Two Models for Improvement of Business Process in the Express Courier Company: A Case of the Post of Serbia

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Abstract. In this paper two models which solve the problem of exceeding time limit in the system of express parcel shipping in the Post of Serbia are described. The existing principle of organizing the courier delivery area is explained, as well as the problem of exceeding the time limit to perform the service which leads to the delay in serving a user. Two approaches for the problem solving are proposed. The first is based on the fuzzy set theory, i.e. fuzzy logic system, whereas the other uses the algorithm "zoning-routing".

1. Introduction

Modern environment has an effect on the increase in the exchange of information, goods and other services. The recent research has shown that the new technological development, first of all IT and e-trade, significantly increases the number of postal parcels, primarily the number of packages, that require safe shipment in a short period of time. Accordingly, there are numerous providers in the express courier market which offer quick and safe shipping of parcels.

Modernized business systems focus their activities and resources on increasing business efficiency and quality level for the final users. The business system of express courier companies consists of appropriate technological supplies and systems which satisfy the principle of shipment, regulated by corresponding standards. The technological process of shipment consists of parcel collection, transportation and delivery to the address of the recipient (in some rare cases delivery could be organized in the postal branch).

Modern trend of world's economy and the experience of foreign operators were encouraged for development of express courier companies in Serbia. There are numerous competitors in the market today. The Post of Serbia is a state-owned company which is universal service provider. Besides others, it offers the services of express shipment. This scope of services and corresponding department in the company is called of Post Express. One of the crucial boundary in the service accomplishing is the necessity to act in strictly defined deadlines both in collection and delivery, which should be achieved by using a valid and required quantity of various resources. In the system of shipment, business processes are defined through the company's regulations and competent law [1]. Having previously explained in mind and due to the nature of stochasticity in service demands, the task to organize such a company is very complex.

In this paper, to solve the problem of exceeding deadlines, two approaches are suggested. In both of these approaches, the improvement of business processes is carried out, and this will be shown using BPMN notation. The first approach is based on the application of fuzzy set theory, i.e. of fuzzy logic system [2,3], and the other is based on the algorithm application "zoning-routing" [4].

2. Main characteristics of post express system and analytical approach in organizing the collection and delivery

Post Express is an express courier service of the Post of Serbia. According to the statistical analysis, the most popular (used in 95%) service is "Next day delivery service", so the organization of this business system is the most critical [5]. Suggested models in this paper are related to the service which enables delivery of the parcels next day from 8 to 12 a.m.

To accomplish a high quality of express service, the Post of Serbia organizes the special delivery of the express items regardless to the delivery of other postal items.

Main organizational requirements are related to technical and technological supplies, transport capacity and human resources. Some of the main objectives are to divide territories into zones, to form collection areas and to determine the correct number engaged couriers and vehicles.

Collection and delivery of express parcels are carried out in the same territory where the delivery of ordinary mail is organized. The ordinary delivery is organized based on the mailman delivery areas. A mailman delivery area is a territory served by one employee. The defined mailman delivery areas are used to form the zone for courier delivery (Figure 1). The precondition for optimal zone organizing is the optimal mailman delivery areas organizing.

