TALLINN UNIVERSITY OF TECHNOLOGY

IDU0330: Business Process Modelling

DRIVING LICENSE GRANTING BY ESTONIAN ROAD ADMINISTRATION: NEW BUSINESS PROCESSES FOR TAKING THEORY AND PRACTICE EXAMS

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Tallinn 2015

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1. Introduction

Obtaining driving license in Estonia is a standardized, but not an optimized service. As a part of this service, the customers need to take theory and driving exams, for which general process models exist. However, analyzing these processes more precisely and applying additional modeling possibilities, such as process simulation, can help optimize them. In this paper, we aim to create TO-BE models for taking theory and driving exams, discuss how the first of them can be transferred to online domain, and, as a result, offer suggestions for further actions that the Road Administration is advised to take from financial, customer, internal, and learning perspectives.

1.1 Organization Type

The Estonian Road Administration (ERA) is a government agency operating within the administrative area of the Ministry of Economic Affairs and Communications. Among its main functions, the ERA performs the implementation of state policy and development programs, management duties, state supervision and applies the enforcement powers of the state in the field of road management, traffic safety, public transport and the environmental safety of vehicles (ERA webpage, 2015).

1.2 Legal Basis

In performing its functions, the ERA represents the state. Its activities are based on the legal acts of the Republic of Estonia and the European Union, international treaties which bind the Republic of Estonia, the regulations and orders of the government of the Republic, the regulations and directives of the Minister of Economic Affairs and Communications and the statutes of the ERA, as well as the relevant regulations of other ministers (ERA webpage, 2015).

1.3 Main Functions

The main functions of the Road Administration are road and traffic management, issuing and supervision of driving rights, and legislative activities.

1.4 Mission Statement

The mission for 2013 to 2015: ERA develops a safe and working traffic environment. ERA provides public services, which allow traffickers to use the created road network in a safe and efficient manner, as well as ensures its preservation and working. At the same time, ERA applies requirements to traffickers and vehicles to ensure a safe and working traffic environment.

1.5 Vision

The vision for 2013 to 2015: To become a highly-valued competence center for road users and partners.

1.6 Staff

The employment relations of the Administration as an organization of the public sector are governed by either public law or private law; so, the employees of the Administration include 262 officials and 263 employees under employment contracts. High staff turnover that started in 2013 is cooling down and has stopped at 8.7%. 45 new employees were recruited by the Road Administration in 2014. When responsibility sectors and job profiles are considered, the employees divide into leaders (management members, heads of departments, divisions, and bureaus), total of 74; top specialists (i.e. experienced experts with high market competition who have a significant impact upon reaching the strategic goals of the Administration), total of 179 and medium level specialists and workers, respective total 267 and 5 (ERA Yearbook, 2014).

2. Driving Licenses and Examinations

Estonian Road Administration is the only authority in Estonia that organizes theory and practical driving tests, approves examination results, and grants the right to drive a power-driven vehicle (ERA webpage, 2015).

2.1 General Requirements

Right to drive a power-driven vehicle is granted to a person:

- whose permanent residence is in Estonia (permanent residence is a place where a person usually lives at least 185 days during every calendar year because of personal relations or work. Permanent residence is attested by the data from the population register);
- whose age and state of health comply with the requirements;
- who has obtained the qualification of a driver of a power-driven vehicle.

To obtain the qualification of a driver of a power-driven vehicle, the applicant for the right to drive must pass:

- the preparation at driving school;
- first-aid training;
- successfully a theory and practical driving test at the regional testing center of Estonian Road Administration (ERA webpage, 2015).

2.2 Test Centers

Estonian Road Administration has 18 regional testing centers in Estonia:

- 4 in North (2 in Tallinn, Saue and Rapla)
- 5 in South (Tartu, Valga, Võru, Põlva and Jõgeva)
- 4 in East (Jõhvi, Rakvere, Paide and Narva)
- 5 in West (Pärnu, Viljandi, Kuressaare, Haapsalu and Kärdla)

2.3 Employees in Test Centers

A number of employees whose work is directly or indirectly related to issuing the driving licenses are 164. Employees who are directly involved with driving license exams is 40 (i.e. examiners).

2.4 Driving Licenses and Fees

In 2014, Estonian Road Administration issued 49 227 driving licenses. To get driving licenses, a candidate must pay state fee 86 euros (if applied online) or 92 euros (if applied in the office). The state fee contains:

- 20 euros for the documents applied online or 26 euros if applied in the office + 26 euros for theory exam + 40 euros for driving exam.

3. Business Processes for Theory and Driving Exams

In this part, two business processes are discussed: theory and driving exams. For each one, AS-IS and TO-BE versions are offered. For theory exam, we also provide online redesigned version. Unfortunately, the same is not possible for driving exam, because driving must be live. Also, we analyze simulation results on these processes.

