The International Journal of
TRANSPORT & *LOGISTICS*
Medzinárodný časopis
DOPRAVA A LOGISTIKA

ISSN 1451-107X

ANALYSIS OF PLANNING, MANAGEMENT AND EXECUTION OF MOTOR VEHICLES REPAIR SERVICES FOR THE PURPOSES OF DEVELOPMENT OF AN OPERATIONAL PLANNING MODEL

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Abstract: *The article describes an analysis of management and execution of motor vehicle repair services as a logistic system and a proposal for a repairs operational planning and execution model. It also describes its relation to performance and productivity evaluation of the service workers.*

Key words: *Creating a service order, operational planning of repairs, performance evaluation of the service technicians and mechanics*

1 INTRODUCTION

Efficiency and productivity of the motor vehicle repairs service (MVRS) depends crucially on the elasticity of the service – i.e. the ability to meet customer's demands as quickly as possible; on the ability to utilize the maximum capacity of the service technicians, their specific expertise and skills; and on the objective motivation of the employees [5]. This can be achieved in particular using a quality model for operational planning and workers' performance evaluation [4].

Operational planning of service operations, i.e. allocation of work to individual maintenance technicians in time units, is performed subjectively "manually" or through IT (e.g. in Excel) by the receiving technicians.
There are several types of planners that plan servicing operations in the car repair shops. Some are a part of a complex process that includes processing of vehicle reception and return up to accounts and stock records. E.g. CarRepairPlanner in Ford, Global scheduler for repair shops – TEAS Car Service, AZsofAutoservis, eCare [4].
However, none of these planners is dynamic in the sense that it would include the order in the plan at the time of its reception, and assign the order according to time priority and technician's quality and specialization [4].
In case of passenger motor vehicle repair services, the processes of repairs execution have a stochastic character in terms of planning. This means that at opening and planning of a service order (SO) it is not possible to specify in advance the scope, nature and duration of the service operations. Processes of stochastic nature put great demands on the operational planning level, the fact which transforms this process into a dominant process in the management of the system [1, 2].

2 LOGISTICS FLOW ANALYSIS

Execution, management and checking of the various activities during the passage of a motor vehicle through the servicing process are provided by specialist staff of the servicing shop. In order to understand these processes, their course and their assignment to appropriate specialists, it is necessary to characterize their job descriptions:

1. Service Advisor (receiving technician) – has an important role in the whole process of reception and returning of a vehicle to and from the service. He is responsible for successful processing of the order from the opening, execution and closing of the SO.
2. Diagnostic technician – specialist in vehicle diagnostics.
3. Warranty technician – is responsible for the guarantee of vehicles, deals with warranty services, is responsible for communication, support and technical documentation in the event of vehicle complaints.
4. Maintenance technicians - responsible for performing of repairing operations
5. Manager of vehicle repair service – manages, supervises and is responsible for servicing activities

Logistics flow of motor vehicle service consists of the following processes:

a) Reception of a vehicle for service and opening a SO
b) Operational planning of inspections and SO
c) Execution and management of repairs
d) Returning vehicle to the customer

2.1 Reception of a vehicle for service and opening a service order

Classification of service orders

When analysing the processes of reception and return of motor vehicles to and from the service, it is important to understand the basic concepts and classification of individual orders and processes associated with the repair of vehicles. The basic classification in terms of

management, optimization and streamlining can be further divided depending mainly on the need for further analysis.
From the perspective of repairs planning the basic division is based on service orders:

- Planned SO
- Unplanned SO

Unplanned SO

Unplanned SO are orders in case of unexpected events. They cannot be anticipated by the service shop or by the customer. Compared to all orders, they statistically comprise around 10 % of all service operations.

Examples include:

- Failure of vehicle on the road – required towing to a service shop
- Failure of vehicle on the road – the vehicle is capable of a journey to service on its own
- The customer indicates a failure when starting the vehicle and requires immediate repair
- Required customer service without prior ordering
- Unplanned repairs of claims

Planned SO

Planned SO are orders that can be scheduled in advance both by a customer as well as by a service shop. They can be statistically estimated, based especially on the service history from previous periods, the actual sales of new vehicles, and on the current situation on the aftermarket in the region.

