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**STATISTIKA HAVÁRIÍ V PRŮMYSLOVÝCH ZÓNÁCH V LETECH 1997-2004**

STATISTICS OF ACCIDENTS IN INDUSTRIAL ZONES IN YEARS 1997 - 2004[1]

**Abstrakt**

Článek se zabývá hodnocením vývoje mimořádných událostí v průmyslových zónách v letech 1997 - 2004 a to z hlediska počtu zásahů, ale i z hlediska počtů zraněných nebo usmrcených.

**Abstract**

Contribution deals with assessing number of the accidents in industrial zones in years 1997 – 2004 from point of view of number of firemen on-site deployment and number of injured and killed.

**Key words:** industrial zone, synergic impact, HZS

**Úvod**

Czech Republic by agency Czech Invest [4] invests yearly into creation and expansion of industrial zones hundreds of millions Czech crowns. In context of expansion of the industrial zones it is being discussed possible dangers connected with its usage.

One of problems being discussed today are so called *synergic effects* of incidents especially because the industrial buildings are developed especially with the focus to the fire safety themselves, but not as a part of larger building complex of various industrial zone property owners.

Synergic effects are well considered usually for heavy industry – chemical technological processes due to legislative [3], which obviously are not part of the industrial zones.

In this article we will focus on statistical assessment of HZS (Fire Rescue Brigade) of the Czech Republic intervention during incidents in industrial zones.

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Method of gathering of statistical data from all accidents with presence of firemen defines Directive of Director General and Deputy Minister of the Interior from March 13th
2006, which states rules for statistical tracking of accidents and documentation and about the course of its getting under control [1]. This directive basically ensures continuity and integrity of data.

In evaluated period of 1997 – 2004 there were 1053 incidents in industrial zones (see fig. 1).

Values of the indicators were inset by the line for easier visual identification of trends in data. As seen on fig. 1 – there is continuous increase on incidents handled by HZS. Majority of these disasters were of non-fire nature. Number of fires in evaluated period did also increase, but this figure ~~increase~~ has been slow in comparison with number of other disasters.

The increase itself is not so surprising considering continuous increase of number of industrial zones and companies investing in them. Complex statistic of these zones is not available. To make general view on development in industrial zones we may use as basis number of industrial zones financially supported by agency CzechInvest [2].
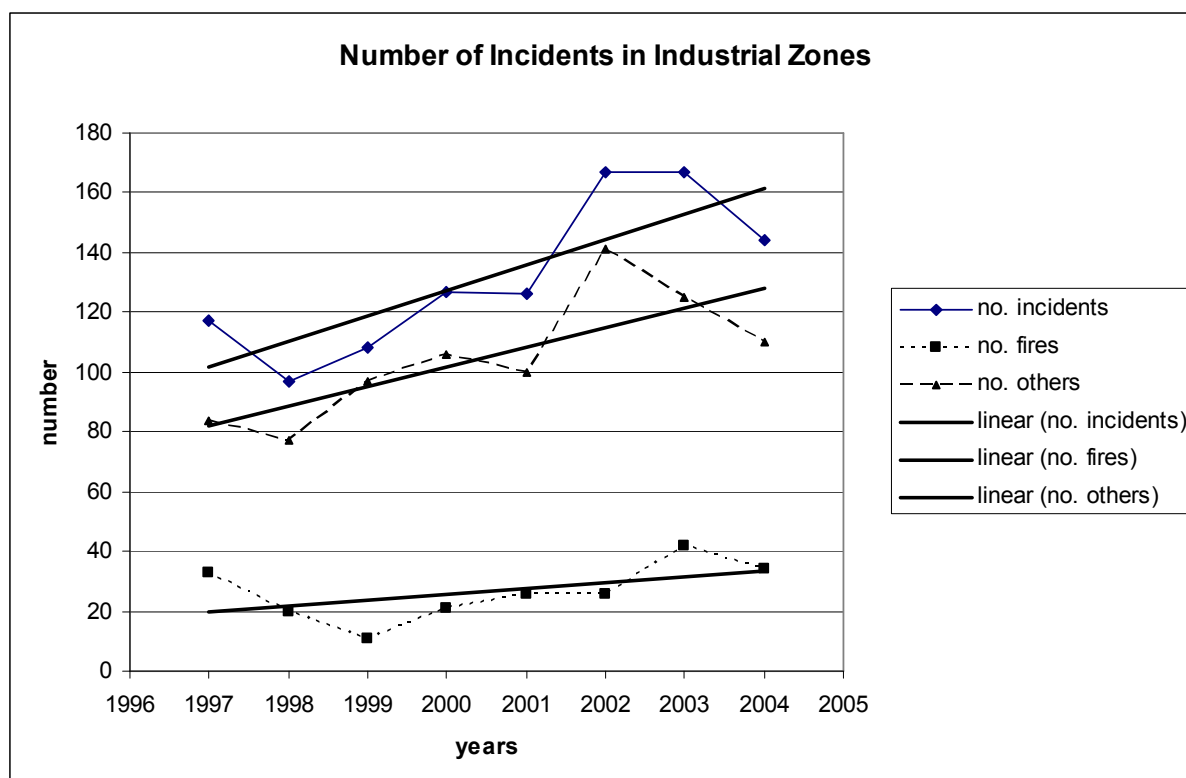


