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AND  
UNIVERSITY OF LJUBLJANA  
FACULTY OF MARITIME STUDIES AND TRANSPORT

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# REFERATI

## PAPERS

po priimku prvega avtorja

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# EMPLOYMENT DYNAMICS IN THE CROATIAN TRAFFIC SYSTEM

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## ABSTRACT

The personnel potential employed in the traffic system is of extreme importance, especially regarding its role in the technological, organizational, and economic development. The state and level of employment in the subsystems of the traffic system influence directly also the productivity of work in them.

Regarding the significance of the employment in the traffic system the paper studies:

- the employment status in the Croatian traffic system (absolute and relative share of subsystems in the structure),
- the employment dynamics of the traffic systems and their subsystems, regarding the status in 1992 and 2002,
- the change in the employment structure in the traffic system regarding their subsystems and the status in 1992 and 2002,
- formation of the mathematical prognostic trend models (statistically significant with  $p < 0.05$ ) of the employment development of single traffic subsystems and traffic system in general, as a scientifically founded basis for forecasting of this traffic value in the future.

## 1 INTRODUCTION

Modelling of the traffic system development is extremely significant and depends directly both on general and special objectives of the economic and overall social development.

The employment status in the traffic system is an essential element of its organizational stratum. The personnel potential certainly represents a crucial resource of any country, and thus also in the traffic and transport sector it represents the key factor of development, especially of its technological and economic stratum. Similarly, the status and level of employment in the traffic system affect the productivity of work in the subsystems, as well as in the overall system.

## 2 EMPLOYMENT STATUS IN THE CROATIAN TRAFFIC SYSTEM

The employment status per traffic subsystems (absolute and relative) is presented in Table 1, and the data are presented also in a graphical form further in the text.

**Table 1:** Employment status in the traffic system of the Republic of Croatia

Number of employees in the traffic subsystem	Y E A R					
	Number	1998	1999	2000	2001	2002
Railway traffic	ABS.	20688	19468	18535	18170	16077
	REL.	26.4 %	24.9 %	23.7 %	23.2 %	20.6 %
Road traffic	ABS.	12703	12028	10624	9712	6710
	REL.	16.2 %	15.4 %	13.6 %	12.4 %	8.6 %
Urban - suburban traffic	ABS.	7865	7863	7807	7686	7520
	REL.	10.1 %	10.1 %	10.0 %	9.8 %	9.6 %
Maritime traffic	ABS.	5913	4794	4578	4556	4533
	REL.	7.6 %	6.1 %	5.9 %	5.8 %	5.8 %
River traffic	ABS.	527	459	490	442	345
	REL.	0.7 %	0.6 %	0.6 %	0.6 %	0.4 %
Air traffic	ABS.	2559	2582	2623	2812	2911
	REL.	3.3 %	3.3 %	3.4 %	3.6 %	3.7 %
Transshipment and storage	ABS.	3804	5074	5012	4913	4549
	REL.	4.9 %	6.5 %	6.4 %	6.3 %	5.8 %
Pipelines	ABS.	542	630	474	481	527
	REL.	0.7 %	0.8 %	0.6 %	0.6 %	0.7 %
Postal traffic and telecommunications	ABS.	23617	24020	24544	24246	23602
	REL.	30.2 %	30.7 %	31.4 %	31.0 %	30.2 %
Traffic system	ABS.	78218	76918	74687	73018	66774
Total	REL.	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

Source: State Office for Statistics of the Republic of Croatia, Statistical reports 1197, Zagreb, 2003.

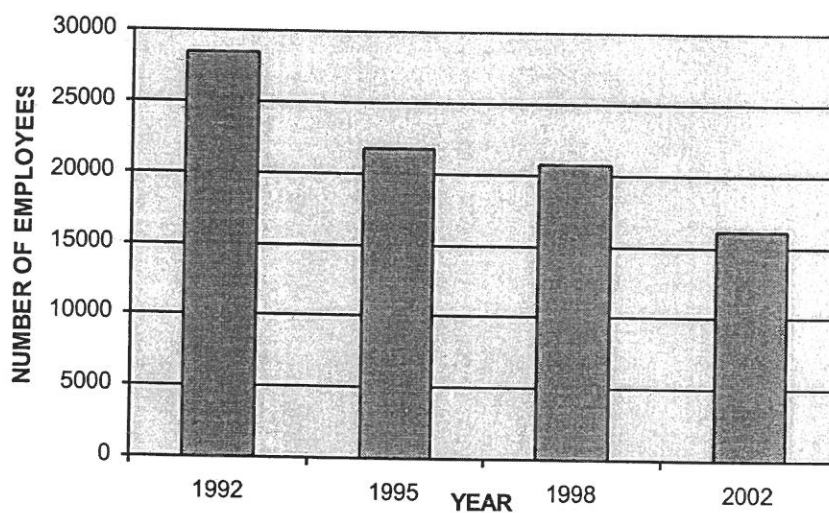
The analysis of the data presented in Table 1 shows that there is a decline in the employment rate in the traffic system of the Republic of Croatia with an average negative annual rate of change of 3.8 percent, and the following may be stated for the traffic subsystems:

- road traffic subsystem marks an employment decline at an average rate of change of -14.7 %,
- railway traffic subsystem marks an employment decline at an average rate of change of -6.1 %,
- river traffic subsystem marks an employment decline at an average rate of change of -10.0 %,

