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Original Article

Evaluation of the Statistics of the Fire Engine Response from the Cheb Station

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Abstract - *This paper evaluates the statistics for dispatching a fire engine from the Cheb station (Fire Rescue Service of the Karlovy Vary) for the period reviewed from 1 March 2017 to 31 December 2021. The paper analyses emergency statistics of fire engine departures from the Cheb station in the monitored period. The paper focuses on the distance travelled and the number of responses about time. The analysis was performed within a specific timeframe throughout the day and in individual months, depending on the number of kilometers travelled to the emergency location. The machinery department can use the listed results of the departure statistics analysis for the fire engine utilisation rate from the Cheb station. They can also determine the need and subsequent replacement of fire protection equipment in the fire engine. Last but not least, the results of this paper can also be used for prevention and informative purposes regarding departure statistics in different periods.*

Keywords – *Fire engine, Emergency, Distance travelled, Time period.*

1. Introduction

The work of a firefighter can generally be characterized as a risky and mentally and physically strenuous occupation. It also requires a considerable amount of specific knowledge, skills, and, last but not least, lots of special equipment and other gear. Among the most important of these used to ensure the professional and effective protection of the population of the Czech Republic in terms of fire protection are undoubtedly mobile firefighting equipment. Fire engines are most often dispatched from individual fire stations to emergencies. These vehicles are equipped with a water and foam tank, a pump, gear for carrying out most types of response and, of course, a cab for transporting the firefighting crew. These fire engines are designated in the Czech Republic, for example, CAS 20/4000/240 – S2T. These fire engines are thus technically ready twenty-four hours a day to respond to various incidents.

An analysis and evaluation of the statistics of intervention activities of a specific fire engine from selected fire stations in the South Moravian Region, the Zlín Region and the Moravian-Silesian Region are provided in projects within Student Grant Competitions [1, 2] at the VSB - the Technical University of Ostrava, Faculty of Safety Engineering. The projects focus on the safe driving mobile firefighting equipment to emergency events. They analyze departure activities concerning selected driving characteristics and main routes and track vehicles when driving to emergencies. A general evaluation of the fire protection unit statistics is provided annually in statistical yearbooks [3]. However, these documents only evaluate the statistics of the fire station's intervention activities.

The analysis and evaluation of intervention activity statistics for individual periods and months are addressed further in the paper [4]. However, the authors only address the deployment of fire engines to different types of fires in New York City. The paper also only addresses the distance travelled to the location of the emergency (fire) as a function of time. The authors also presented a similar analysis in the paper [5]. They only dealt with deploying fire engines to fires in individual months and on individual days. The publication [6] marginally deals with deploying fire engines to emergencies at night, during the day and in traffic jams depending on the distance travelled and time. However, it primarily deals with the rescue of people from building fires.

In their paper [7], the authors discuss selected building fires (case studies) in terms of the loss of human life in India. One of the reasons for the very high loss of human life was the very long time it took fire engines to arrive at the scene of an emergency. This problem was due to peak traffic on the roads during the drive of the fire engines to the scene [8]. The very long distance travelled to the emergency scene was also important. The authors' recommendation of

this publication only focuses on building fire prevention. The paper does not provide recommendations for the repressive part, which deals with the drive of fire protection units to the scene of an emergency about the chosen route or the choice of a suitable type of fire engine.

A very appropriate solution for the travel of fire engines in peak traffic is presented in the paper [9]. Thanks to an emergency vehicle recognition system, fire engines can use a designated route to the scene of an emergency, avoiding the need to bypass traffic jams and thus increase the number of kilometers travelled to the scene of an emergency as a function of time. It gives fire engines much better passage through intersections and other restrictions when driving to an emergency. Fire engines in selected Central European countries have the GINA system [10, 11]. This special navigation system shows fire engines the shortest or fastest possible distance to the emergency scene. The GINA system is also constantly working with the current traffic situation (accidents, closures, traffic jams). The distance travelled to a scene of an emergency can vary greatly at night and during the day.