*Fig. 1: No. of incidents in industrial zones*

Cumulated number of CzechInvest financially supported industrial zones is described on fig. 2.

CzechInvest supported industrial zones are not the only existing industrial zones in Czech Republic. Nerveless with non-existent complex industrial zones statistics, we have to

use what's available and use it to estimate its trend in hope, that supported zones form up representative sample of all industrial zones (or better its increase).

Then we may explore possible connection between increase in number of supported zones and disasters documented happening in them (see fig. 2).
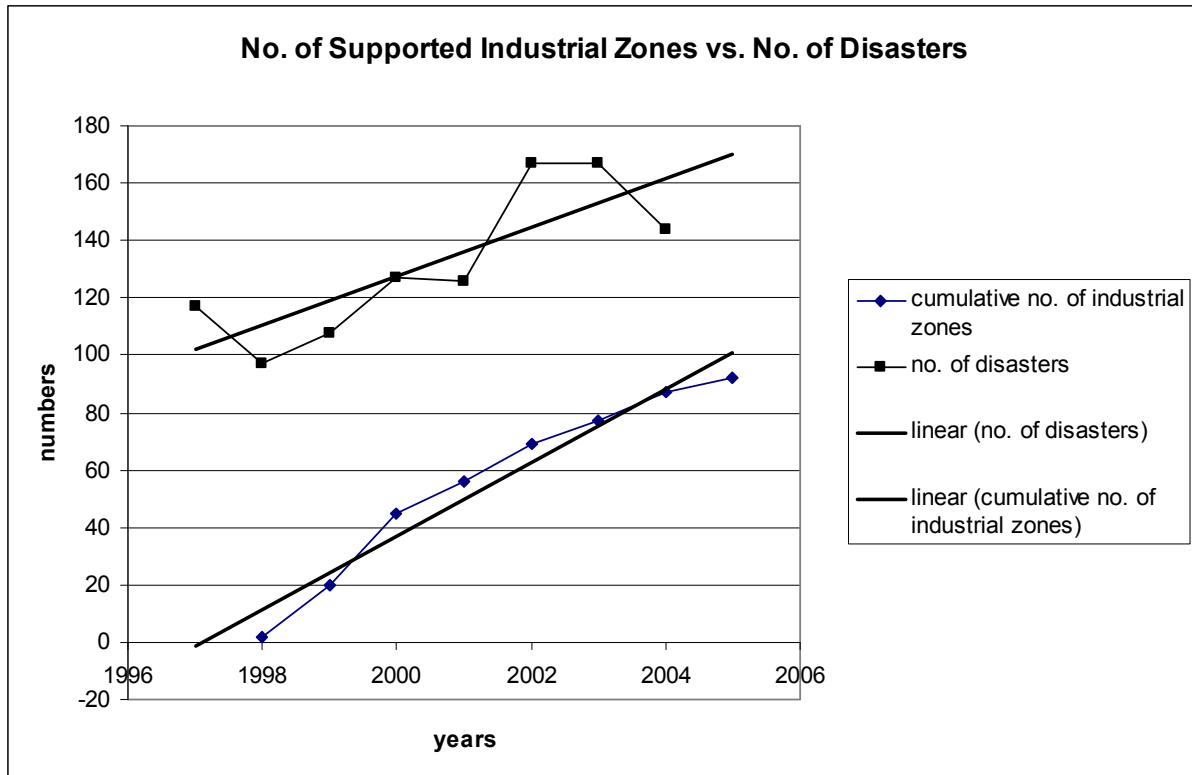