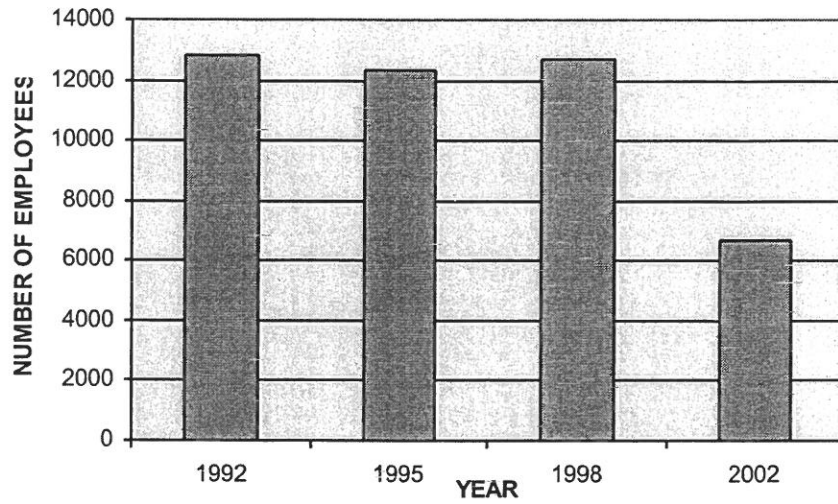
- urban and suburban traffic subsystem marks an employment decline at an average rate of change of -1.1 %,
- and only air traffic subsystem marks an increase in employment at an average rate of change of +3.3 %.

### 3 EMPLOYMENT DYNAMICS OF THE TRAFFIC SYSTEM

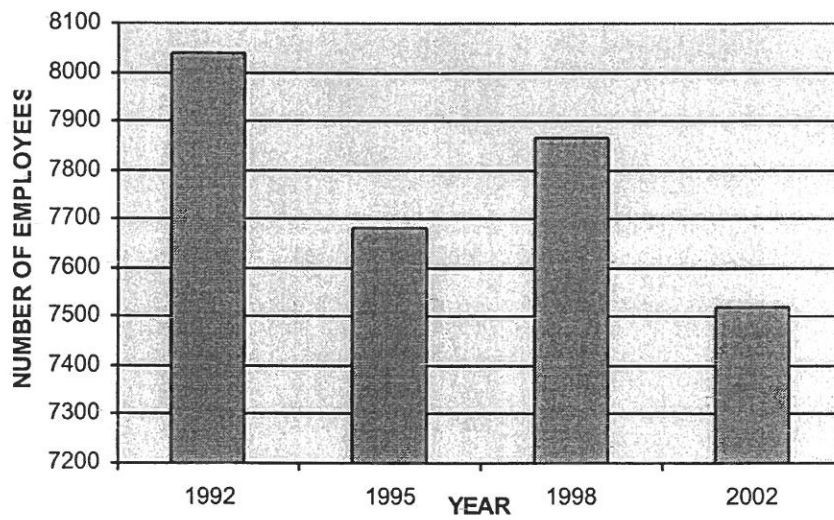
When one analyzes a longer period of time, e.g. from 1992 to 2002, one can obtain information about a longer trend in the employment dynamics in the Croatian traffic system and its subsystems. Further in the paper the dynamics of employment is presented starting from 1992 until 2002, with cross-sections for 1995 and 1998.



**Figure 1:** Employment status dynamics of the Croatian railway traffic system for the period 1992-2002 (Source: State Office for Statistics of the Republic of Croatia, Statistical reports 1197, Zagreb, 2003)



**Figure 2:** Employment status dynamics of the Croatian road traffic system in the period from 1992-2002 (Source: State Office for Statistics of the Republic of Croatia, Statistical reports 1197, Zagreb, 2003)



**Figure 3:** Employment status dynamics of the Croatian urban-suburban traffic system in the period from 1992-2002 (Source: State Office for Statistics of the Republic of Croatia, Statistical reports 1197, Zagreb, 2003)

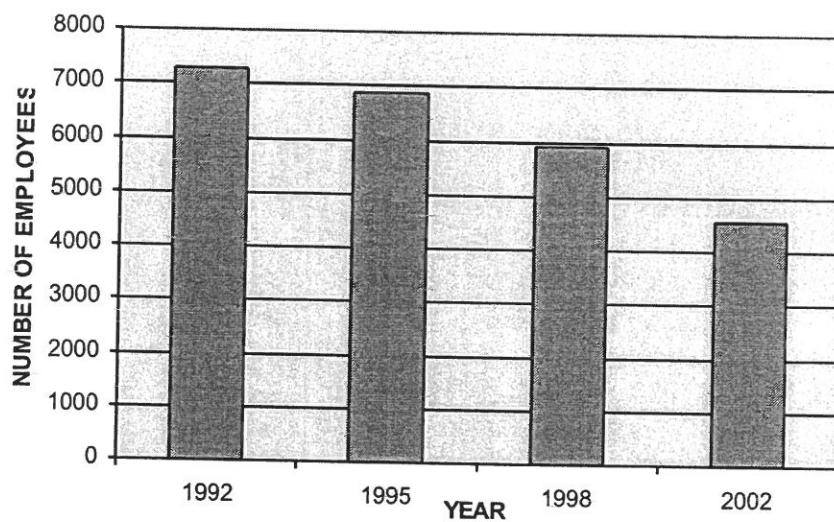


Figure 4 - Employment status dynamics of the Croatian maritime traffic system in the period from 1992-2002 (Source: State Office for Statistics of the Republic of Croatia, Statistical reports 1197, Zagreb, 2003)