The above was an impetus for conducting research, the aim of which is to comprehensively evaluate the statistics of the response activity of a fire engine from a specific fire station in a given fire district in the monitored period. The research will focus on analysing the statistics of emergency events as a function of the analysis of departures of the fire engine over time, in individual months, all concerning the distance travelled to the emergency site. The above mentioned problem is not dealt with in the Czech Republic; it is completely absent. This is, therefore, unique research (among rescue units within the integrated rescue system), the results of which can be used by the Fire Rescue Service of the Czech Republic.

2. Characteristics of the monitored firefighting equipment

For the evaluation of the statistics of the first response, the Scania CAS 20/4000/240 – S2T fire engine was chosen, which is stationed at the Fire Rescue Service of the Karlovy Vary Region, Cheb Local Department, specifically at the central fire station in Cheb. It was assigned to the Cheb fire station in December 2016. The town of Cheb financed the purchase of the fire engine (without fire protection equipment) at over CZK 6 500 000. After training the firefighting crew and passing trial runs [12], the fire engine was put into operation on 1 March 2017.

Basic tactical and technical data have been taken from the IKIS information system, specifically from the “Technical Specifications Card” [13]. The Scania RZ 3K5 1139 fire engine has the fire designation CAS 20/4000/240 – S2T. It has the Scania P 440 CB 4 x 4 two-axle chassis with a modular frame and is designed for operation in mixed-traffic facilities (category 2). The vehicle has a permanent rear drive axle equipped with a differential. It also has a front axle drive equipped with a differential. The vehicle has a length of 8 280 mm, a width of 2 550 mm and a height of 3 100 mm. The vehicle has a curb weight of 12 400 kg and a gross vehicle weight of 18 000 kg (weight class S). The water tank capacity is 4 000 l, and the foam tank capacity is 240 l. The pump output is 2 400 l/min.

The requirements for the design, construction and technical equipment [14, 15] of the fire engines show that the fire engine from the Cheb station has a superstructure supplied by WISS CZECH (T). The fire engine from the Cheb station is equipped for:

- Firefighting (water tank, fire hoses B, C, nozzles and other fittings for two-attack streams, supply and transport lines, foam extinguishing with foam supply for two CAS water tanks, high-pressure water extinguishing, pressurizing fan).
- Responding to hazardous substances.
- Traffic accidents (equipment for firefighting units designed for traffic accidents - hydraulic extrication equipment).
- Providing technical assistance (engineering tools, means for breaking into and opening up locked spaces).
- Lighting up the scene of intervention (power station with lighting mast).
- Pumping polluted water (floating and sludge pump).
- Assisting with the injured (transport and stabilization of an injured person, first aid kit, blanket, emergency oxygen machine and automatic external defibrillator).
- Working at heights and above free-fall areas, belay equipment (for two firefighting climbers and 60 m of lifeline).

3. Methods for scientific research

An analysis is a mental and systematic division of the subject under study (dispatching the fire engine from the Cheb station) into individual parts, aspects, planes, links, and points of view, together with the application of contexts specific to each of these divisions (number of dispatches, total distance travelled to the location of the emergency). Along with this, the analysis also looks at the relationships between the two delineated parts. However, relating the parts to each other is a step from analysis to synthesis. The product of the analysis is a description of reality, while synthesis is the explanation of it. Analysis determines and confirms individual facts, while synthesis leads to their understanding [16]. The values of the monitored variables (the number of trips and total distance travelled to the emergency location) were determined for the selected objects (dispatches of the fire engine from the Cheb station). Before a statistical analysis in software systems, it is necessary to define the file (period) into which the data

obtained is to be entered. Almost any data file is suitable for determining the intensity of the dependence of the variables and assessing when that dependence is higher and when lower. MS Excel was used for these purposes.

3.1. Methods of statistical evaluation

Statistics and statistical data monitoring use two basic means to present statistical results. According to the literature [17, 18], line graphs and tables are the most suitable for illustrating results and dependencies. Initial information for time series analysis will be obtained from graphs. These graphs consist of individual time series values plotted in coordinate axes on which the respective scales are marked. The time variable is plotted on the horizontal axis, and the time series values are plotted on the vertical axis [19]. For an evaluation of the statistics of the intervention activity of a fire engine, the line graphs show the number of departures and the distance traveled to the place of the emergency, which are recorded at different time intervals. These graphs show fluctuations in values over time.