3.1 AS-IS Taking Theory Exam Process

The current process (see Fig 1) was not described in text by the organization. So, the following description is created by the authors of this study on the basis of the existing process model:

- The process begins with the necessity to perform theory exam by the client;
- The customer appears to the Road Administration office for examination;
- The examiner checks their ID card. If identity is correct, prerequisites for an exam are checked in ARIS database. If identity is incorrect, the process ends with a multiple end, meaning that various actions are possible afterwards;
- If the conditions correspond, the customer is offered a choice between paper-based and computer exam versions. In case of wrong prerequisites, the process finishes with an error end;
- When paper-based version is chosen, the application presence is checked by the examiner. If the application is present, then the process continues with forming the exam commission by the examiner, otherwise the process ends with an error. Afterwards, test presence is checked by the examiner in a similar way – the customer either proceeds with taking the exam, or the process stops;
- When computer version is chosen, only test presence is checked by the examiner. If the test is present, then the client takes the exam, otherwise the process ends with an error. Afterwards, the ARIS employee checks whether the exam is performed and either appoints other required exams, or registers the completion in exam database. After the latter action, the client has the exam performed.

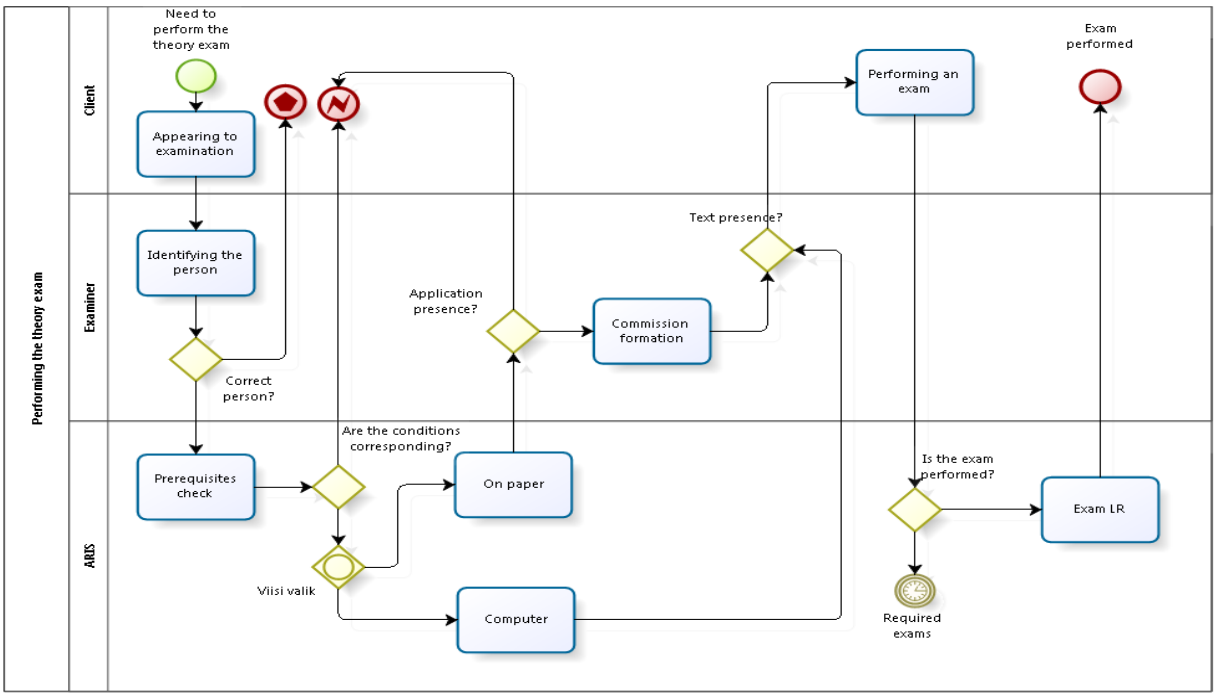


Figure 1. Process AS-IS for Theory Exam

3.2 TO-BE Taking Theory Exam Process

A number of improvements are suggested for the described AS-IS process. Below, each of them is explained in detail.

Firstly, the data from the Road Administration suggests that *only two parties are involved in the process of taking theory exam: client and examiner*. The examiner checks conditions for examination, conducts an exam, informs the client about results, etc. During these actions, data from information system is used and added by the examiner. For instance, they check the ARIS database for personal prerequisites and make a record in this database with an exam choice (computer or paper). So, we demonstrate data objects instead of a separate pool for database that was in the initial version: record in ARIS database is made by the examiner with the choice of exam version, exam file is submitted by the customer to the examiner, record in LR database is made by the examiner with the exam result, and e-mail with the result is sent to the client by the examiner.

Secondly, *test presence gateway is redundant*. A gateway is used either to split the flow of the process or to merge it (Business Process Model and Notation 2.0, p. 34). In the case of theory exam process, two actions lead to the gateway and two actions follow out of it. So, this gateway is incorrectly modeled. Moreover, the Road Administration provided the information

that test is always present. As a result, this gateway does not influence the process and can be deleted from the activity diagram.