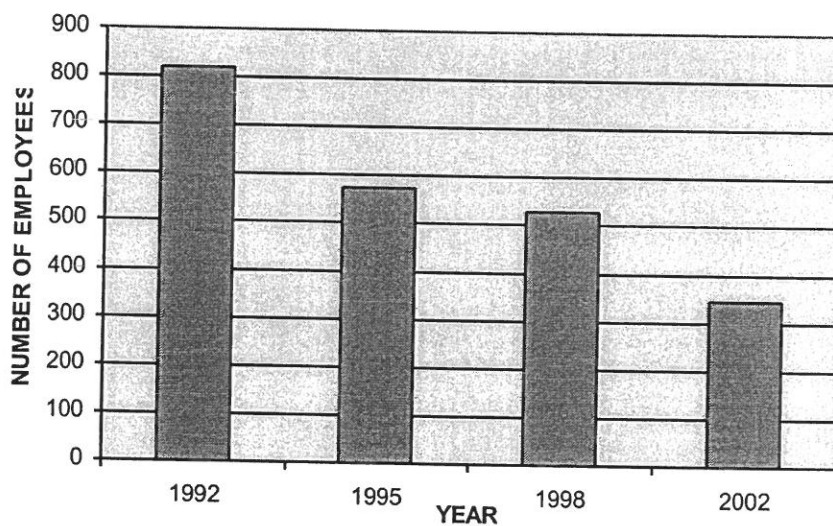
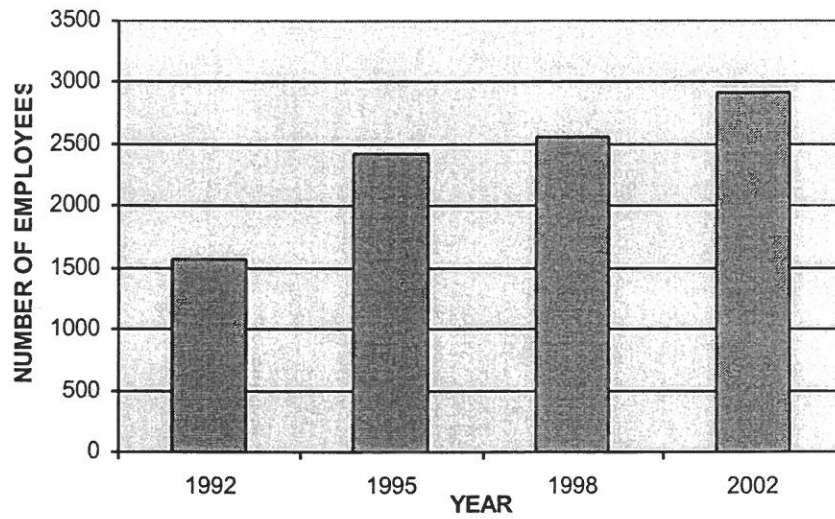
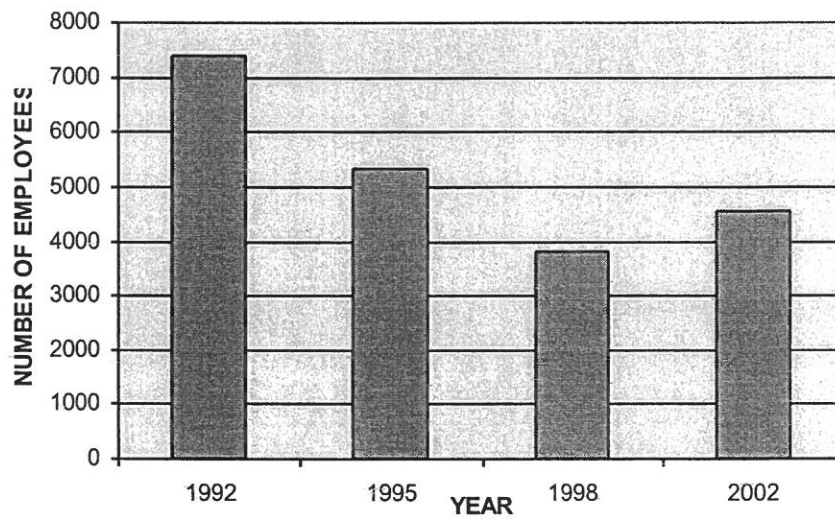


