka Street, Poland

Abstract The article presents the genesis of courier services in Poland, since the first such businesses in 1982. Courier companies in Poland are relatively short on the market, holding the prominent place in the economy of the country. The courier services in comparison with the countries of Western Europe are still in the development stage. After 2000 began the process of merger of best organised national courier companies by the largest global companies. In the article are presented factors affecting development of courier service in Poland, as well as the changes, which occurred within a few years, such as the level of employment, enterprises operating range and their generated revenue.

Keywords courier services, transport, logistics

JEL L87, L91

1. Introduction

Courier services are of crucial importance and an integral element of global logistics services market, they rely on an efficient, safe, timely and reliable transport of goods or documents between the sender and recipient. Potential to provide transport services in Poland is higher than the reported demand. In this respect, a constant struggle for customer and competing for it with other companies, operating on the market, can be noted. This will keep the prices of freight on a fairly low level.

Changes in the world economy (transport globalisation) cause that logistics and transport are increasingly more important in the organization and management of goods with the least cost and in the shortest possible time. Economic effectiveness of car use in a transport company is one of the numerous measures used in the evaluation of transportation services [5].

Supply chain management refers to the management of materials, information and funds for the entire supply chain, from suppliers, through production and distribution, to the final consumer [7]. More and more we can meet the contract outsourcing, where manufacturing companies give up their own transport for another entity by outsourcing their own transport to a courier company. A similar situation on the market of courier and postal services observed authors [7, 8, 14] on the Slovak market.

Despite many legal and economic determinants of industry courier service, there are real opportunities for developing such enterprises. From a legal point of view courier and express services are such type of postal activity, which does not require a license [12]. This is regulated by provisions of the Law of 2nd July 2004 on the freedom of economic activity.

The segment of courier services without any doubt is one of the fastest growing sectors – both in the world and in Poland. Here are offered tailored service for individual and institutional customers. Courier services industry is often referred to as barometer of the Polish economy, and this is due to the fact that, it was the first one feels fluctuations in the domestic market.

2. The courier services in Poland

Polish courier services industry has 20 years. Consignments were initially supported by national operator PSM C. Hart-wing, which acted as an intermediary for all foreign carriers. In those times Polish law prevented the foreign capital on the domestic market. In the late 80s and early 90s were set up companies, which for a long time played a key role in CEP in-dustry (Courier, Express and Parcel Delivery Services). The first national courier companies were such companies as *Servisco* (1982) or *Masterlink Express* (1991). The beginning of their activities were aimed at creating an operational net-work and technical- organizational facilities. Then operators built sorting plants and subsidiaries and invested in car fleet [11]. In works [2, 3, 4, 5], authors analyzed of data related to the costs of repair of delivery vans used by the Polish Mail Company.

Courier services market in Poland in the first half of nineties grew rapidly. Competition between companies primarily came down to price competition. In order to standardise courier services, and in particular to protect fundamental interests of *Poczta Polska*, in 1995 was introduced an obligation to have a license to perform this type of service. It significantly restricted the development of competition in the parcels and letters delivery and complicated the process for setting up new companies, but as a whole it has not been stopped. After the introduction of obligation of

DOI: 10.26552/tac.C.2015.1.5

having license were set up further, significant companies in the Polish market such as: *Siódemka* (1998), *Szybka Paczka* (1998) and *Opek* (1999). In the second half of the 90s the companies began to compete by means of modern information technologies, which resulted in automation of certain operations, and as well providing customers with information on packages carried. Polish courier companies very quickly caught up with global companies, both in terms of quality and technology [11].

3. Dynamics of courier services in Poland

The development of national courier services sector is primarily affected by a large demand for this type of service, the size of the Polish market, as well as attractive geographical location. In addition, boosting factors are: development of infrastructure, the reduction in charges for services, new flight services, and also the growing customer requirements concerning the diversity of services and an increase in e-commerce. CEP services market is one of the fastest growing market sectors, both in the world and in Poland. It is worth noting that carriers are increasingly willing to invest, which applies to both staff, infrastructure and technology.

With the increase in delivery services, there is growing a desire to increase market attractiveness, among both large companies and smaller institutions [6]. It is important that the operators not only invest considerable amounts in order to modernise and expand their branches, but also operate so-called hubs, which are an important link between the national and global operational network.

The market of courier services has a twofold impact on development of the domestic economy, through an increase of employment and remuneration, as well as indirect, increasing Polish business attractiveness. Together with the dynamics of CEP industry, changes the level of employment, which is set out in the graph in Figure 1.