Thirdly, *choosing how to make exam gateway is not inclusive*. Inclusive gateways create paths that are alternative and parallel at the same time. Thus, it is possible to follow each path or not to follow any of them (Business Process Model and Notation 2.0, p. 292). In our example, it is necessary to choose either paper-based or computer exam. It is not possible to do both versions or to continue the process without choosing one of them. So, this gateway is exclusive.

Fourthly, *the choice of exam type is a task for the customer, not the employee*. In the initial version, the ARIS employee chooses between paper-based and computer exam versions. However, the explanation from the Road Administration states that the client is supposed to perform the exam on computer by default, but they can choose to do a paper version. As can be seen, the choice is made by the customer, and not by the ARIS employee. Also, this choice should be marked as a gateway result, and not as a separate task. At the same time, two new tasks are required for the examiner: to offer the choice options and to mark the chosen one in information system.

Moreover, *required exams event cannot be an end*. Timer events are used when it is necessary to indicate that they happen at the specific time of the process (Business Process Model and Notation 2.0, p. 243). Such events are intermediate, and the process continues after them. In our case, required exams event stops the process, so such event is not correct. Instead, a new end and corresponding tasks are added to the new process. If the exam is failed, the examiner needs to inform the customer that new exam is required. Upon receiving this message by the client, the process ends. If the exam is passed, the examiner needs to register the result in the database and inform the client about their result. Upon receiving this message by the customer, the process successfully finishes.

Finally, *communication tasks between pools are lacking*. In the initial diagram, end events take place for the customer without receiving corresponding messages. This is not correct because the client is supposed to find out about the decision before finishing the process. So, several communication tasks between the examiner and the client are added to the diagram. For example, if prerequisites are not met, the examiner says to the customer that they cannot take an exam, and, upon immediate receiving this rejection by the client, the process ends. Overall TO-BE process is shown in Figure 2.

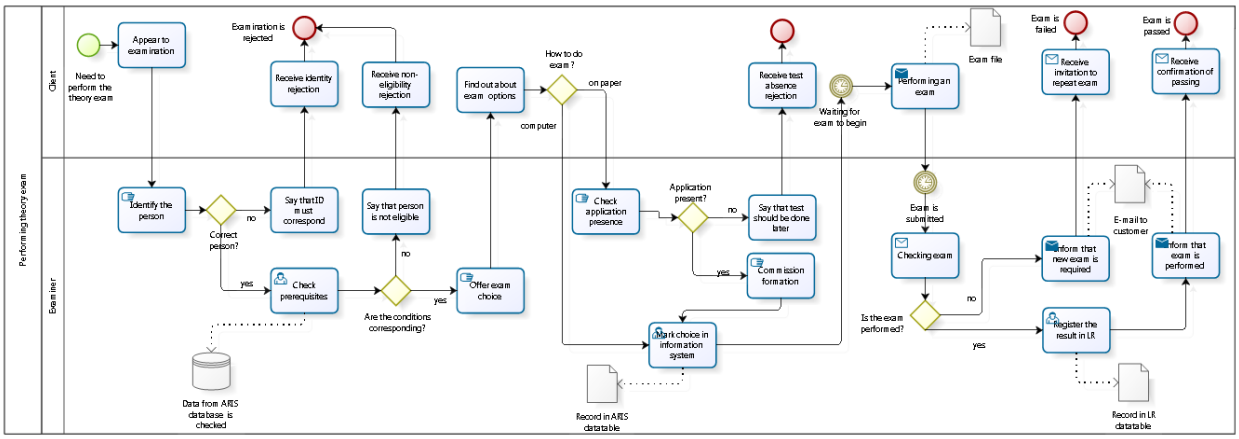


Figure 2. Process TO-BE for Theory Exam

3.3 Simulation Results for Theory Exam

The simulation was performed on TO-BE theory exam process in order to check utilization of resources. The initial data was obtained from the Road Administration and complemented by our assumptions where necessary:

- A group of clients comes to perform an exam: 15 people arrive with an average interval of 1 minute;
- Maximum 4 examiners are available to work with the group;
- Examiners check customers' conditions: 1 examiner and around 10 seconds are necessary to perform each task (e.g. to offer an exam choice);
- The probability of being identified as a correct person is 74%;
- The probability of having corresponding conditions is 99%;
- The probability of choosing to do an exam on computer is 95%;
- Waiting time to begin is less than one minute;
- Performing an exam takes 30 minutes for the whole group (15 persons). Taking into account modeling limitations, we assume that it is 2 minutes per 1 person because the model understands that each person is handled consecutively. In reality, the group is handled simultaneously;
- All exam papers from the group are submitted in 15 minutes, so it is 1 minute per one paper;
- Checking one exam takes around 15 minutes;
- The probability of performing an exam successfully is 90%;

- The following communication tasks take 10 seconds each one (e.g. to register the result in LR database);
- The process does not include additional tasks that take place after examination. For instance, some administrative work is carried out, and eventually it might take 2 days for a person to receive the result. These tasks belong to other sub processes.