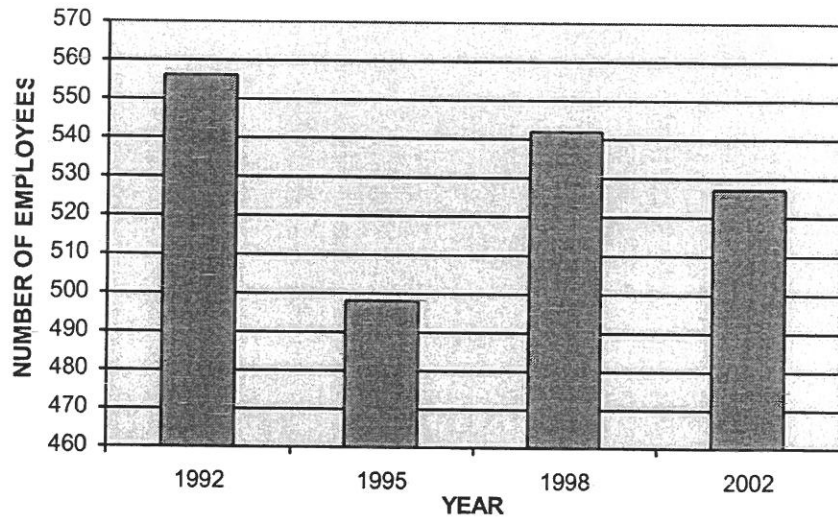
Figure 5 - Employment status dynamics of the Croatian river traffic system in the period from 1992-2002 (Source: State Office for Statistics of the Republic of Croatia, Statistical reports 1197, Zagreb, 2003)



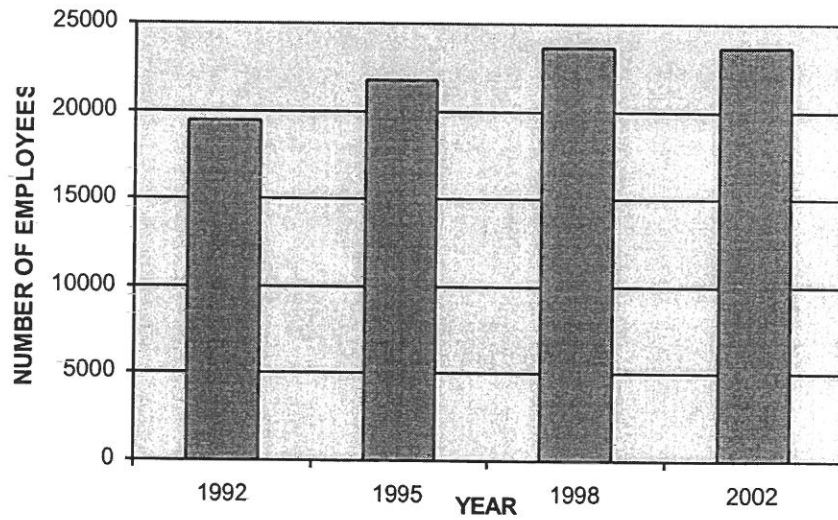
**Figure 6:** Employment status dynamics of the Croatian air traffic system in the period from 1992-2002 (Source: State Office for Statistics of the Republic of Croatia, Statistical reports 1197, Zagreb, 2003)



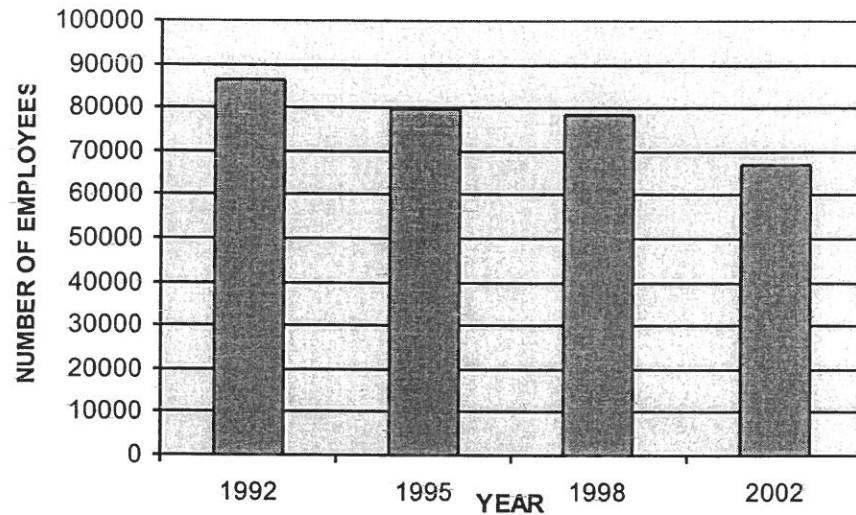
**Figure 7:** Employment status dynamics of the Croatian transshipment and storage system in the period from 1992-2002 (Source: State Office for Statistics of the Republic of Croatia, Statistical reports 1197, Zagreb, 2003)



**Figure 8:** Employment status dynamics of the Croatian pipeline traffic system in the period from 1992-2002 (Source: State Office for Statistics of the Republic of Croatia, Statistical reports 1197, Zagreb, 2003)



**Figure 9:** Employment status dynamics of the Croatian postal and telecommunications traffic system in the period from 1992-2002 (Source: State Office for Statistics of the Republic of Croatia, Statistical reports 1197, Zagreb, 2003)



**Figure 10:** Employment status dynamics of the Croatian traffic system in the period from 1992-2002 (Source: State Office for Statistics of the Republic of Croatia, Statistical reports 1197, Zagreb, 2003)

Mathematical processing of data on the employment status dynamics in the Croatian traffic system and its subsystems in the period from 1992-2002 shows the following:

a) decrease in employment with an average annual negative rate of change in the employment status of –

- 5.9% in railway system (decrease in the number of employees in 2002 compared to 1992 by 43.6%),

- 6.7% in road system (decrease in the number of employees in 2002 compared to 1992 by 47.7%),

- 0.7% in the urban-suburban traffic system (decrease in the number of employees in 2002 compared to 1992 by 6.5%),