The basic characteristics of zone are: assigning to certain delivery Post Office, set of PAK (Postal Address Code), zone work time, certain type of services and carriers that are used.
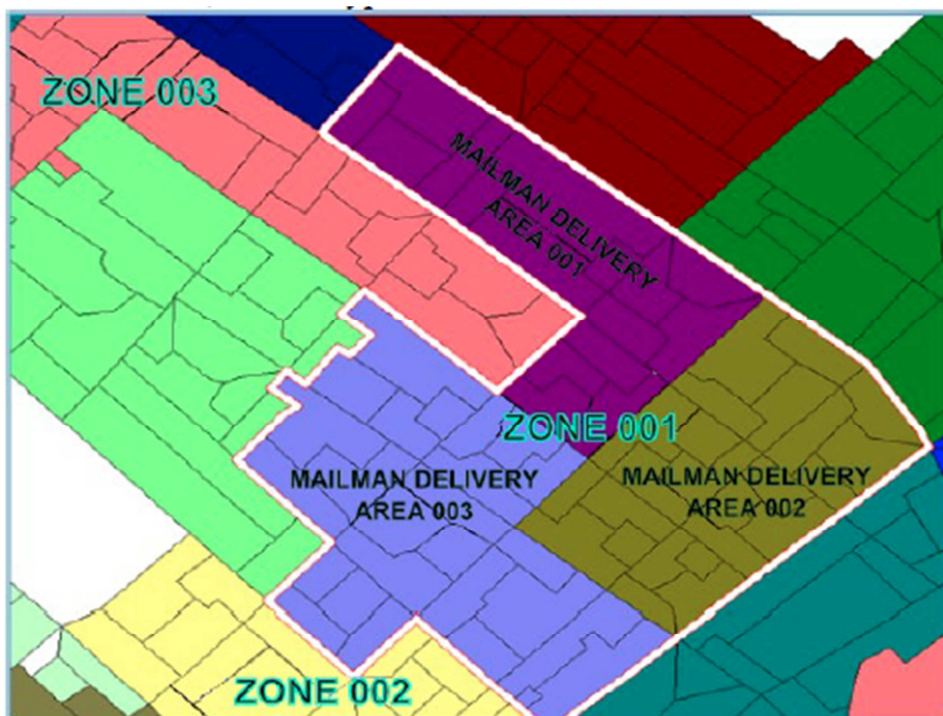

Fig.1. Illustration of the mailman delivery areas and zones

When a zone should be designed, it is very important to pay attention to the territory which is created from locally connected mailman delivery areas. These areas form an urban or natural unity. It is necessary to take into account the transport along the defined zone. Therefore, it is not recommended to use transport on large geographical barriers and large roads
(high-ways, railway tracks).

The analytical approach to the collection and delivery organizing has as a goal the achievement of high service quality level by using rationally all necessary resources (technical and technological supplies, transport capacity, human resources). To organize collection and delivery well, it is very important to consider the number of parcels that should be delivered and the number of addresses that need to be visited. It often happens that more parcels are delivered on the same address.

Different number of zones for service could be assigned to the courier, depending on the service demands and imposed deadlines [6]. Zone planning for the collection and delivery of the express parcels is accomplished on the level of larger areas, such as a city, one or more nearby municipalities. The main parameters for zone planning are time of stay at the address and time necessary for courier to come to the observed area. There is a recommended time for the courier to serve the zone in the period which shouldn't be longer than 80 min [6]. The created zones are assigned to the couriers who will service them depending on the type of work and defined periods of time. The number of zones is defined and assigned to the courier according to his determined working time on the terrain, (working time of courier [min] / 80 min). After that, necessary number of the couriers on the covered territory can be determined. The zones which are assigned to one courier are called courier delivery area. In the case of the Post of Serbia, the reengineering of the created courier delivery areas is not carried out very often. Besides the systematic creation of zones and areas, and couriers' assigning to the area, there are a lot of other problems. Next, the problem of exceeding time limit of the parcel collection and delivery will be presented.

3. Problem description

Transport demands have an attribute of stochasticity. The same is valid for the express courier service which can cause increased or decreased number of demands in some moment of time. According to the statistic data, expected number of users' demands for service on the considered territory is determined by the special studies. Based on these data, the zones and mailman delivery areas are created, as described in the previous chapter. Each courier is assigned his courier delivery area for parcel collection and delivery which consists of defined number of zones. However, smaller or larger deviations can appear in a day because the need for collection and delivery of the parcels on considered territory is more than expected. In the case of smaller demands it is not problem to the company to perform the service. Even after the courier completes the activities related to the collection delivery, he/she will be assigned other activities in the business process. In the opposite case, when the demands are higher there   is a problem to achieve the quality targets. In the reality the deviations in traffic volumes are in the segment of increased demands. The larger number of demands causes the problem which leads to the deviation from predefined deadlines. Certain number of users will send/receive their parcels with delay in regard to the expected time. In this case, according to the real users´ demands, operator's role is to act in advance and to prevent the time exceeding.