*Fig. 2: Relation between No. of financially supported industrial zones and No. of incidents in them*

Increasing trend in no. of industrial zones and no. of disasters in them look similar. Dependence between both trends computed using correlation coefficient (1) is 0,88 – which indicates strong dependence.

$$r = \frac{c}{\sigma(x) \cdot \sigma(y)} = \frac{\frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})}{\sigma(x) \cdot \sigma(y)}$$

(1)

where  r        correlation coefficient
        c        co-variation
        $\sigma$        standard deviation
        n        data count
        $\bar{x}, \bar{y}$      average

If we described the both trends using equations, we could write for no. of disasters trend (2)

*y = 8,5119x – 16896*

(2)

and trend of no. of cumulated industrial zones (3).

*y = 12,786x – 25535*                                                                                          (3)

Industrial zones trend is sheerer then disasters trend. Possible explanation may be, that there are gradually introduced new strict legislative, especially in area of Health & Safety during work and industry safety in general.

Since year 2003 there are in statistics also data about direct loss due to disaster and so called saved loss – the loss which has been saved due to the action of firemen (HZS). Saved loss is number partially artificially constructed and it is necessary to have this in mind when looking at the figures bellow, also its interpretation should be very careful, to protect ourselves against false assumptions.

Direct loss is from point of view of assessment more interesting. Direct loss as number is showing gravity of the disaster. Graphical assessment of these data is available on figure 3.
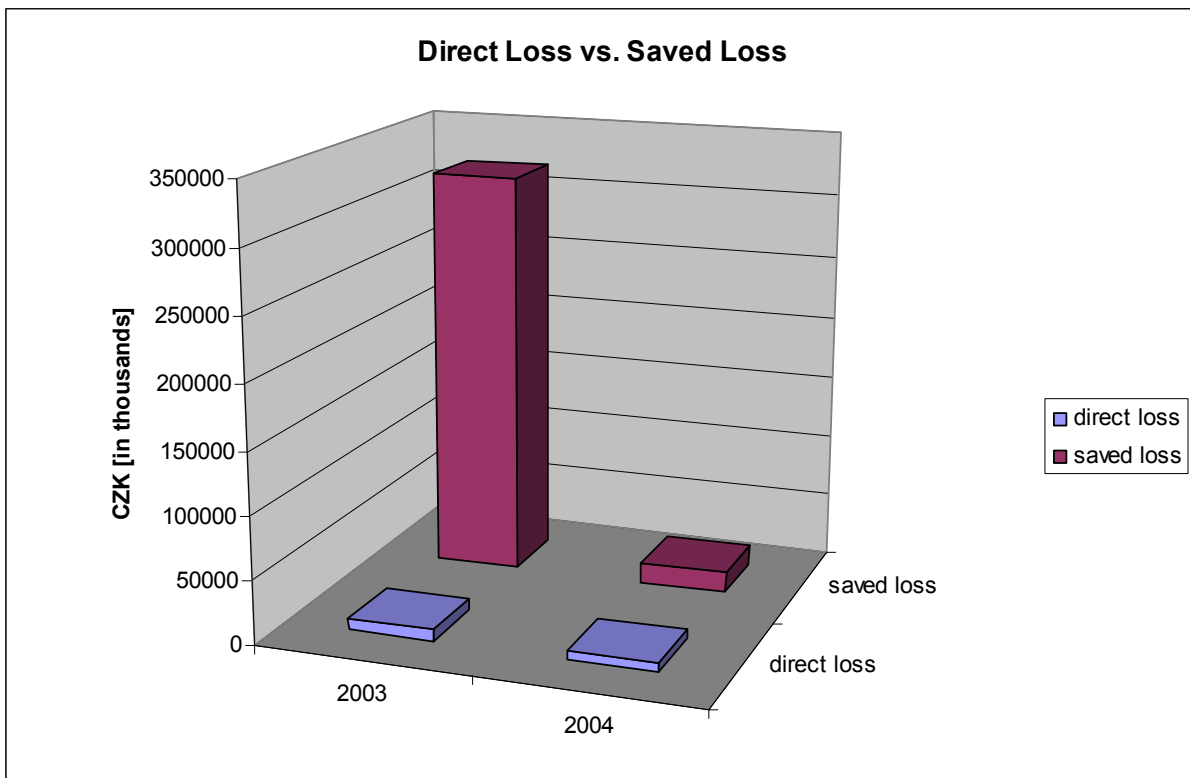