The exact numbers and observed values are subsequently presented in individual tables. It makes it a primary statistical tool. This paper uses statistical presentation tables showing processed and analysed results [19].

4. Analysis of emergency statistics

Emergency events are harmful forces and phenomena caused by human activities, natural influences and accidents that threaten the life, health or property of individuals or the environment and require rescue and liquidation work [20]. Emergency events with fire protection unit interventions are classified as follows for the needs of statistical monitoring of emergency events of the Fire Rescue Service of the Czech Republic:

- Fires.
- Traffic accidents.
- Hazardous chemical leaks (HazMat leaks).
- Technical assistance.
- Other emergencies.
- False alarms.

Table 1 shows the number of departures from the Cheb station for the monitored period from 1 March 2017 to 31 December 2021. Departures are classified according to different types of emergencies.

Table 2 shows the statistics of fire engine departures for different types of emergency events. These are all emergencies in which a fire engine from the Cheb station intervened during the monitored period. The fire engine intervened in cross-border cooperation in the Karlovy Vary Region and the Federal Republic of Germany.

Table 2 clearly shows that the fire engine most often intervened in emergencies related to technical assistance, followed by traffic accidents and various fires. The statistics of fire engine interventions from the Cheb station align with the current trend in the Czech Republic, where fire protection units most often provide technical assistance, followed by intervention in traffic accidents and, subsequently, fires.

Table 1. Number of dispatches from the Cheb station in the monitored period

Year	Fires	Traffic accidents	HazMat leakages	Technical accidents	Other emergencies	False alarms	Total
2017	114	117	52	451	17	68	819
2018	128	102	53	428	30	52	793
2019	100	96	52	446	18	47	759
2020	134	130	78	399	34	62	837
2021	63	114	54	521	75	71	898
Total	539	559	289	2 245	174	300	4 106

Source: Statistical Monitoring of Emergencies (2022), Exports of Operational Data from IKIS II (2022)

Table 2. Number of dispatches of fire engine departures from the Cheb station in the monitored period

Year	Fires	Traffic accidents	HazMat leakages	Technical accidents	Other emergencies	False alarms	Total
2017	64	87	41	160	17	48	417
2018	76	77	40	171	27	27	418
2019	93	89	50	240	16	47	535
2020	104	110	51	188	16	53	522
2021	51	96	42	244	21	63	517
Total	388	459	224	1 003	97	238	2 409

Source: Statistical Monitoring of Emergencies (2022), Exports of Operational Data from IKIS II (2022)

Table 3. Dispatch and operational information statistics of the CAS 20/4000/240 – S2T Scania

Year	Response trips	Other trips	Travelled [km]	MTH	Tachometer [km]	Amount of fuel [liters]	Costs [CZK]
2017	417	151	9 706	127	10 524	5 315	155 674
2018	418	114	7 807	92	18 344	4 087	142 318
2019	535	167	7 625	147	25 969	4 411	128 654
2020	522	186	8 281	136	34 250	4 590	113 699
2021	517	198	8 689	121	42 939	4 856	134 114
Total	2 409	816	42 108	624	42 939	23 259	674 458

Source: Statistical Monitoring of Emergencies (2022), Exports of Operational Data from IKIS II (2022)

According to the statistics of emergencies from the operational log for the reporting period from 1 March 2017 to 31 December 2021, the fire engine responded to 2 409 emergencies. The total distance travelled was 42 939 km. Table 3 shows the fire engine's dispatch statistics and operational information for the reporting period each year.

For comparison purposes, Fig. 1 shows the total number of all dispatches from the Cheb station and the number of fire engine dispatches from the Cheb station in the period under review.