4. Suggested methodology for problem solving

In this paper two approaches for the problem solving are suggested. They refer to the next day delivery until 12 a. m.

4.1 The first approach for solving the problem

This approach uses the existing organization of zones and courier delivery areas. Since the delivery demands are known one day before in the evening, the organizer should consider if a courier can achieve the imposed targets. If it is concluded that the courier is overloaded some solution should be find. The proposed model is based on the application of fuzzy logic

system which gives a result in the form of preference value (need, validity) that one more courier should be assigned to the observed courier delivery area to avoid the exceeding time of delivery, i.e. delay. The whole fuzzy logic systém is described in details in the paper of Lazarević and Živanović [7]. The suggested approach is the system of support for operator in decision making process, who makes the final decision for courier's assigning. Briefly, the existing organization of areas will stay the same, but daily, the need for assigning one more courier to the appropriate area is considered on the base of demands that arrive.

According to the demands (the number of addresses that need to be visited next day) and average time of stay at the address, real time necessary for the delivery in the certain area is determined. Based on the calculated time, deviation is determined (O) compared to the expected time for delivery (regulated by service), formula (1):

$$O = t_p - t_r, \tag{1}$$

where t_p is regulated time (in concrete case 240 min), and t_r is the real time of delivery, calculated according to the real demands in the form of the number of addresses which need to be served.

Using the fuzzy logic system, whose inputs are calculated deviation compared to the delivery time (O), the number of disposable couriers and the number of remaining courier delivery areas for the analysis at a given moment, the value of preference is defined [7] for assigning one more courier to the observed courier delivery area. Disposable couriers are the couriers with periodical contracts in the company or more often the couriers who are appointed to some other activities in the business process. Timetable of alternate couriers for the next day is determined after analysis of the demands for service. The remaining courier delivery areas are those which are not analyzed yet in the moment of decision making. If a small/large number of areas for analysis remain at a given moment, it will have an important effect on the value of preference together with the number of disposable couriers and time deviation. Larger number of areas remained for analysis at a given moment will influence on preference reduction in some situations, i.e. on the decision to assign one more courier to the observed area. The reason for that is increased possibility for more couriers to employ in some of these areas. Using the proposed methodology is justified if the need for additional couriers is rare in a certain courier delivery area during one month (based on the opinion of operator). If the exceeding of demands happen more often in a certain courier delivery area, the results of the methodology could give a better insight in actual situation which could be an indicator for essential reengineering. The
concept of explained methodology is illustrated in Figure 2 by using BPMN notation (Business
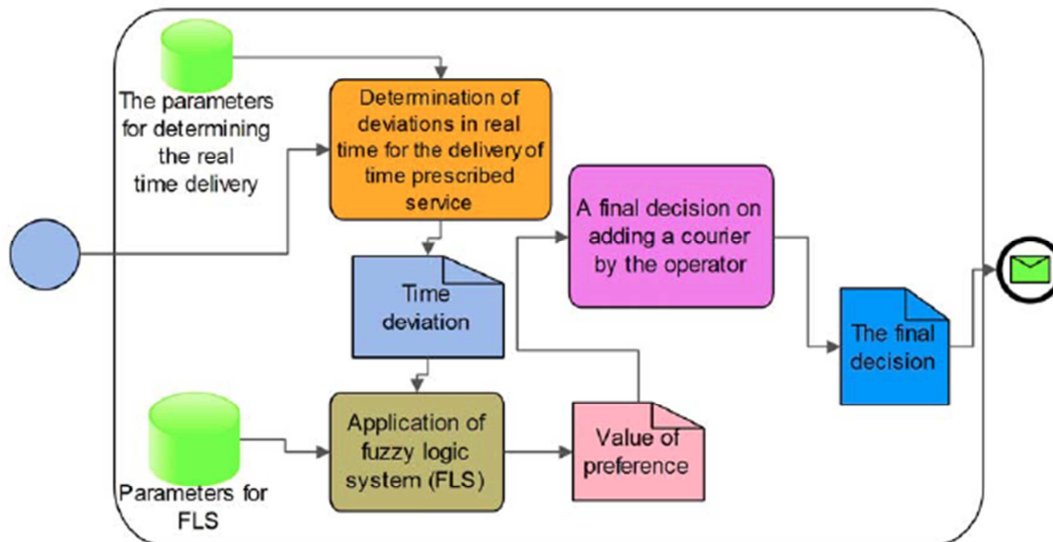Process Modeling Notation).