*Fig. 3: Direct loss vs. saved loss*

Financial values of fig. 3 are in thousands of CZK and converted to prices of year 2004 (4, 5).

$H_k = H_p(1 + i)^n$                                                                                          (4)

where  $H_k$      future financial value
       $H_p$      present financial value
       $i$        inflation
       $n$        no. of years

Inflation is unfortunately not constant, so we have to modify equation to take it into account (5).

$$H_k = H_p \prod_{j=1}^{n} (1 + i_j)$$ (5)

where $H_k$     future financial value
       $H_p$     present financial value
       $i_j$      inflation in the year
       n      no. of years

Values of inflation in Czech Republic are available in table 1.

*Tab. 1: Inflation[2] in the Czech Republic in the years 1997 – 2004*

| 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|------|------|------|------|------|------|------|------|
| 8,5 | 10,7 | 2,1 | 3,9 | 4,7 | 1,8 | 0,1 | 2,8 |

With both loss values, there is problem. Both values are unfortunately systematically included in statistic only since 2003. To be able to perform systematic analysis of these values, we would need values for larger period of time.

Companies providing data for statistic are also not forced by anything to fill in loss report for the HZS and so large portion of them is not doing it, which is evident from fig. 3. This of course further lowers usability of the loss values.

It is interesting, that the companies more willingly gave loss estimation for fire disasters then other disasters in ration 99:1, considering that the ratio for fire : other disasters is around 20:80.

Other interesting indicators are no. of injured and killed during disaster (see fig. 4 and 5).