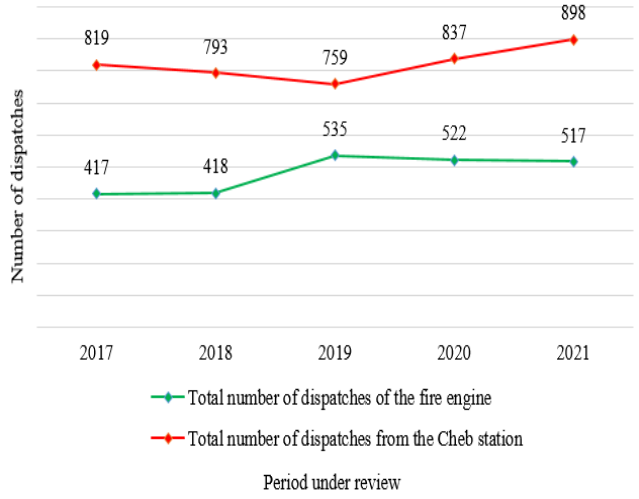

Fig. 1 Total number of dispatches for the monitored period

From the perspective of responses, 2019 was a breakout year. This phenomenon can be seen in Figure 1, with a rapid increase in emergencies. It was mainly a free service to the citizens of the Karlovy Vary Region in the form of technical assistance – opening up an apartment or other locked space and eliminating stinging insects. The fire engine crew carries out these types of interventions. Since 2020, emergencies have been addressed by the Fire Rescue Service of the Karlovy Vary Region in connection with the COVID-19 pandemic. Tasks related to the COVID-19 pandemic are based on § 3 dealing with emergencies under the Fire and Rescue Service Act of the Czech Republic [21]. The fire engine is not always used to handle all emergencies. There are responses, such as forest fires, where the large-volume CAS 30 T 815 is dispatched, or responses where auxiliary equipment is dispatched to another Territorial Department (Sokolov, Karlovy Vary) or as reinforcements for branch fire stations (Aš, Mariánské Lázně). These are mainly dispatches of the AZ 40 Iveco high-rise equipment, TA CH Iveco rescue vehicle, the HFS Somati high-volume pump or other special equipment stationed at the central fire station in Cheb. Then there are situations where the fire engine has to go in for regular servicing, revisions, and state technical inspections. For example, in July 2017, it was out of service for 31 days. As a spare response vehicle, a backup CAS 20/3400/210 – S2T Scania had to be used, which is stationed at the central fire station in Cheb based on the decree [14].

5. Analysis of dispatching in relation to time

Traffic conditions can be affected by the time of day, where a driver travelling to an emergency will find it easier to drive at night with hardly any traffic than during the day when the traffic on the roads can be very heavy. Another consideration may be the time of year. During the winter, there is a risk of snow or ice on the roads, and extra caution should be taken during such weather. More inexperienced drivers and other vehicle users are on the roads in the summer months. It also makes a difference when driving through traffic jams in the city center or with minimal traffic outside.

5.1. Dispatch activity day and night

This section analyses dispatching the fire engine in a specific time interface. For the analysis of the dispatch activity, each day of the week has been divided into three parts, namely daytime, evening and nighttime. Daytime is from 7:00 to 18:00 when firefighters start their regular shift at 7:00. Evening is from 18:00 to 23:00 when firefighters have personal time off. These times are deliberately chosen according to the performance of duty in the firefighting unit based on the decree [14], which sets out specific activities within the organizational management that are distributed throughout the day. Night time is then from 23:00 to 07:00 on the following day. During this time, firefighters are allowed to rest on their cots, being on standby at their place of duty. However, they must be able to leave the fire station garage within two minutes of the alarm being raised.

Table 4 shows the number of fire-engine dispatches from the Cheb station for the monitored period in a specific time interface, and the distance travelled to the emergency place for daytime, evening and night.

Table 4 shows that the largest number of dispatches during the monitored period was in the daytime, namely 1 595 with a distance travelled to the emergency place of 19 251 km. During the free time of the firefighters, from 18:00 to 23:00, the number of dispatches was 507, with a total distance of 5 967 km. The fewest number of dispatches is when the firefighters are on duty, from 23:00 to 07:00. There were 307 dispatches with a total distance of 4 014 km. These are the dispatches when the fire engine crew is resting on their cots. Within two minutes, the firefighters have to leave the fire station's garage in the fire engine. During the journey to the point of emergency, drowsy fire crews are at a much greater risk of causing an accident. Based on the analysis and the export of operational data from IKIS [13], the distance travelled at night from the response site back to the Cheb station is the same as the distance travelled to the response site. However, it could be different in the daytime, as the unit commander may, for example, order a fitness run or inspect road closures. Due to this, the distance travelled from the emergency scene is much higher in the daytime. The fire engine often goes to emergencies when the traffic on the roads is heaviest. As a result, fire crews travel the most kilometers to the scene of an emergency and back to base at the times of heaviest traffic.