Examples include:

- Ordinary servicing – workshop SO
- Free servicing
- Warranty servicing
- Planned repairs of claims
- Pre-sale inspection of new vehicles
- Pre-purchase inspection of used vehicles
- Planned seasonal servicing events and offers

Reception of a vehicle for servicing involves the first contact and communication with a customer (by phone, e-mail, personal) and obtaining basic information about the required operation, repair. At this stage, the service advisor shall check whether the customer will claim a replacement vehicle (he has to find out whether the customer is or is not entitled to such vehicle) and, if so, he shall provide it in collaboration with the department responsible for available vehicles.

He shall discuss any change regarding the loan with the department responsible for available vehicles.

Following the communication with the customer and after the vehicle inspection, he shall provisionally identify the failure, the extent of service inspection, service work and develop a preliminary quotation for the particular issue.

Vehicle identification:

1. Vehicle data, fill in, if necessary (vehicle registration number, VIN, date of first registration...)
2. Holder data
3. Make a copy of a certificate of roadworthiness

4. Print a job sheet
5. Record the exact description of the failure according to the customer's statement
6. Sign the contract and have it signed by the customer
7. Attach a copy from the EVA system to the contract – recall notices checking
8. Record the exact number of kilometres travelled, fuel status, vehicle equipment, validity of Vehicle Inspection, Emission Inspection

Based on the obtained data, a type of contract shall be specified (Type of contract must be clear – workshop, free of charge, warranty, insurance claim,...)

- who pays it (importer, customer, internal costs)
- method of payment (cash, card, invoice)
- agreed scope of works and their duration
- reception of the vehicle from the customer directly at the vehicle with a registration of any damage on the vehicle and a list of objects left inside the vehicle

If a precise identification of the condition and potential failures of the vehicle requires so, a test drive shall be taken with a customer, or a specialist from the workshop may be invited for consultation.

2.2 Operational planning of inspections and service orders

The planning process plays a very important role in the chain of downstream activities in the provision of vehicle maintenance and repair services.

Basic input data, which must be evaluated in the optimal planning include:

- number of brands of motor vehicles, for which the company provides an authorized service
- number of mechanics, their classification according to their expertise/specialization
- number of sites equipped for the execution of a complex inspection and service
- number of specialized sites (vehicle geometry, brake tester, lights setting, tire service)
- car repair shop's opening hours
- working hours of employees
- statistical ratio between planned SO and unplanned SO
- qualified estimate given by the service advisers with regard to the execution of various inspections, operations and repairs

The planning process and the execution of vehicle servicing in the Motor-Car Košice s.r.o. follows the standards and procedures applicable to the entire MOTOR CAR GROUP network.

When comparing the development and continuous improvement of this tool, the initial planning paper forms used a few years ago must be recalled. Fig. 1 shows a reception plan dated 2.8.2011. The form of this plan is based on a table with lines X and columns Y. The lines listed the names of individual mechanics, or sometimes a line for a specialized facility. Based on the work required and operational times, the individual mechanics were assigned servicing operations for the given day.

The existing planning tool in Motor-Car Košice s.r.o. is a planning calendar, in which the individual service orders and contracts are assigned in advance upon agreement with the customer.

Tab. 1 *Example of an operational plan of servicing activities in Motor-Car Košice*

Name/ Time	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30	17:00	17:30
Mechanic 1	Comp. 1- replacement of control unit								Lunch	Comp. 8- replacement of shock absorber				Comp. 4- tires+ geometry					
Mechanic 2	Comp. 5- inspection ASSYST B			Comp. 2- engine diagnostic					Lunch	Comp. 7- inspection ASSYST C			Comp. 11- lights setting		Comp. 9- brake linings replacement				
Mechanic 3	Comp. 10- inspection ASSYST C			Comp. 3- oil change		Comp. 13- inspection ASSYST B			Lunch	Comp. 20- brake linings replacement					Comp. 14- engine diagnostic				
Mechanic 4	Comp. 12- windshield replacement				Comp. 21- windshield replacement				Lunch	Comp. 6- engine diagnostic					Comp. 16- replacing fuel pump				
Mechanic 5	Comp. 13- geometry			Comp. 22- inspection ASSYST A					Lunch	Comp. 5- brake linings replacement					Comp. 17- geometry			Comp. 4- oil change	
Mechanic 6	Comp. 19- replacement of shock absorber				Comp. 23- inspection ASSYST A				Lunch	Comp. 3- replacement of control unit							Comp. 33- inspection ASSYST B		
Mechanic 7	Comp. 30- replacement of control unit								Lunch	Comp. 34- tires			Comp. 1- oil change		Comp. 28- brake linings replacement				
Mechanic 8	Comp. 11- inspection ASSYST A				Comp. 40- replacement of shock absorber				Lunch	Comp. 37- oil change		Comp. 37- geometry			Comp. 42- lights setting				
Mechanic 9	Comp. 31- brake linings replacement					Comp. 35- inspection ASSYST C			Lunch	Comp. 3- oil change		Comp. 19- inspection ASSYST C			Comp. 4- tires			Comp. 28- lights setting	
Mechanic 10	Comp. 66- oil change		Comp. 47- tires+ geometry						Lunch	Comp. 50- inspection ASSYST B			Comp. 44- replacement of control unit						

