DECISION SUPPORT IN EMERGENCY CALL SERVICE

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ABSTRACT

The emergency call service (telephone number 113) in Slovenia yearly receives more than half million calls. The communication between the caller and the policeman receiving the call is occasionally error prone due to stress and related conditions. From the above it is clear that a reliable operation of communication infrastructure and human resources is a prerequisite for efficient performance In this paper we explore possible ways of improving the emergency call service by providing decision support to the officer who receives the calls and dispatches a patrol to the place of the event.

1 INTRODUCTION

When accepting a call, the police officer writes down the received information using the computer program called Event log of Operation communication centre (ELOCC). The recorded information is then processed by another police officer who faces the following dilemma:

1. How urgent is this event in comparison with others which are already in process or are on standby for dispatch?
2. How many police officers are required for solving the event?

The emergency call service (telephone number 113) in Slovenia yearly receives more than half million calls. In order to handle such a great amount of information and react efficiently to specific circumstances of each individual call highly skilled personnel is required. The user interface of the ELOCC provides means for storing information required for further activities of the centre. The user interface in the current version serves its duty but could be improved by providing additional features such as context-aware forms and decision support. Some initial results of our usability testig of alternative ways of recording information of a call have been reported in [1]. In this paper we explore the possibility of including some kind of decision support to help the officer in disapatch phase.

Currently ELOCC does not have any decision support. The first decision about the priority of an event is made by a police officer in the acceptance phase. He can optionally mark an event as urgent (Figure 1). In 2012, the emergency telephone number 113 has received 496.432 calls to all operation communication centres (OCC) in Slovenia, among them 194.135 calls that needed a police intervention on a place of the event and 9.317 of these calls have been classified as urgent. [2]

Urgent events are all events where eminent danger to a human life or property exists. The crime is still in progress or perpetrators are preparing to do it.

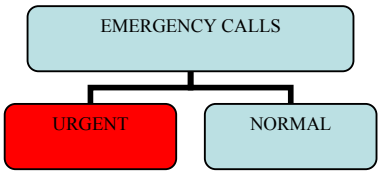

Figure 1. Emergency calls

In our work toward providing some decision support to ELOCC we followed the principles of Multi-Attribute Utility Theory (MAUT) [3]. The model is created in Microsoft Excel and has been developed in conformance with the recommendations presented in [4]. According to [3], the decision support is a part of decision making process. A decision is defined as the choice of one among a number of alternatives. Decision making refers to whole process of making the choice, which includes:

- assessing the problem,
- collecting and verifying information,
- identifying alternatives,
- anticipating consequences of decisions,
- making the choice using sound and logical judgment based on available information,
- informing others of decision and rationale,
- evaluating decisions.

Numerous papers related to the emergency call number 911 in North America as well as papers describing emergency service in other countries have been published. Most of them focus on emergency service infrastructure and management issues, while reports dealing with the problems of processing the incoming calls are relatively few. In [5], local expertise at an emergency call centre is described. The paper is primarily focused on how to combine the knowledge and expertise of the involved personnel in a time effective way. In [6], a case study of design for a police emergency-response system is reported.

The lesson learned of not undertaking a user-centered design process described in the paper gives additional motivation to our work. Higher level emergency operation strategies and solutions are reported in [7], [8]. Decision support issues are described in [9], [10]. However, due to considerable differences in practice they could only serve to some extend as guidelines and not as complete solutions.

2 DEFINING ATTRIBUTES OF THE MAUT MODEL

The process of defining the attributes of the MAUT model implicitly affects the priority of human life. The decree published in Uradni list Republike Slovenije No.63/2013 defines the role of police when protecting certain people and places. The decree gives priority to the life of the president and other people who are mentioned in this decree over the life of an ordinary resident. Implementation in practice is, of course, another story. The police law [11] article 4 defines police tasks in protecting life, personal security and property. In accordance with it we identify the following questions which represent the attributes of our model.