- 4.9% in the maritime system (decrease in the number of employees in 2002 compared to 1992 by 37.8%),

- 9.0% in the river system (decrease in the number of employees in 2002 compared to 1992 by 57.9%),

- 4.7% in the transshipment and storage system (decrease in the number of employees in 2002 compared to 1992 by 38.3%),

- 0.5% in the pipeline traffic system (decrease in the number of employees in 2002 compared to 1992 by 5.2%), and

- 2.5% in the Croatian traffic system (decrease in the number of employees in 2002 compared to 1992 by 22.7%);

b) increase in the employment level –

+ 6.3% in air traffic system (increase of the number of employees in 2002 compared to 1992 by 84.7%), as well as

+ 2.0% in the postal and telecommunication traffic system (increase in the number of employees in 2002 compared to 1992 by 21.5%).



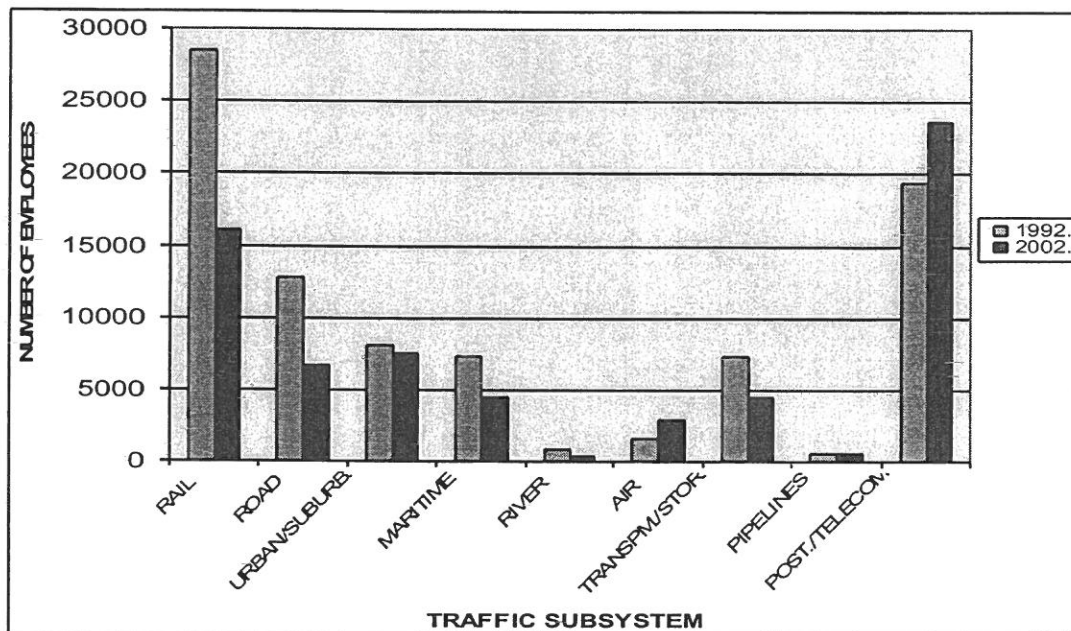
#### 4 CHANGE IN THE EMPLOYMENT STRUCTURE IN THE TRAFFIC SYSTEM

Changes in the employment structure in the subsystems of the Croatian traffic system are presented in Table 2, as well as the respective Figures.

**Table 2:** Dynamics of changes of the internal employment structure of the Croatian traffic system compared to the status in 1992 and 2002

YEAR	1992		2002	
RAIL	28494	32.98%	16077	24.08%
ROAD	12820	14.84%	6710	10.05%
URB./SUBURB.	8041	9.31%	7520	11.26%
MARITIME	7291	8.44%	4533	6.79%
RIVER	820	0.95%	345	0.52%
AIR	1576	1.82%	2911	4.36%
TRANSPM. STORAGE	7376	8.54%	4549	6.81%
PIPELINES	556	0.64%	527	0.79%
POST./TELECOM	19417	22.48%	23602	35.35%
TRAFFIC SYSTEM	86391	100.00%	66774	100.00%

Source: Statistical reports 1029/1996 and 1197/2003, Croatian State Office for Statistics



**Figure 11:** Structure of the number of employees in the Croatian traffic system regarding their absolute share per traffic subsystems (Source: Table 2)