Characteristics of operational planning

Operative planning has a dynamic character. It means that when planning a contract for repair, it is necessary to inform the customer about the provisional end of the repair, price of the repair and keep them updated in case of any changes in time and price.

However, the end of the repair depends on the repair processes and procedures performed only on the basis of a professional assessment given by a receiving technician. The procedure itself, work processes, spare parts needs as well as specialists' operations required are discovered only after the vehicle is dismantled. That means that the process of operational planning must have at least two phases. In the first phase, a contract is assigned upon a professional failure assessment to the available particularly qualified mechanic in the nearest spare capacity (time).

In the second phase, after the identification of the physical failure, the contract is returned to the operational planning process and a particular work flow is specified: operations, operating times (according to the standards), spare parts needs, cooperation needs and preliminary cost calculation. The customer must be informed of any changes related to the repairs of the vehicle.

Times of operations are determined by the times of repair standards, but they largely depend on the skills and abilities of the service mechanic. That means that at the time of planning, they have highly stochastic nature.

2.3 Execution and management of repairs

Repairs execution process includes the following activities:

- assignment of a vehicle repair to system or diagnostic technicians according to the scheduling calendar, or according to consideration even beyond this plan
- a mechanic to whom the vehicle was assigned must familiarize with the technological procedures of individual activities for specific vehicles, or he shall define an exact procedure of the failure repair or vehicle inspection
- execution of the repair
- inspection of ongoing repairs
- in case of long-term repairs, the customer shall be informed of the course of repair
- the mechanic shall ascertain the successful execution of repairs, order or personally take a test drive
- if rectified, wash the vehicle in the car wash
- complete the documentation regarding the executed operations
- in case of a warranty service, when it is not clear how it will be implemented, or who will pay the contract, a warranty technician must be consulted

2.4 Returning vehicle to the customer

The process of returning the vehicle to the customer is conducted in the following steps:

- issue records of vehicle inspection, work performed and calculation of service operations
- service advisor shall agree a date of return of the vehicle to the customer
- inform customer and explain all the operations performed on their vehicle, explain and discuss with them the price of the charged parts, labour, any discounts or surcharges
- return the vehicle, and confirm the return of the vehicle with your signature as well as the signature of the customer
- if a customer demands and – according to internal company directives is entitled to it –, issue them an invoice with the relevant amount, however, confirm the payment discipline of the given customer beforehand
- contact the customer within 48 hours of the submission of the vehicle and find out customer's satisfaction with the performed service operations, note the result of the interview in the Follow-up form

3 PROPOSAL FOR AN OPERATIONAL PLANNING MODEL

Methods for solving stochastic processes are based on the controlled planning, gradual specification of tasks, operations, inputs and costs. The actual repair procedure is formed during its course. However, there are rules, which are generally applied in operational planning models, that combine standards, procedures and rules for repair (artificial intelligence) with the knowledge, creativity and expertise of the professionals in the field (human intelligence). Such a methodology is known as a heuristic approach.

Mathematically, these problems are very difficult to solve, and yet car services work, cars are maintained, repaired, and people plan and manage these processes more or less successfully. Therefore, one possibility is to model the activities of experts in this field and combine them with the generally applicable standards, regulations, procedures; develop an algorithm; and use the possibilities of the current IT to create a dynamic planning system that can increase the effectiveness of repairs management processes associated with the monitoring of performance, motivation and remuneration of employees.