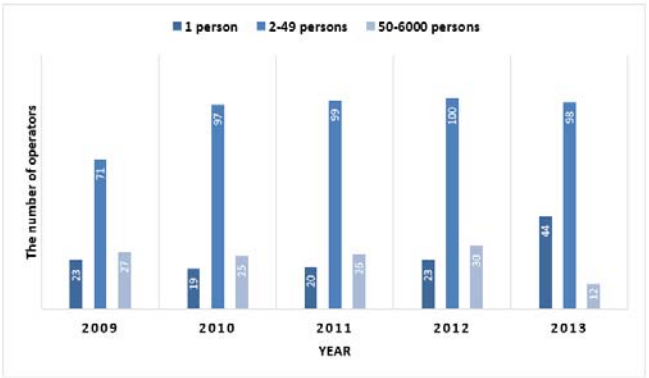

Figure 1. Number of employees in alternative postal operators (status on 31st December each year) [10].

Employment status in the group of alternative postal operators was very varied. In recent years can be noted a significant increase in conducting a single business.

In Poland there are two types of courier companies. The first of these is a large company with foreign capital. Mostly these companies buy smaller local enterprises, creating their own affiliates in this place. This gives them an easier orientation on the local market and take over their customers. There are also many relatively small companies, operating mainly in the local market, or the national one, employing up to several dozen people. Figure 2 shows the range of courier operators over the years 2009-2013.

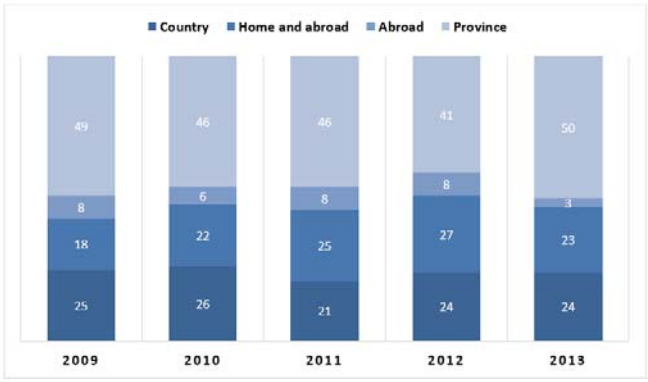

Figure 2. Operating range of courier companies over the years 2009-2013 [10].

Observing the changes that have occurred in the period 2009-2013, it can be said that the Polish market is dominated by local companies, and there is increasingly less companies being active only in a foreign market.

In the development of companies from the CEP sector an important feature is the ability to expand the offered suite of services. The company must be open to new solutions, in order to meet increasingly complex customer needs. High chance is also an increase in interest in e-commerce, both by business customers, as well as by individual ones.

The courier sector becomes lately one of the most important aspects of modern logistics systems, as well as supply chains, thus allowing for lower costs in customers enterprises, and above all it gives current business customers more and more flexibility. Courier services with its fundamental features are attractive from the point of view of logistical challenges [1].

Shipping industry in Poland is developing. It's not easy to define and identify companies, implementing this type of service. The range is also high in identifying companies, declaring courier services, as a basis for or part of their activities. This is difficult to determine the value and dynamics of growth of this market. In a certain way can be helpful estimates of Office of Electronic Communications.

The data presented in the table 1, show that over the years 1996-2013 occurred more than eighteen fold increase in the number of private operators. The largest percentage increase in comparison to the last year was recorded in 2002 (about 73 %).

Table 1. Number of registered alternative postal operators in the years 1996-2013 (as at 31st December each year) [10]

Year	Number of private operators on the Polish market	Increase in relation to the previous year	
1996	15	-	-
1997	17	2	13,00%
1998	18	1	6,00%
1999	21	3	17,00%
2000	21	-	0,00%
2001	30	9	43,00%
2002	52	22	73,00%
2003	58	6	12,00%
2004	90	32	55,00%
2005	113	23	26,00%
2006	157	44	39,00%
2007	164	7	4,00%
2008	182	18	11,00%
2009	209	27	15,00%
2010	244	35	17,00%
2011	247	3	1,00%
2012	267	20	8,00%
2013	274	7	3,00%

Not all registered operators take shipping activities. According to the survey conducted by Office of the Electronic Communications at the end of 2013, the largest number of postal operators have been found in the Lubelskie voivodship, where there were operating 63 out of 102, however, the least number was in Opole province. Only one out of two registered operators was active.

The significant impact on the development of the courier service sector have also occurring globalization processes. Extending of common customs territory of European Union contributes to creating new solutions in improving delivery systems, which is closely related to decreasing time of transport in international relations. Thanks to such solutions courier companies are able to offer their customers new standards of services. In this way, institutional customers and sometimes individual ones decide to send small batches of loads, rather than large, integrated packages. As consequences of such actions change also storage systems and reduce stocks [6].