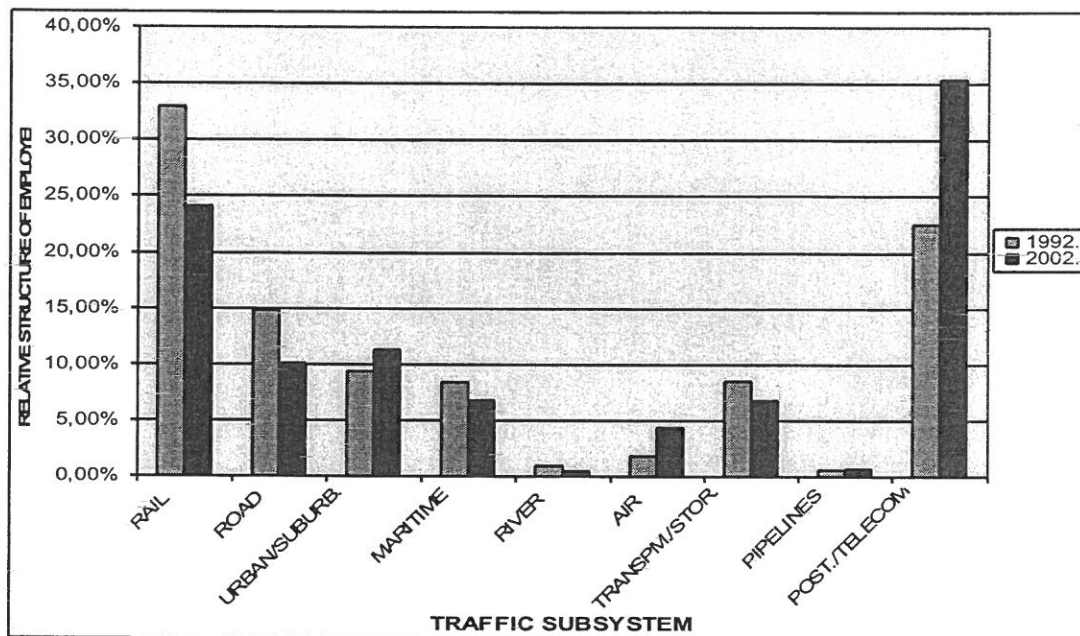


Figure 12: Structure of the number of employees in the Croatian traffic system regarding their relative share per traffic subsystems (Source: Table 2)

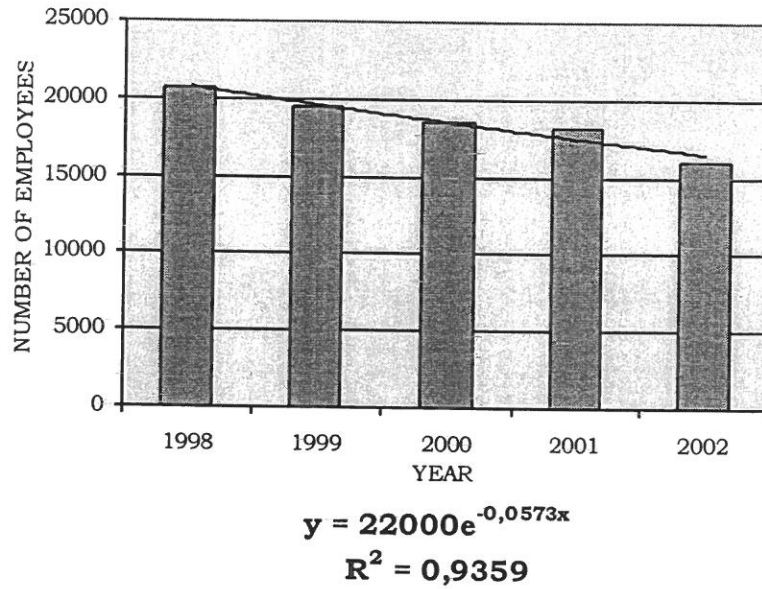
## 5 PROGNOSTIC TREND MODELS OF EMPLOYMENT DEVELOPMENT IN THE TRAFFIC SYSTEM

The paper presents further the Figures and detailed mathematical and statistical analyses of the traffic values in Table 1.

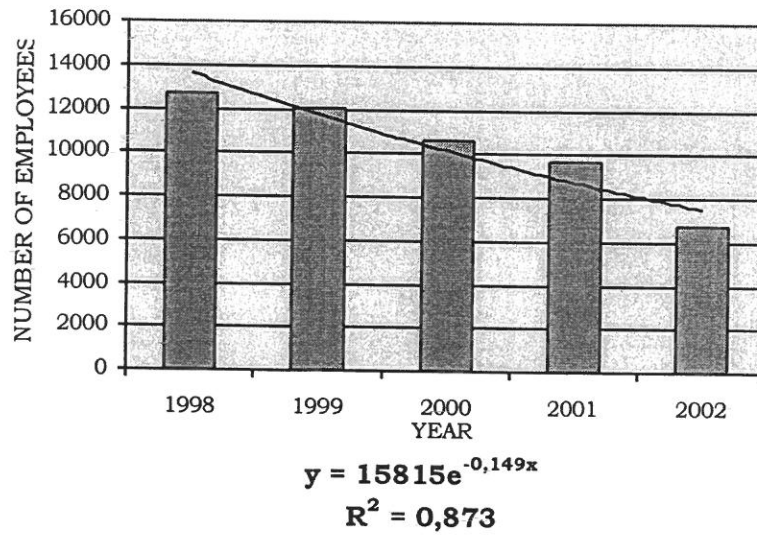
The prognostic trend model of development dynamics of single traffic values obtained by means of the computer program "Microsoft Excel" has been defined by the equation and determination coefficient ( $R^2$ ), and it is presented in a Figure. The determination coefficient ( $R^2$ ) measures the intensity of the relation of the observed variable in the mathematical model and the time. If the relation is functional, then the value of the determination coefficient is  $R^2 = 1$ , and the closer  $R^2$  to this value, the stronger the relation.<sup>1</sup> When the determination coefficient value  $R^2$  is greater than 0.77 there follows the conclusion that the determined mathematical model of the prognostic trend of the studied variable is statistically significant.<sup>2</sup>

<sup>1</sup> Serdar V., Šošić I.: Uvod in statistiku, Školska knjiga, Zagreb, 1998, pp. 125-131.