Table 5 shows an analysis of dispatching the fire engine from the Cheb station for the period under review during individual hours from 7:00 to 18:00, i.e. during the day. Table 5 also shows the number of trips and the distance travelled to the emergency site.

Table 5 shows that the fire engine's largest number of responses during the period under review was made between 11:00 and 12:00. In total, there were 167 calls. Compared to the traffic volume, this is the period with the lowest traffic on the roads during the day. The highest number of kilometers travelled to the scene of the incident was between 15:00 and 16:00. In total, 2 214 km were travelled. Compared to the traffic volume, this is the peak time on roads in the afternoon. The lowest number of responses was between 7:00 and 8:00. In total, there were 87 dispatches with a minimum distance travelled of 1 039 km to the scene of the incident. Compared to the traffic volume, this is the peak time on roads in the morning hours.

During the time from 18:00 to 7:00, the fire engine has almost half the number of trips during the day. This is two hours, even assuming a longer time than during the day. The number of kilometers travelled to the incident scene corresponds to this. For this reason, this work does not deal with this analysis or the analysis of response activity. This fact is due to the intensity of traffic, the human factor and its activity during the night. This fact was confirmed by analysing the Statistical Almanacs of the Fire Rescue Service of the Czech Republic [3] for the period under review.

5.2. Dispatching activity in individual months

The deployment of the fire engine can be further analyzed by individual months for the monitored period. During the winter, there is a risk of snow or ice on the roads, and increased caution must be exercised in such weather. Driving to an emergency may thus be prolonged by several minutes. There is also a greater risk of an accident with the fire engine. In the summer months, more inexperienced drivers and other road users, such as cyclists, are on the roads. Table 6 analyses the dispatching activity and the total distance travelled by the fire engine to the incident scene by month for the period under review.

Table 4. Number of dispatches in a specific time interface

Time interval [h]	from 23:00 to 7:00	from 7:00 to 18:00	from 18:00 to 23:00
Numbers of dispatches	307	1 595	507
Distance travelled [km]	4 014	19 251	5 967

Source: Statistical Monitoring of Emergencies (2022), Exports of Operational Data from IKIS II (2022)

Table 5. Analysis of dispatch activity during the day

Time interval [h]	7 - 8	8 - 9	9 - 10	10 - 11	11 - 12	12 - 13	13 - 14	14 - 15	15 - 16	16 - 17	17 - 18
Numbers of dispatches	87	120	145	156	167	154	156	149	165	164	132
Distance travelled [km]	1 039	1 485	1 799	1 911	1 901	1 587	1 843	1 829	2 214	2 058	1 585

Source: Statistical Monitoring of Emergencies (2022), Exports of Operational Data from IKIS II (2022)

Table 6. Analysis of the dispatching activity according to individual months

Month	January	February	March	April	May	June	July	August	September	October	November	December
Numbers of dispatches	153	168	188	174	238	219	239	240	250	189	165	198
Distance travelled [km]	1 865	2 054	2 056	2 164	2 789	2 840	3 103	2 958	3 128	2 268	2 113	1 944

Source: Statistical Monitoring of Emergencies (2022), Exports of Operational Data from IKIS II (2022)

Table 7. The total amount of fire engine departures from the Cheb station in the monitored period

	Fires	Traffic accidents	HazMat leakages	Technical accidents	Other emergencies	False alarms	Total
Total	388	459	224	1 003	97	238	2 409
Average	78	92	45	201	19	48	482
Account [%]	16	19	9	42	4	10	

Source: Statistical Monitoring of Emergencies (2022), Exports of Operational Data from IKIS II (2022)

The largest number of dispatches with the greatest distance travelled to the scene of an emergency is in September. The fire engine responded to 250 emergencies, and the total distance travelled to these emergencies was 3 128 km. The lowest number of emergencies is in winter (December, January, and February). The shortest distance to emergencies was in January, just 1 865 km.

Table 6 also shows that the winter months, when conditions are some of the worst for driving a fire engine, have the lowest number of responses and the least distance travelled to emergencies.