Hypotheses:

- Four examiners are too many, so their utilization will be lower than 25%;
- Clients have few tasks, so their utilization will be lower than 20%;

Results:

The first hypothesis was incorrect. The actual utilization of examiners is 38,18%. Particularly, checking exams might take more time than expected, with a maximum waiting time being 29m 40s. At the same time, their utilization is very low before this point of the process. For instance, checking identity and prerequisites might require a client to wait maximum 1 minute. So, it seems that 2-3 examiners are enough for conducting the exam, whereas 6-7 would be appropriate to allocate for checking the results and subsequent actions. For example, with 6 examiners and all other conditions remaining the same, their utilization dropped to 29,41%, which is the consequence of checking exams faster.

The second hypothesis proved to be correct. The actual utilization of clients is 0,37%. The only task when they might need more time is performing an exam. However, it should be taken into account that the simulation was adjusted for a consecutive process. In reality, the whole group of customers performs an exam simultaneously. As a result, 15 clients is a manageable group, and their number can be even increased. For instance, with 30 customers and all other conditions remaining the same, the utilization of clients became 0,54% and the utilization of examiners increased to 52,08%, which still seems to be acceptable.

3.4 Automated TO-BE Taking Theory Exam Process

The process of taking theory exam can be performed online. In this case, the client does not need to appear to the Road Administration office. The gains are related to time and distance for the customer. Also, such service seems suitable for people with disabilities. For the Road

Administration, the use of information technology will help save the costs in the long-term perspective, though training employees might rise their costs in the short-term one.

The general model for an automated process is the following:

- The process begins with the necessity to perform theory exam by the client;
- The customer registers in online system (Application record is added to the database);
- The examiner reviews their application (Population registry is used);
- If the person is not eligible, the non-eligibility message is sent by the examiner (Update in client profile is made). Upon receiving this message by the customer, the process ends;
- If the person is eligible, the examiner appoints exam fee (Update in client profile is made);
- When fee message is received, the customer pays online to perform an exam at a specific time;
- When the fee is submitted, the examiner confirms the appointment (Update in client profile is made);
- When the time for an exam comes, the customer logs into the system;
- The examiner begins video exam;
- The client performs the exam online;
- When the exam is submitted, the examiner checks it;
- If the exam is failed, the corresponding message is sent by the examiner (Update in client profile is made). Upon receiving this message by the customer, the process finishes;
- If the exam is passed, the corresponding message is sent by the examiner (Update in client profile is made). Upon receiving this message by the customer, the process ends successfully.

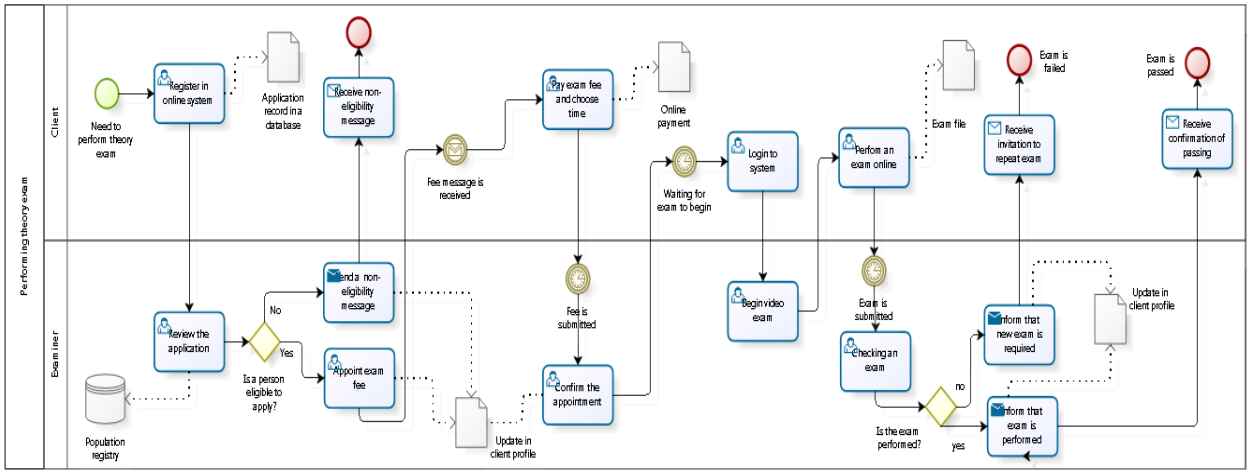


Figure 3. Automated Process TO-BE for Theory Exam

3.5 AS-IS Taking Driving Exam Process

The AS-IS driving exam was not described in text by the Road Administration. The text description is created by the authors of this study on the basis of the existing process model:

- The AS-IS driving exam process begins with the necessity to perform the driving exam by the client;
- The client appears to the Road Administration office for examination;
- The examiner checks their ID card (or any other identification document). If identity of the client is incorrect, the process ends with a multiple end, meaning that various actions are possible afterwards. If the client identity is correct, prerequisites for an exam are checked in ARIS (Road Administration Information System) database. ARIS is connected to National Population Registry (RR) and Penalty Registry (KARS);
- If the conditions do not correspond then the process is terminated i.e. the process finishes with an error end;
- If the conditions correspond, then the ARIS will check if the square exam is necessary. There might be that the client has already successfully passed the driving exam on square and therefore has the right to do only the driving exam in traffic. Without passing the driving exam on square it is not possible to continue to the driving exam in traffic;
- If the driving exam on square is needed then client must do the driving exam on square. After the driving exam on square, the examiner does the evaluation. If the driving exam on square is not passed then the client has to do the square exam again;

- If the driving exam on square is passed then the client has to do the driving exam in traffic. After the driving exam in traffic, the examiner does the evaluation. If the driving exam in traffic is not passed then the client has to do the driving exam in traffic again;
- If the driving exam in traffic is passed then the exam result are registered in the Traffic Registry (LR) and for the client the driving exam process has performed.

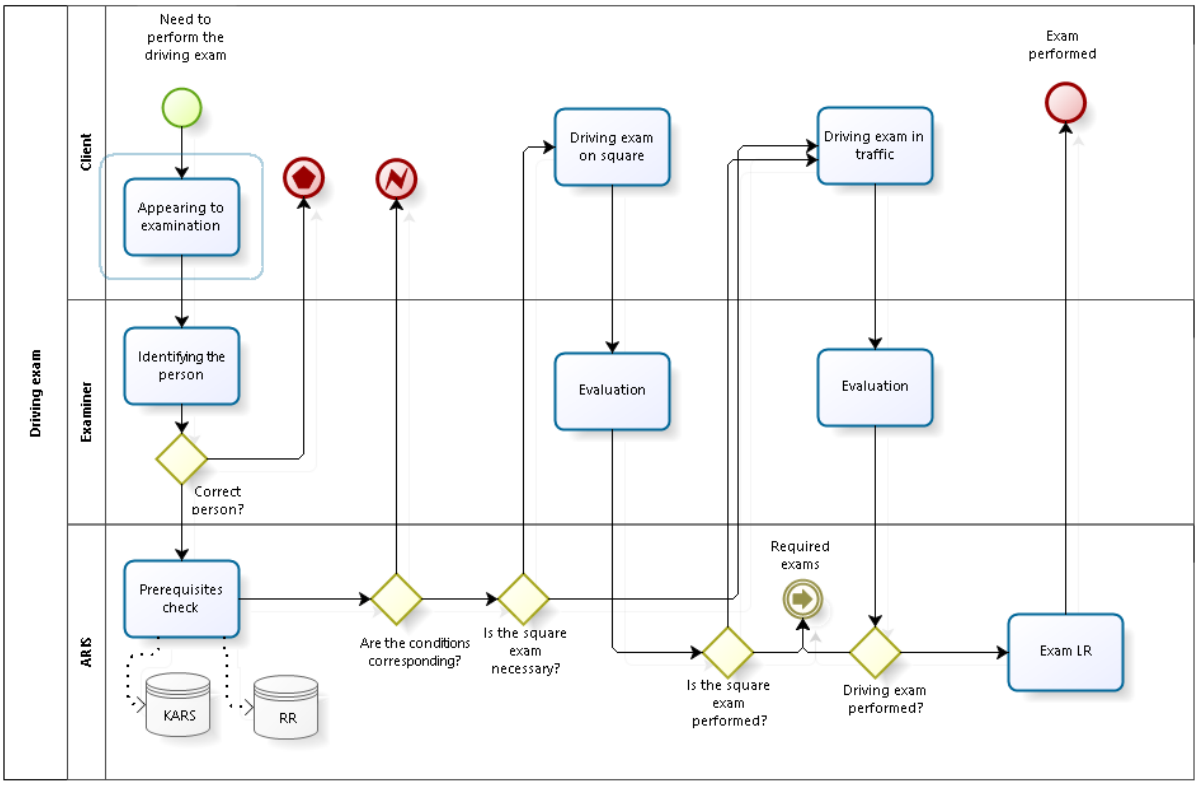


Figure 4. AS-IS Driving Exam Process

3.6 TO-BE Taking Driving Exam Process

Some improvements are suggested for the described AS-IS driving exam process. Below, the improvements are explained in TO-BE driving exam process in detail.