<sup>2</sup> Ibidem, pp. 406-407

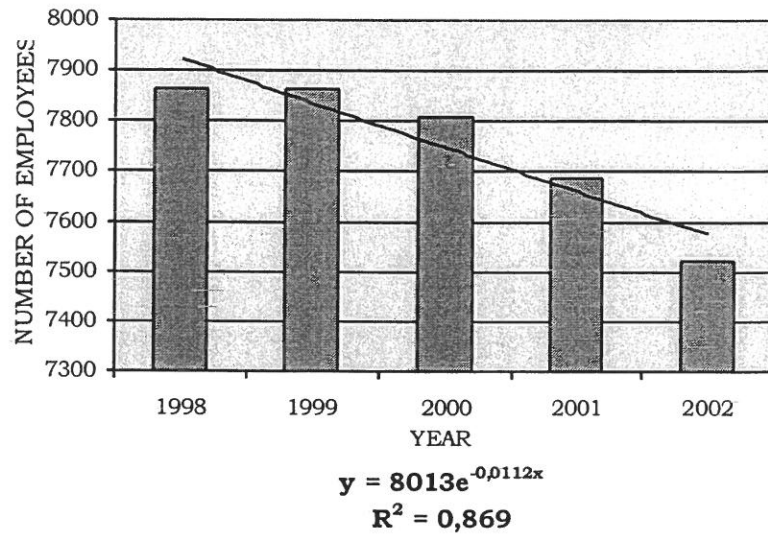


(1)  
**Figure 13:** Dynamics of the number of employees in the Croatian railway traffic system<sup>3</sup>  
 (Source: Table 1)



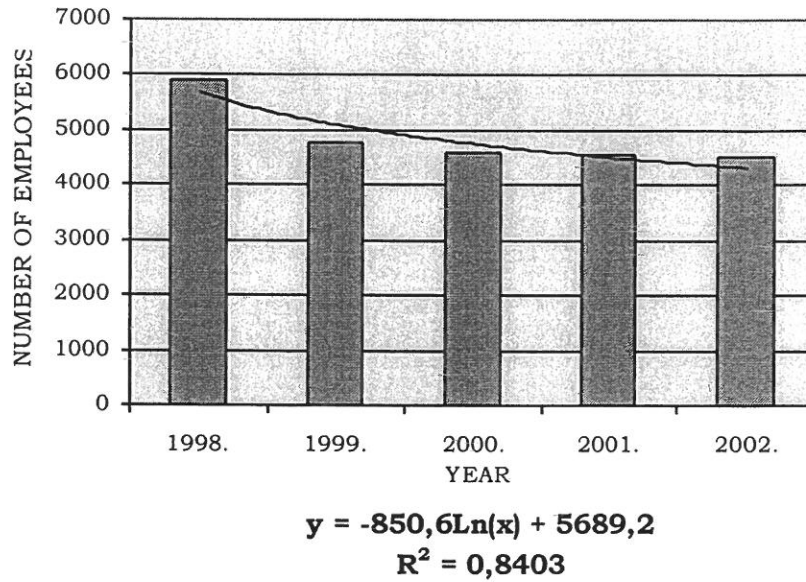
(2)  
**Figure 14:** Dynamics of the number of employees in the Croatian road traffic system  
 (Source: Table 1)

<sup>3</sup> In all the prognostic trend models in this paper the convention is used that x represents the time value, so that e.g. x = 1 for the initial year of the observed time period.



(3)

**Figure 15:** Dynamics of the number of employees in the Croatian public urban-suburban traffic system (Source: Table 1)



(4)

**Figure 16:** Dynamics of the number of employees in the Croatian maritime traffic system (Source: Table 1)

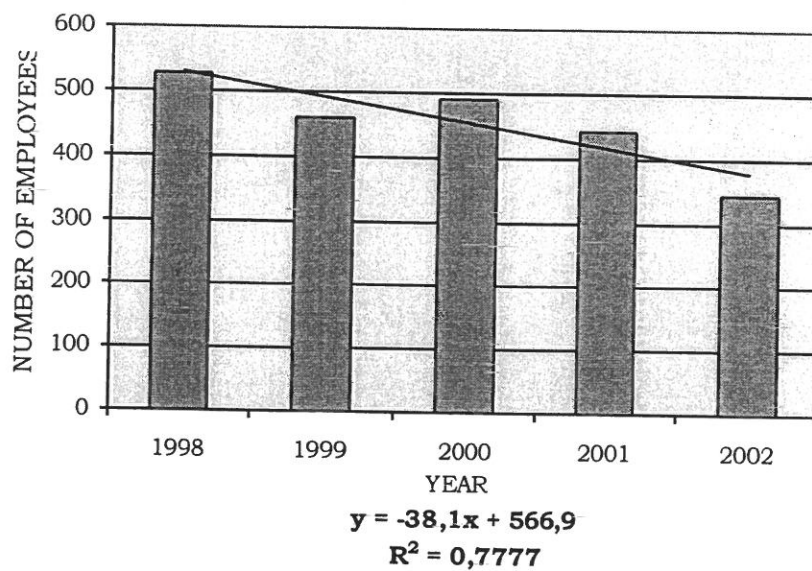


Figure 17: Dynamics of the number of employees in the Croatian river traffic system (Source: Table 1) (5)