Fig. 2. Sub-process of decision making about adding additional courier to the courier delivery area

4.2 The second approach for solving the problem

In the second approach a different territory organization is suggested compared to the existing. It is based on the daily analysis of real demands, and according to them some algorithms are carried out. These algorithms are based on the principle "zoning-routing". The existence of more service centers of Post Express is considered for certain territory, which are of interest for the service offering. When a certain territory is organized, the previously defined mailman delivery area should not be taken into consideration. Therefore, independent zones should be created on a daily level.
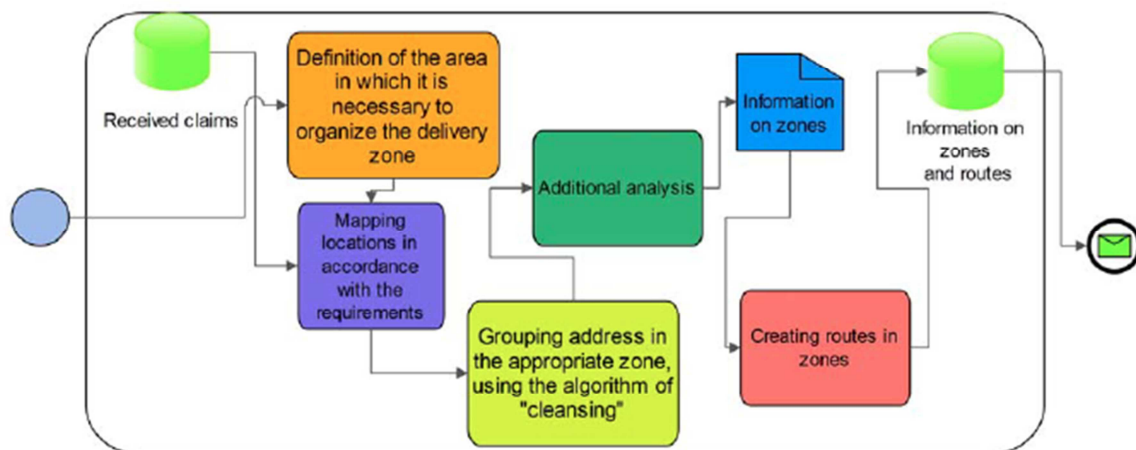

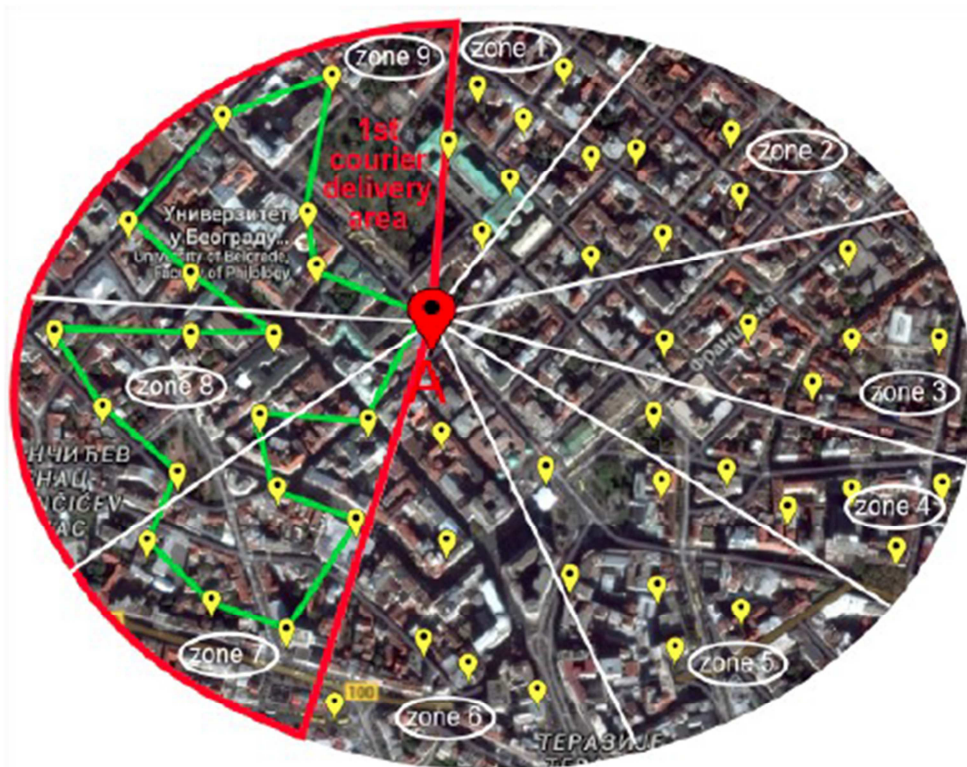Fig. 3. Sub-process of creating zones and associated routes shown BPMN notation