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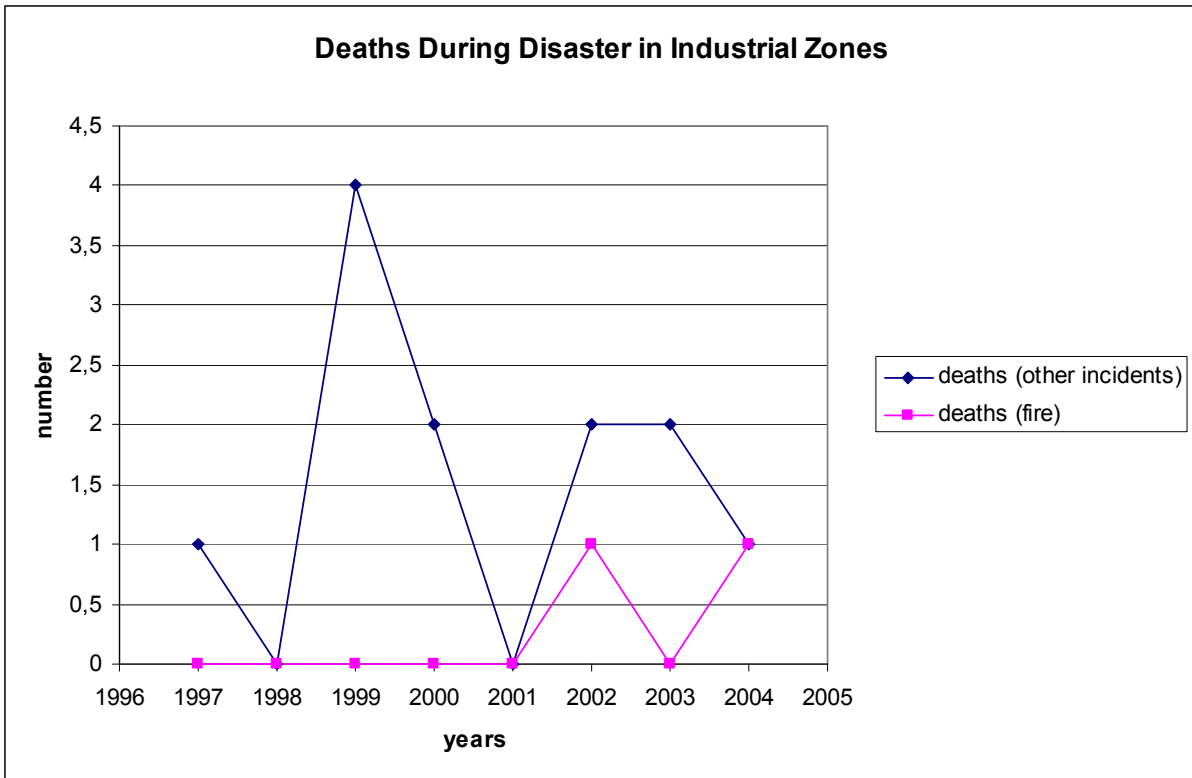[2] Inflation values has been taken from Czech Statistical Bureau [5]

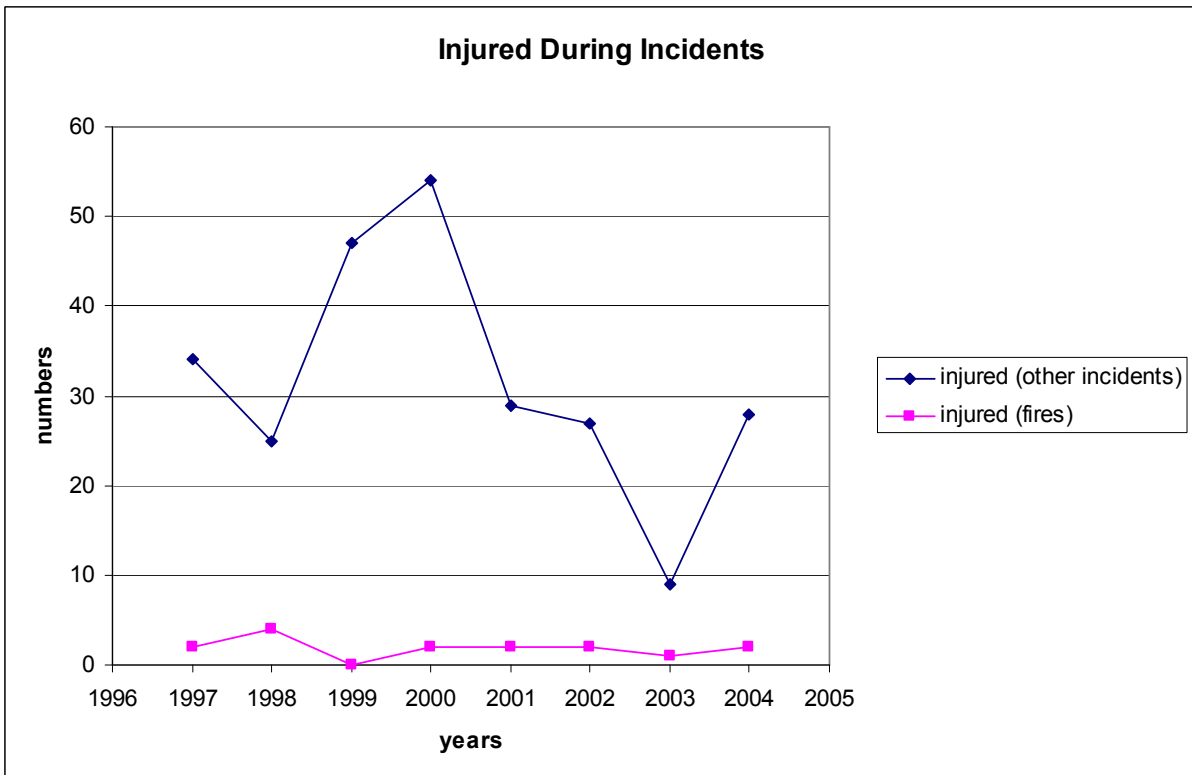*Fig. 4: Deaths during incidents in industrial zones*