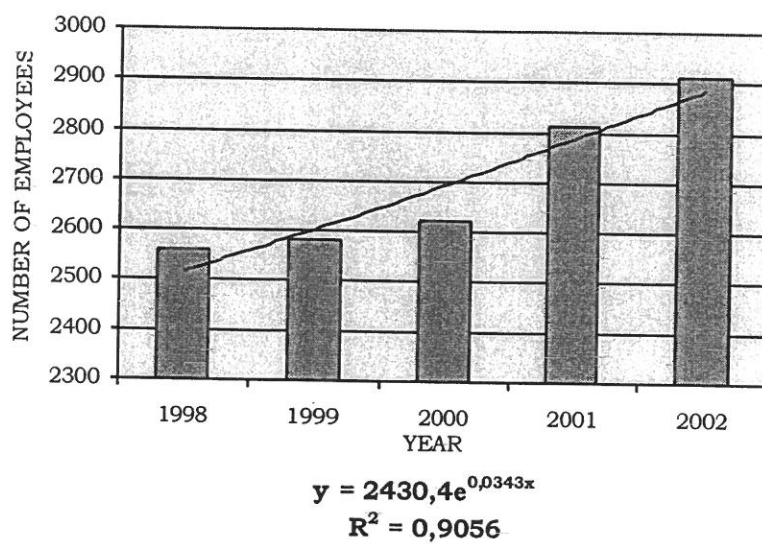
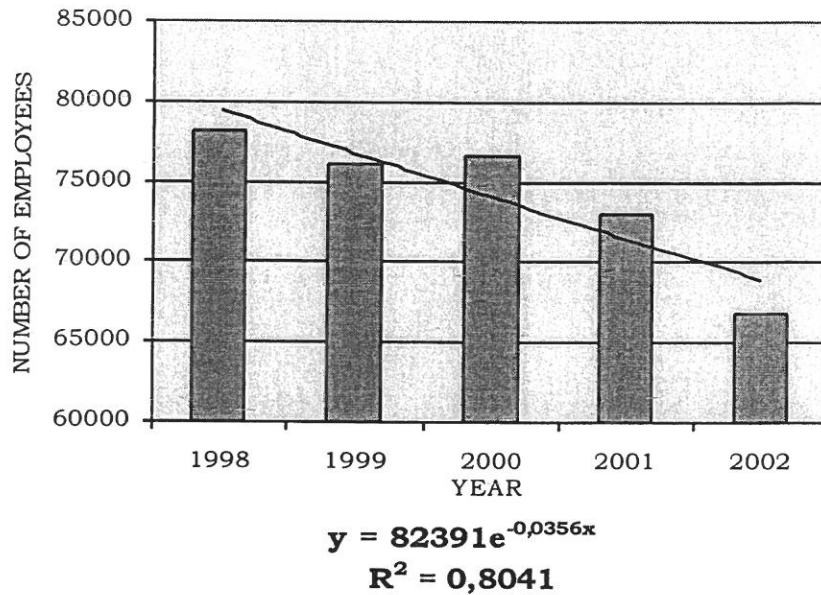


Figure 18: Dynamics of the number of employees in the Croatian air traffic system (Source: Table 1) (6)



(7)

Figure 19 - Dynamics of the total number of employees in the Croatian traffic system (Source: Table 1)

According to the performed mathematical statistical analyses of the observed values from Table 1 in the time period between 1998-2002 the statistically significant ( $p < 0.05$ ) trend model was determined as follows for:<sup>4</sup>

- railway, road, urban-suburban, maritime, river and air subsystem of the Croatian traffic system, as well as for the entire Croatian traffic system.

For the transshipment and storage systems ( $R^2=0.35$ ), pipeline ( $R^2=0.19$ ) and postal telecommunication traffic ( $R^2=0.08$ ) the statistically significant mathematical prognostic trend model has not been determined and therefore these have not been presented graphically in the previous Figures, nor is the respective function of probability provided.

## 6 CONCLUSION

The established mathematical prognostic trend models that are statistically significant represent the scientifically founded basis for forecasting the number of employees in the traffic system of the Republic of Croatia in the future.

The employment status in the Croatian traffic system in the observed time period is characterized by the following:

- a) decrease in the total number of employees in the national traffic system by 22.7%, at an average negative annual rate of change of -2.5%,
- b) decrease in the number of employees in subsystems of
  - railway traffic by 43.6%, at an average annual negative rate of change of 5.9%,
  - road traffic by 47.7%, at an average annual negative rate of change of 6.7%,

<sup>4</sup> Cf. Serdar V., Šošić I.: Uvod u statistiku, Školska knjiga, Zagreb, 1988, pp.406-407

- urban suburban traffic by 6.5%, at an average annual negative rate of change of 0.7%,
  - maritime traffic by 37.8%, at an average annual negative rate of change of 4.9%,
  - river traffic by 57.9%, at an average annual negative rate of change of 9%,
  - transshipment and storage by 38.3%, at an average annual negative rate of change of 4.7%,
- c) increase in the number of employees in subsystems
- air traffic by 84.7%, at an average annual positive rate of change of 6.3%, and
  - postal and telecommunication traffic by 21.5%, at an average annual positive rate of change of 2%.

Mathematical statistical analysis of the number of employees in the period from 1998 to 2002 was used to determine the statistically significant ( $p < 0.05$ ) trend model for:

- railway, road, urban-suburban, maritime, river and air subsystem of the traffic system of the Republic of Croatia, as well as for the entire Croatian traffic system.

## REFERENCES

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