Firstly, the data from the Road Administration suggests that *only two parties are involved in the process of taking the driving exam: the client and the examiner*. The examiner checks conditions for examination, conducts an exam, informs the client about results, etc. During these actions, data from information system is used and added by the examiner. For instance, the examiner checks the ARIS system, which is connected to National Population Registry (RR) and Penalty Registry (KARS), with the database for personal prerequisites. So, we demonstrate data objects instead of a separate pool for database that was in the initial version: record in ARIS

system is made by the examiner, record in Traffic Registry (LR) database is made by the examiner with the exam result, and e-mail with the result is sent to the client by the examiner.

Secondly, the *communication tasks between pools are lacking*. In the initial AS-IS driving exam process diagram, end events take place for the client without receiving corresponding messages. This is not correct because the client is supposed to find out about the decision before the process is finished. So, several communication tasks between the examiner and the client are added to the diagram. For example, if prerequisites are not corresponding, the examiner says to the client that they cannot take an exam, and, upon immediate receiving this rejection, the process ends. Such events are intermediate, and the process continues after them. If the exam is failed, the examiner needs to inform the client that new exam is required. Upon receiving this message, the process ends. If the exam is passed, the examiner needs to register the result in the Traffic Registry's (LR) database and inform the client about their result. Upon receiving this message from the client, the process successfully finishes.

Thirdly, *a gateway for finding out if the driving exam in traffic is needed* was added. In AS-IS model, there was linked event but it is not correct. Thanks to those changes the simulation model works as well.

Fourthly, *for all gateways, the explanations were added*. In AS-IS model, it was very difficult to understand what the outgoing transitions mean. Now it is very easy to follow the whole process.

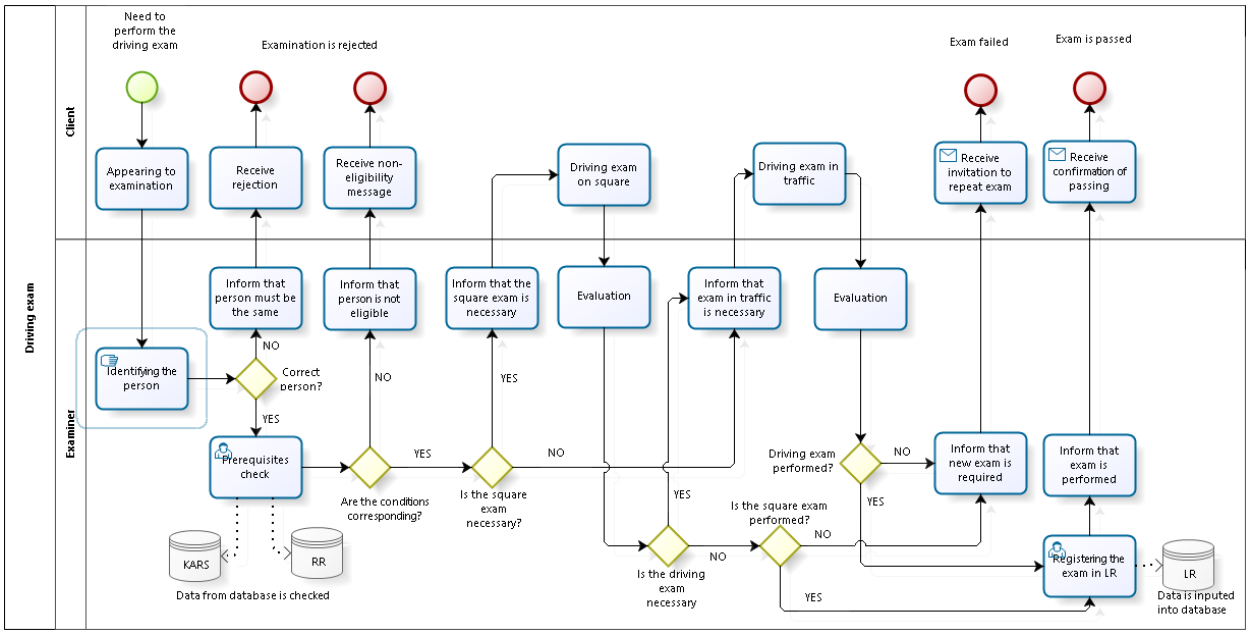


Figure 5. TO-BE Driving Exam Process

3.7 Simulation Results for Driving Exam

The simulation was performed on TO-BE driving exam process to check utilization of resources. The initial data was obtained from the Road Administration during the interview and complemented by our assumptions where necessary:

- During a standard work day (e.g. 8 hours) 8 clients come to perform a driving exam;
- During a standard work day (e.g. 8 hours) each client will come after 60 minutes;
- During a standard work day, two examiners are available to work with the clients;
- Examiners check client's identity: it takes around 10 seconds to identify one person;
- The probability of being identified as a correct person is 100%;
- The probability of having corresponding conditions is 99%;
- Performing the driving exam on square takes 15 minutes per client;
- Evaluation of the driving exam on square takes 30 seconds by the examiner;
- Performing the driving exam in traffic takes 45 minutes per client;
- Evaluation of the driving exam in traffic takes 1-2 minutes by the examiner;
- The probability of performing an exam successfully is 56%;
- The added communication tasks take 10 seconds each one.