6. Evaluation of the statistics of the fire engine dispatching activity

The work evaluates the dispatch activity statistics, and the distance travelled to the emergency site by the fire engine from the central fire department in Cheb. The evaluation was carried out to map the utilization of this fire engine and a crew numbering 1+3. The observation period for the data evaluation was from 1 March 2017 to 31 December 2021. Table 2 shows that the fire engine intervened in 51 fires in 2021, which is 50% less than in 2020. This overall reduction in the number of fires was due to progress in construction technologies, particularly tightening technical standards in fire prevention. The growing number of firefighter interventions in the Czech Republic was also reflected in the statistics of firefighter interventions in Cheb. Figure 1 shows that firefighters from the central station in Cheb intervened in 898 emergencies in 2021. It is an 18% increase in interventions compared to 2019. This increase was due to the ever-increasing number of technical accident interventions and tasks related to the COVID-19 pandemic. The increase in fire engine departures from the Cheb station is naturally also associated with this. In 2019, fire engines intervened in 535 emergencies, 28% more than in 2017.

Tables 4 and 5 provide an evaluation of departures in different periods and show the subsequent distance travelled to the place of the emergency. Table 4 shows that the busiest time during the day is between 7:00 am and 6:00 pm. Departures are shown in further detail in Table 5. The most fire engine departures in the monitored period were between 11:00 am and 12:00 noon. This is a deviation from a practical perspective, as this is not the time when traffic or human activity is at its peak. According to statistics [3] of emergency calls to 112 or 150, there is another deviation, as the highest number of emergency calls are made in the afternoon. The performed analysis and logical deduction show that the fire engine intervenes in emergencies much more during the day than at night. However, the evaluation of statistics and the analysis of departures of the fire engine from the Cheb station corresponds to nationwide tendencies in the intervention activities of fire protection units.

Table 7 shows the total number of fire engine departures to different emergency events in the monitored period. Table 7 also shows the annual average and the share of individual emergency events.

Table 7 shows that technical assistance accounts for most interventions, namely 42%. It is almost every other fire engine departure. Traffic accidents account for 19% of fire engine departures. From the perspective of firefighters, this is another kind of technical intervention. This is why technical T-fire engines are used. In comparison, on average, the fire engine intervenes in 78 fires every year. The nationwide decline in the number of fire interventions [3] was also reflected in the statistics in Cheb.

7. Conclusion

This paper has dealt with an evaluation of the statistics of the dispatch activity, and the distance travelled to the place of emergency by the fire engine from the central fire department in Cheb. The evaluation was carried out to map the utilization of this fire engine for the reporting period from 1 March 2017 to 31 December 2021.

First, the paper described and characterized the fire engine together with the techno-tactical data. Next, the statistics of the fire engine's dispatch activity and operational information were analyzed. The IKIS information system was used for the actual evaluation of the records. The data for the period under study were exported from this system. Subsequently, unnecessary data (regular checks of the electric winch, state technical inspection, emissions, motor hours and fuel consumption, including costs, etc.) was not included. Then the records of driving to the emergency and the kilometers travelled there were evaluated and processed in a Microsoft Excel spreadsheet.

The machinery department can use the listed results of the departure statistics analysis for the fire engine utilisation rate from the Cheb station. They can also determine the need and subsequent replacement of fire protection equipment in the fire engine. Based on departure statistics and the increase in technical interventions, the fire equipment was reduced in 2020 and funds were allocated for technical assistance equipment in the fire engine from the Cheb station. The Fire Rescue Service of the Capital City of Prague states [22] that statistical data are very important in evaluating the activities of fire protection units and their need for new mobile fire equipment. Last but not least, the results of this paper can also be used for prevention and informative purposes regarding departure statistics in different periods.

Compared to other research the authors mentioned in this paper's introduction, this is a comprehensive evaluation of the statistics of the intervention activity of a fire engine. The research provides a detailed analysis of departures of the fire engine as a function of time, and the distance travelled to all types of emergency events. In their papers, the authors mentioned above only dealt with evaluating intervention activities, especially in the case of fires and in a specific time period. The data necessary for research was exported from the IKIS information system. The distance travelled to the emergency site was determined based on the GINA navigation system. In the Czech Republic, this is one of the most modern and accurate systems for recording intervention activity and travel data of emergency services within the integrated rescue system.