Fig. 4. Zones, courier delivery area and corresponding route

It is suggested to form zone and route of couriers applying the approach "zoning-routing", without connecting to the existing mailman delivery areas. In other words, we take into consideration the territory without predefined areas and according to the defined parameters we perform zoning. First, this means that the observed territory should be separated on smaller parts (zones). After that, these zones are assigned to the couriers, in the form of courier delivery areas and the routing problem for one courier is solved in her/his specific area (Figure 4). By this the primary principle "zoning-routing " is partly changed and the structure is illustrated in Figure 3 by using BPMN notation. The parameter that is considered in zoning is the average time for performing the service on a location so the first step   represents   the "time-zoning". The creation of zoning according to the service time can be described through some algorithmic steps:

1. Defining the observed territory (territory where zones for delivery need to be organized).

2. Address mapping according to the demands.

3. Address grouping in the appropriate zones by applying the appropriate algorithms in accordance with the average stay time at address (e.g. algorithm of "cleanup"). In case more districts need to be served, it is essential to use algorithm of "cleanup"[4]. By moving clockwise there is a need to control the relationship of accumulative demand and capacity of transport vehicle used or the available time. In the case of Post of Serbia the mentioned time limit was 80 minutes for one zone to be served (Figure 4).

4. Additional analysis of created zones and locations that are not assigned. The analysis of the locations which are not assigned to one of the zones is considered due to the exceeding limits. Assigning of mentioned location to the zones should be also taken into consideration. It is also very important to consider factors as terrain topography, transport conditions, natural barriers (rivers, hills...) etc. because of the correction of defined zones.

5. Conclusion

The problem of exceeding time limit in the system of express courier service is present when some greater demands appear as opposed to those which are included indirectly, through various indicators necessary for planning areas for collection and delivery. In this way, for a certain number of users, parcels are collected and delivered with delay. The delay of collection and delivery, has costs which result in decrease of service quality for the final user. In these situations, acting in advance is important for operator. Two approaches for solving the problem are proposed in this paper and illustrated in the case of the next day delivery service until 12 a.m. The first approach involves the existing organization of zones and mailman delivery areas, highlighting their analysis regarding given demands. The model is based on the fuzzy logic system, where the final result is the preference value for assigning one more courier to the courier delivery area, in order to avoid the exceeding time of delivery. This methodology represents the system of support for operator in decision making process. The second approach suggests the existence of more centers of Post Express service on territory which is of interest for service offering. When the territory is organized, the existing mailman delivery areas and zones are not considered. However, it is important to create independent zones on a daily level. To form the courier delivery area and courier`s route it is suggested to apply the principle "zoning-routing", according to the present demands. Two proposed approaches, with certain adjustment could be applied in similar state-owned or private companies, as well as in different systems for goods distribution.

6. Acknowledgement

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