Hypotheses:

- Two examiners is not enough to handle the load (8 clients/exam per day), so the utilization will be over 70%;
- One examiner is enough for the load (8 clients/exam per day), so the load will be under 30%.

Results:

- The first hypothesis was incorrect. The actual utilization of two examiners is 1,87%. For the standard workday (e.g. 8 hours), two examiners are more than enough. As the driving exam on square takes 15 minutes and driving exam in traffic takes 45 minutes, then each client comes after every 60 minutes. The clients are coming at the previously appointed time so that the exam can start on time. There is a chance that doing both exam parts (driving exam on square and in traffic) take longer time than one hour but, as there are two examiners, then the clients do not have to wait.

- The second hypothesis proved to be correct. The actual utilization of one examiner is 3,74%. For the standard workday (e.g. 8 hours) one examiner is enough. The difference between one and two examiners per standard working day is 1,87%. So, it is recommended to use only one examiner. However, certain risks should be mitigated if there is only one examiner per standard working day. For instance, if the performing of exam parts (driving exam on square and in traffic) takes longer than one hour, then the next client will have to wait.

4. Balanced Scorecard

The balanced scorecard is "a strategic planning and management system that is used extensively in business and industry, government, and nonprofit organizations worldwide to align business activities to the vision and strategy of the organization, improve internal and external communications, and monitor organization performance against strategic goals" (Balanced Scorecard Institute, 2014). Thus, this tool is appropriate to use in case of a governmental organization like the Road Administration. The scorecard below illustrates the Administration's functions and expectations of their outcomes.

- **Learning:** is oriented on optimizing workforce, increasing the ability of employees to use online tools, and increasing their awareness of using business process models;
- **Financial:** is about decreasing costs of taking theory exam by using online service and decreasing costs of both exams by implementing business process simulation results;
- **Customer:** is offered to take theory exam remotely and perform fewer actions to complete this exam. Also, they benefit from the increased quality of new exam processes.
- **Internal**: aims at decreasing the time per one theory exam and serving more customers during one day, using fewer resources more efficiently, and employing optimized business processes.