1. Is there endangered life or property?
2. Is the influence on life or propertyof the event in question increasing?
3. Whose life is endangered? (police officer, medical rescue, fire fighter, child, VIP, weak person, etc.)
4. Is there anybody injured?
5. How many people are injured?
6. What kind of injures do they have?
7. Is there anybody dead at the place of event?
8. How many persons are dead?
9. What kind of property is endangered? (national importance, cultural, protected property, etc.)
10. What kind of event has happened? (alarm, murder, other kind of crime, offence, etc.)
11. Will immediate arrival of police secure life of persons or property?
12. Is there some other service more competent to handle this event and is it available?
13. Is the reported event still in progress?
14. Are the perpetrators on the run and must be immediately captured?
15. Are the perpetrators still at the place of the event and are still treating life or property?

In the MAUT model, a weight from 1 to 10 is assigned to each attribute in the preference metric chart. Furthermore, a basic function of usefulness is defined for each attribute. As shown in Figure 2, the function of usefulness of the attributes 1, 2, 4, 7, 11, 12, 13, 14 and 15 has only two values (yes and no). Atributes 3, 5, 6, 8, 9 and 10 have multiple values corresponding to the fact that the related question has multiple possible answers. As an example, the function of usefulness of the attribute 3 is shown in Figure 3.

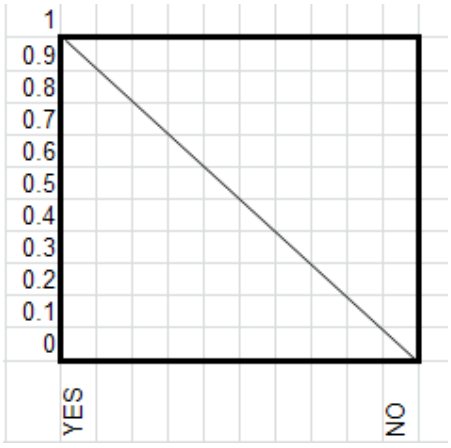

Figure 2: Basic function of usefulness for attributes 1, 2, 4, 7, 11, 12, 13, 14 and 15

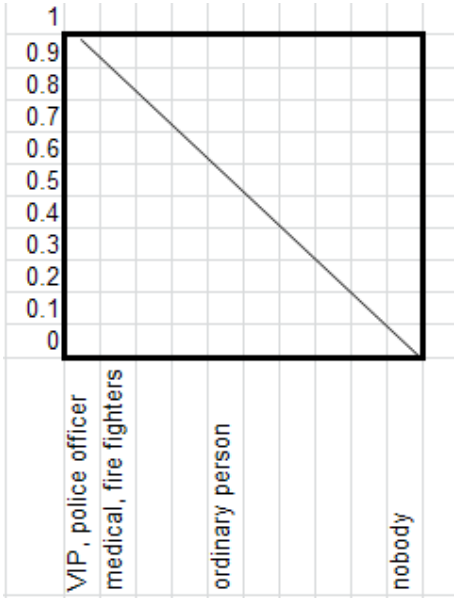

Figure 3: Basic function of usefulness for attribute 3

In order to reduce the number of possible outcomes and consequently to reduce the complexity of the computations we aggregate the attributes into six categories:

- life (attributes 1, 2, 3)
- injuries (attributes 4, 5, 6)
- death (attributes 7, 8)
- event 1 (attributes 10 and 11)
- event 2 (attributes 12 and 13)
- perpetrators (attributes 14 and 15)

In the next step we further aggregate the above categories into the final three:

- life,

- injuries and death,
- event and property.

The resulting model is shown in Figure 4.

3 SCENARIOS AND MODEL CHECKING

In order to evaluate the model we applied a number of scenarios which can happen in real life:

- Murder, Perpetrator has killed his neighbor and called to police to report himself. The crime has ended and there is no other influence.
- Shooting where police officer on duty is involved while he tried to solve the event reported by the urgency call. Nobody is injured at the moment. Attack is still happening.
- Shooting where a non-police person is involved and is calling the police. Nobody is injured at the moment. Attack is still happening.
- Traffic accident on a freeway, with one dead person, many injured (unknown stage of injuries) and leaking dangerous substance. It is a great danger of exposition and for other people to crash into these cars.
- Fight among six people and near is a crowd of hundred people which are hostile to police. Nobody is injured, event is still happening.
- Verbal fight between two neighbors. Nobody injured, event is still happening. They can move to house and end the verbal fight.
- Stolen license plate from a car a few hours ago. The event has ended, nobody is endangered.
- The calling person discovered that somebody has stolen a wallet. Event has ended, nobody is endangered.