*Fig. 5: Injured during disasters in industrial zones*

Number of killed persons is relatively low, especially during fire disasters. Similarly number of injured during the fire disaster is also low and does not have increasing trend.

Perhaps we can interpret it as result of massive introduction of modern smoke detection and smoke extraction systems, which provide early indication of fire and allows safe evacuation of personnel.

In number of injured it is possible to see declining trend since 2001 even with increasing number of industrial zones. Again we may see the possible influence of new stricter legislative with emphasis on increase of the safety.
Tabled valued for above mentioned values are part of table 2.

*Tab. 2: Statistical data about industrial zones*

| year | No. Incidents | fires | Incidents | Other deaths | injured | fire deaths | injured | Sum deaths | injured |
|---|---|---|---|---|---|---|---|---|---|
| **1997** | 117 | 33 | 84 | 1 | 34 | 0 | 2 | 1 | 36 |
| **1998** | 97 | 20 | 77 | 0 | 25 | 0 | 4 | 0 | 29 |
| **1999** | 108 | 11 | 97 | 4 | 47 | 0 | 0 | 4 | 47 |
| **2000** | 127 | 21 | 106 | 2 | 54 | 0 | 2 | 2 | 56 |
| **2001** | 126 | 26 | 100 | 0 | 29 | 0 | 2 | 0 | 31 |
| **2002** | 167 | 26 | 141 | 2 | 27 | 1 | 2 | 3 | 29 |
| **2003** | 167 | 42 | 125 | 2 | 9 | 0 | 1 | 2 | 10 |
| **2004** | 144 | 34 | 110 | 1 | 28 | 1 | 2 | 2 | 30 |
| **Sum** | 1053 | 213 | 840 | 12 | 253 | 2 | 15 | 14 | 268 |

**Conclusion**

In Czech Republic there are in average 130 incident in industrial zones (25 fires and 105 other incidents).

As number of industrial zones increases, number of incidents inside of them increases too. From point of view of the endangered humans during fires, we can see, that even as the number of zones increases the number of injured or deceased does not increase. With other incidents number of injured or deceased has declining trend since 2001. This trend may be result of increased emphasis on safety in companies due to legislative changes.

Interesting indicator could be direct losses values, unfortunately this indicator is used too shortly and the companies are not cooperating properly during gathering of data. That's why today this indicator is close to unusable.

**Literature**

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4. *Homepage of CzechInvest agency* [on-line]. Available from WWW <URL: http://www.czechinvest.cz/ > [cit. 2007-01-02]

5.  *Homepage of Czech Statistical Bureau* [on-line]. Available from WWW <URL: http//www.czso.cz/ > [cit. 2007-01-02]

**Summary**

As number of industrial zones increases, number of incidents inside of them increases too. From point of view of the endangered humans during fires, we can see, that even as the number of zones increases the number of injured or deceased does not increase. With other incidents number of injured or deceased has declining trend since 2001. This trend may be result of increased emphasis on safety in companies due to legislative changes.

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