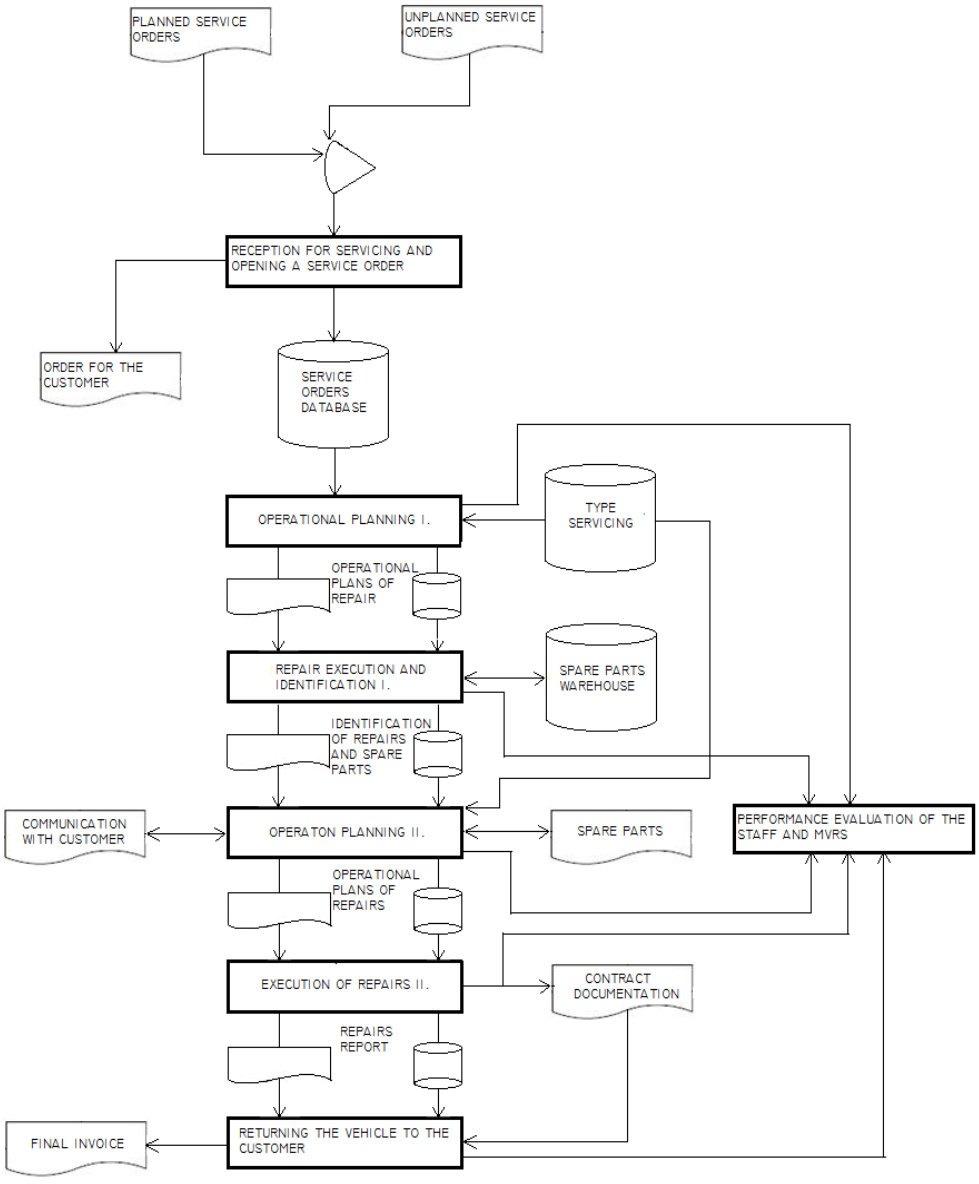

Fig.1 *Proposal for a model for operational planning and execution of service orders*

4 CONCLUSIONS

The article describes an analysis of a certain method of flow of service orders through vehicles servicing. It predominantly focuses on the analysis and definition of a type of operational planning issue related to inspections and repairs, as a dynamic and stochastic problem. It proposes a model for automated operational planning of contracts and monitoring of service technicians and mechanics' performance. The model shall have a heuristic nature, using principles and rules of current planning methods in combination with the use of procedures and norms that are standard for the car repair shops.

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