The first five events would be classified as urgent, the

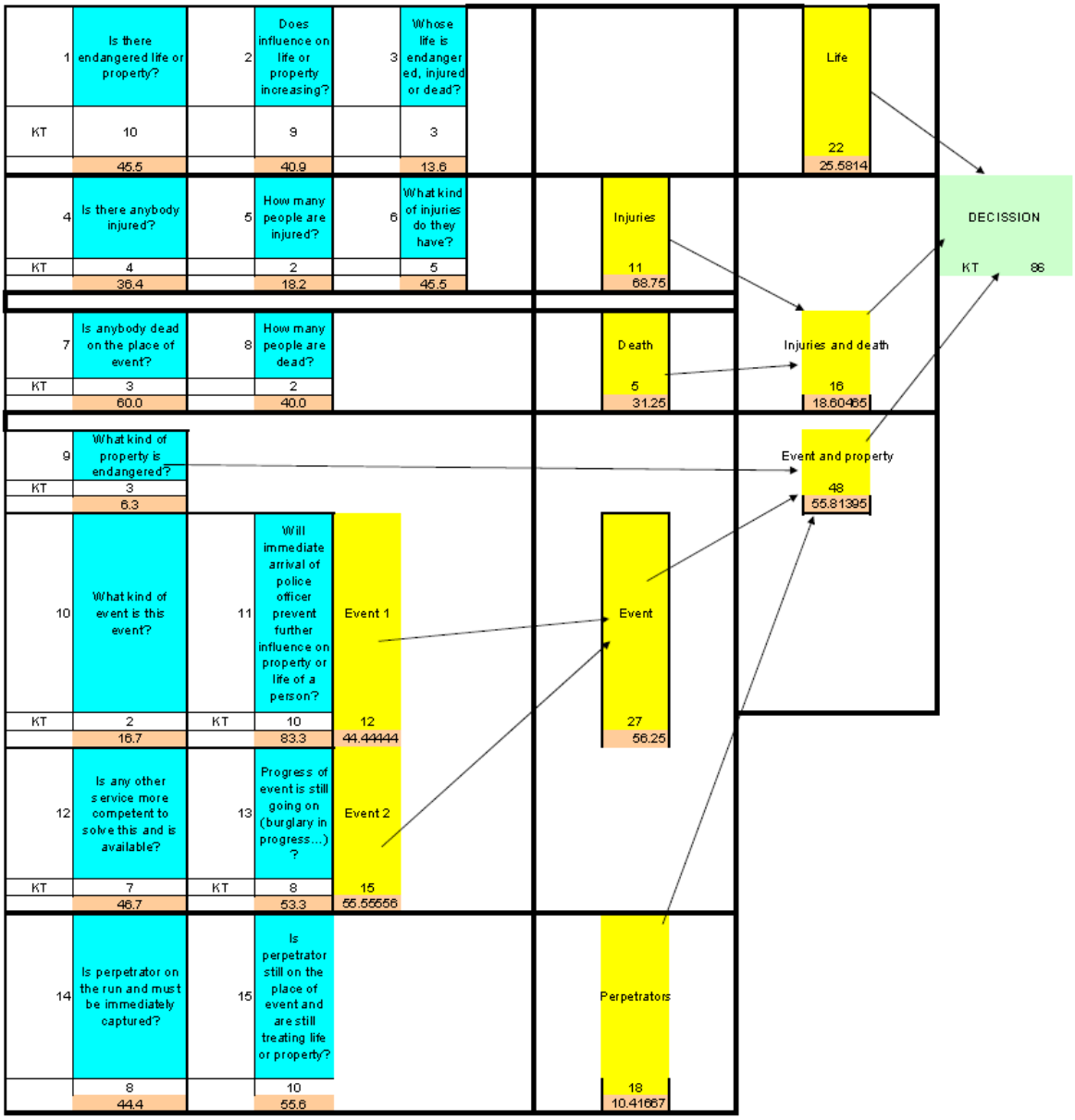

Figure 4: Model structure

last three are normal events and police presence is not immediately required. The question is, to which event a priority should be given in the case that all of them are present at the same time.

Table 1 shows the grades of the events computed using the MAUT model. The resulting priorities of the events corresponding to the computed grades are also shown.