References

[1] L. Jánošík, " Safe driving of the firefighting vehicle to the intervention," Final report from project No. 2017/51. Ostrava: VSB - Technical University of Ostrava.

[2] I. Šudrychová, "Safe driving of the firefighting vehicle to the intervention," Final report from project No. 2019/8. Ostrava: VSB - Technical University of Ostrava.

[3] V. Vonásek, "Statistical Almanacs of the Fire and Rescue Service of the Czech Republic [online]," Prague: Ministry of the Interior - *General Directorate of the Fire and Rescue Service of the Czech Republic,* Available from: http://www.hzscr.cz/clanek/statisticke-rocenky-hasicskeho-zachranneho-sboru-cr.aspx.

[4] H. Corman, E.J. Ignall, K.L. Rider, et al, "Fire casualties and their relation to fire company response distance and demographic factors," *Fire Technology.* vol. 12, p. 193-203, 1976. ISSN 0015-2684.

[5] J. Corcoran, A. Higginson, P. Chhetri, "Spatial and temporal patterns of fire incident response time: a case study of residential fires in Brisbane," *in Proceedings of the State of Australian Cities, Gold Coast, Queensland*.

[6] M. Wrack, "It's about time. Why emergency response times matter to firefighters and the public," *The Fire Brigades Union*. [Online]. London. Available from: https://www.epsu.org/sites/default/files/article/files/6367-Its-about-time-LOW-RES2.pdf

[7] P. Lilly grace murali, M.M. Vijayalakshmi, "Fire Accidents in Buildings – Case Studies," *International Journal of Engineering Trends and Technology (IJETT)*, ISSN 2231-5381, vol. 11, no. 4, pp. 178-184, 2014,

[8] L. Bartoš, "Determining traffic intensity on roads" *First edition, Plzeň*, 2009. ISBN 978-80-87394-06-9.

[9] T. Swathi, B. Veera Mallu, "Emergency Vehicle Recognition System," *International Journal of Engineering Trends and Technology (IJETT)*, vol. 4, no. 4, pp. 987-990, 2013. ISSN 2231-5381.

[10] GINA Software s.r.o. Geographic Information Assistant [online]. Brno. Available from: http://www.ginasystem.com/about-us.php

[11] M. Tomášek, "System GINA," *Firefighter Magazine*. vol. 3, p 44-47. 2022. ISSN 1866-444X.

[12] Instruction No. 56 of the General Director of the Fire and Rescue Service of the Czech Republic of 10 December 2018, which issues the Fire Engine Operational Rules of the Fire and Rescue Service of the Czech Republic.

[13] S. Slezák, " Personal Consultations and Exports of Operational Data from IKIS II," *Fire and Rescue Service of the Karlovy Vary Regio*n. February 2022.

[14] CR. Decree No. 247/2001 Coll., "On the organization and activities of firefighting units," *In Collection of Laws*. 2001.

[15] CR. Decree No. 53/2010 Coll., "Amending Decree No. 35/2007 Coll., on the technical conditions for fire equipment," In Collection of Laws, 2010.

[16] S. Gibilisco, " Statistics without Prior Knowledge," First edition, Brno: Computer Press, a.s., 2009. ISBN 978-80-251-2465-9.
[17] F. Čížek, " Philosophy, Methodology, Science. Svoboda, Prague 1969.
[18] Z. Molnár, "Advanced Methods of Scientific Work," *First edition Prague: Profess Consulting*, s.r.o., 2012. ISBN 978-80-7259-064-3.
[19] J. Borůvková, "Statistics – Introduction to data processing," *First edition, Jihlava*, College of Polytechnics Jihlava, 2013.
[20] CR. Act No. 239/2000 Coll. on integrated rescue system. In Collection of Laws, 2000.
[21] CR. Act No. 133/1985 Coll., on fire protection, as amended. In Collection of Laws,2011.
[22] "Fire and Rescue Service of Capital of Prague," *Statistical data [*online]. Prague. Available from: https://www.hzscr.cz/clanek/statisticke-udaje-za-jednotliva-ctvrtleti-archiv.aspx
[23] Computer program , "Statistical Monitoring of Emergencies," *General Director of the Fire and Rescue Service of the Czech Republic*, 2022.