In Poland there are headquarters of the biggest world's leading courier service (DHL, DPD, TNT). They are working on the market long, while having a developed infrastructure, that consists of warehouses, or various means of transport (cars, planes).

Domestic market of transport services, conducted by means of automotive vehicles has a significant impact on transport system of the country, its marketing and European Union economy. Since the accession of Poland to the EU can be noticed a significant evolution in this sector.

In recent years have appeared on the market also new entities, the so-called brokers. Their task is to consolidate and offer (mainly by the Internet) services of large carriers. They offer low cost and easy way to order, however, such services have unclear legal status, and because of the addition of intermediary company increases communication risk [13].

Over the past years have significantly changed the expectations and needs of customers against courier companies and their employees. The market is full of competing businesses, offering the same goods in a similar price and quality, so it is important to fine-tuning details or points which would distinguish such a company. The most important factor, which changed expectations of the customers against CEP business is development of the internet and modern technology. Courier companies increasingly become both business partner, as well as an advisor. Thus, one of the lines of the development is differentiation and simplifying [9].

Figure 3 shows income reached by courier companies operating in Poland, from 2006 to 2013.

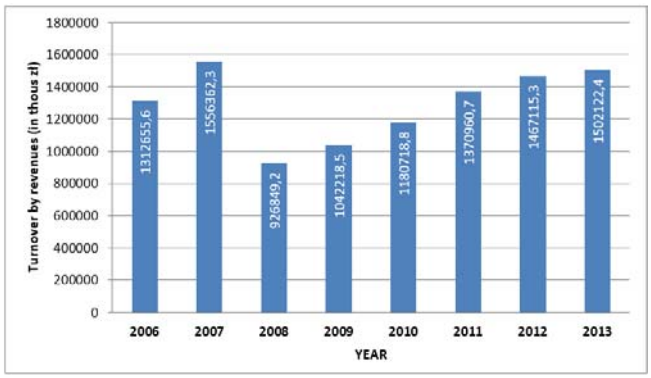

Figure 3. Domestic and foreign turnover of operators in courier industry in Poland over the years 2006-2013 [10].

By analysing a chart in Figure 3 can be seen that this sector has developed rapidly. The only collapse of this segment was due to economic crisis (in 2008), which had contributed to reduce turnover of the companies. However, after 2008, companies started to recover with more and more revenue.

4. Prospects for market growth of courier services in Poland

Impetus for development of the market courier is currently observed and forecast increase in B2C segment, which is an individual customer service. Worth highlighting is the fact that even though the number of parcels in the B2C in Poland is almost twice lower than in the countries of Western Europe, in Poland is the highest increase of number of persons benefiting from e-commerce in Europe [9].

Development of CEP companies is also influenced by:

- creation of the appropriate investment conditions, i.e. appropriate legal regulations;

DOI: 10.26552/tac.C.2015.1.5

- road and air infrastructure, which is a direct costs of courier companies;
- trends in the implementation of environmentally preferable solutions (reduction of fuel consumption, reduction of emissions into the atmosphere and noise dampening).

The trends in the CEP market for the coming years include also slowing down of supply chains, due to the high pressure on price and segmentation of B2C market. A drop in weight of a single consignment will be also significant, and connection of supply volume [13].

There are predictions that in the Polish sector will be especially rapidly developed domestic mail market, and in international transport – a segment of road consignments. From the observation of the market, it appears that customers more and more pay attention to the quality of ordered service and less and less to the price.

5. Conclusions

Courier services in Poland are relatively short, and even though it is a perfect sometime in the national economy. Inclusion of Poland to the European Union has helped to open new markets for companies with foreign capital. Nowadays are present in the country both global and local companies. A steady increase in number of new courier services companies may provide a dynamic home market. Progressive globalization processes, the tendency to out-sourcing and development of integrated supply chain have resulted in changes in logistics systems. Currently there is greater demand for specialized courier operators.

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TRANSPORT AND COMMUNICATIONS

Scientific journal intended to combine theory and practice in the field transport and communications and thus advancement of transport and communications sciences.

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Frequency of publishing: Twice per year.

Publishing language: English

Publisher: The Faculty of Operation and Economics of Transport and Communications, University of Žilina, Univerzitná 1, 010 26 Žilina, Slovakia

Printed: EDIS – Printing House of the University of Žilina, Univerzitná 1, 010 26 Žilina, Slovakia

IČO 00 397 563

Edition: 50 pc

Registered No: EV 4902/13

Tel: ++421/41/5133051

Email: tac@fpedas.uniza.sk

Web: http://tac.uniza.sk

May 2015

DOI: 10.26552/tac.J.2015.1

ISSN 1339-5130

ISSN 1339-5130

DOI: 10.26552/tac.J.2015.1