We can see that the most important scenario is a traffic accident, as it should be. We intentionally give in scenario injured people and dangerous substances, which can lead even to greater danger for other people.

The second priority is given to shooting on police officer and third to shooting on a non-police person. We might agree with a result, because the life of a person who is helping others and is in a given situation more important for further solving of the event than some other person.

The fight among six people is on the forth place and before a murder. We again agree with this. Both cases are important, but on the place of event of a murder the police presence can not do anything, except to arrest a perpetrator. But on the place of a fight the police presence can stop the fight and prevent even something worst to happen

Verbal fight is on the sixth place, before stolen license plates and valet, which is again correct. We can see that is a big difference between murder with 0,42 point and verbal fight with 0,181 point.

Finally, the two thefts are placed with 0,097 point. From legal point of view, both thefts are having the same legal categorization.

TABLE I
EVALUATION OF SCENARIOS

Scenario	Grade	Result
1. Murder	0,420	**5**
2. Shooting on police	0,628	**2**
3. Shooting on person	0,610	**3**
4. Fight 6 people	0,597	**4**
5. Traffic accident	0,630	**1**
6. Verbal fight	0,181	**6**
7. Stolen license plate	0,097	**7, 8**
8. Stolen valet	0,097	**7, 8**

5 **CONCLUSION**

As demonstrated, the developed MAUT model assigns reasonable priorities to the events and might prove to be a useful support in the police dispatch in the case of simultaneous events. A possible application could be as an interactive remainder, which would help the police officer in the acceptance phase to lead conversation and to determine the priority of the event. Its implementation and integration with the existing ELOOC in practice is, however, still an open issue. Any change of such a system obviously requires thorough analysis and preparation. Elaborated case studies nevertheless show that improvements are possible and they can serve as a basis for future strategic decisions.

References

[1] M. Ristič, F. Novak. Towards the improvement of emergency call service, IREIT, 2013, Vol. 1, No. 6. pp. 339-345.

[2] Poročilo o delu policije za 2014, http://policijja.si

[3] M. Bohanec, Odločanje in modeli (DMFA-založništvo, 2006)

[4] M. Bohanec, What is Decision Support?, Proc. Information Society IS-2001: Data Mining and Decision Support in Action, Ljubljana, pp. 86-89.

[5] M. Normark, D. Randall, Local Expertise at an Emergency Call Centre, Proceedings of the 9th European Conference on Computer-Supported Cooperative Work (Pages 347-366, Year of Publication: 2005).

[6] A. Marcus, J. Gasperini, Almost dead on arrival: A Case Study of Non-User-Centered Design for a Police Emergency-Response System, Interactions,Vol. 13, n. 5, pp. 12-18, 2006.

[7] M. Kyng, E. T. Nielsen, M. Kristensen, Challenges in designing interactive systems for emergency response, Proceedings of the 6th conference on Designing Interactive systems (Pages 301-310, Year of Publication: 2006).

[8] R. Bhavanishankar, C. Subramaniam, M. Kumar, D. Dugar, A Context Aware Approach to Emergency Management Systems, Proceedings of the Conference on Wireless Communications and Mobile Computing (Pages 1350-1354,Year of Publication: 2009).

[9] X. Li, P. Fu, Design and Implement of Police Emergency Response System Based on Integrating GIS with Decision-making Models, Proc. 2nd International Conference on Information Engineering and Computer Science (Pages 1-4, Year of Publication: 2010).

[10] A. Adla, M. T. Laskri, J. L. Soubie, A Cooperative Framework for Intelligent Decision Support Systems, International Review on Computers and Software, Vol. 2, n. 4, pp. 292-301, 2007.

[11] Zakon o policiji, Uradni list RS, št. 78/06 z dne 25. 7. 2006

[12] B. Nielsen, H. Loranger: Prioritizing Web Usability, New Riders, 2006.

[13] T. Brinck, D. Gergle, S. D. Wood. Usability for the web designing web sites that work, Morgan Kaufmann, 2002.

[14] M. Manhartsberger, S. Musil. Web usability. Galileo Press GmbH, 2002.

[15] M. Wiklund, J. Kendler, A. Y. Strochlic. Usability testing of medical devices, CRC Press, Taylor & Francis Group, 2011.