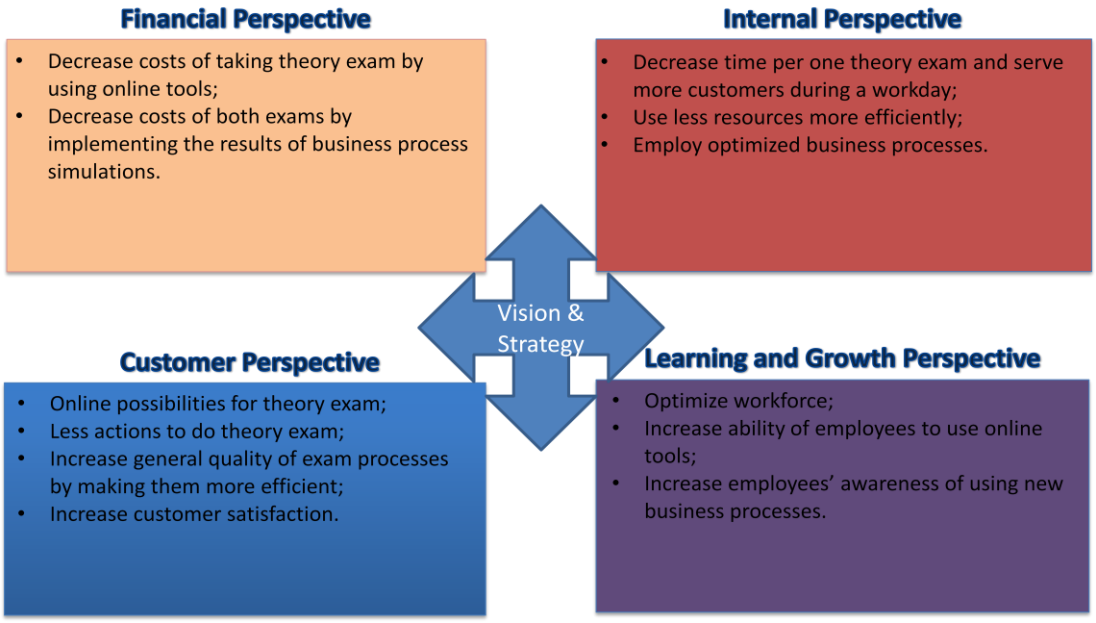


Figure 6. Balanced scorecard

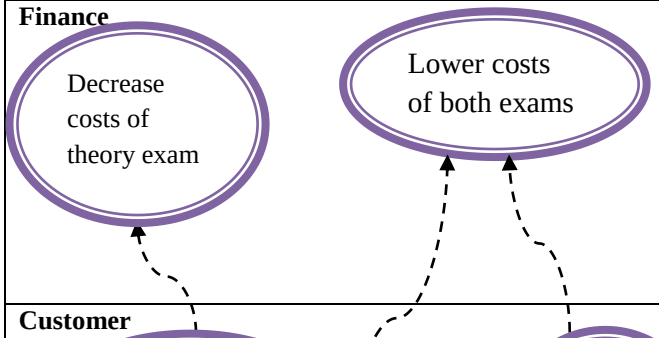
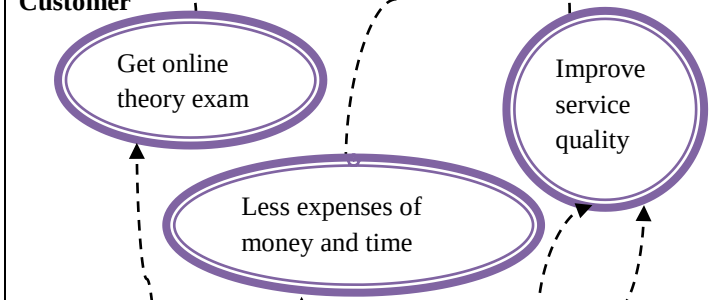
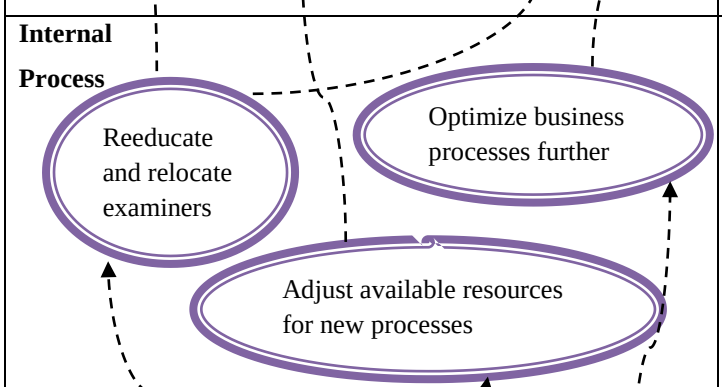
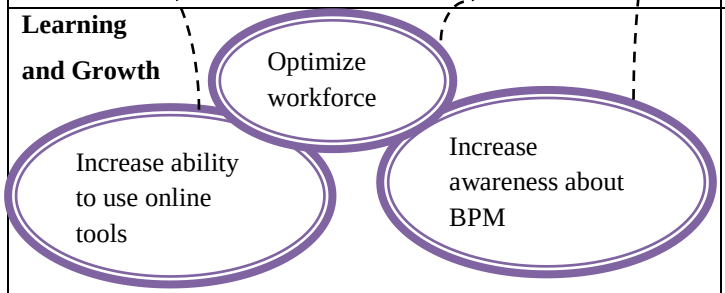
	Strategic objectives	Performance measures	Targets	Initiatives
Finance 	• Decrease costs of taking theory exam by using online service; • Lower costs of both exams through implementing results of business process simulations	• Comparative analysis (old and new costs); • Simulation results	• Decrease costs of taking theory exam by 20% after launching online service; • Synchronize resources and simulation results (e.g. One examiner might be enough for taking driving exams during one day)	• Online service for theory exam; • Optimization of workflows for both exams; • Use examiners more efficiently (e.g. Part-time work at different process stages)
Customer 	• Offer remote theory exam service; • Improve service quality for taking both exams; • Decrease expenses in terms of time and money	• Customer feedback; • Percent of clients that perform theory exam online; • Time that is necessary to perform TO-BE process tasks for both exams	• Positive feedback for taking exams from more than 70% of customers during one year; • Percent of clients that perform theory exam online is 30% out of all who take this exam during one year; • Time for conducting exam processes is reduced by 10%	• Provide on-line theory exam possibility • Provide support and customer feedback system • Measure time for performing TO-BE exam processes
Internal Process 	• Re-educate and relocate examiners; • Optimize business processes by TO-BE versions; • Adjust available resources for new processes	• Measurement of employee attributes (e.g. level of ability to work with online system); • Comparison of business processes; • Automatization measurements	• Percent of examiners able to conduct theory exam online becomes 50% higher in one year; • All exam processes correspond to TO-BE models in half a year; • Adjust 80% of resources to simulation results during one year (e.g. One or two more examiners are allocated for checking theory exams)	• Impose new rules on examiners (e.g. Part-time work for different driving categories); • Implement TO-BE models in organizational environment; • Introduce time measurement system with bonuses for employees
Learning and Growth 	• Optimize workforce; • Increase ability to use online tools; • Increase awareness of using business process models	• Technology analysis score (customer feedback; IT-audit); • Training effectiveness index (for employees)	• All employees pass re-accreditation training in one year; • After pilot period of half a year, five offices launch online service for theory exam	• Bonus system for learning and passing training; • Skills gamification (e.g. Examiners get stars for successfully taken online theory exams)

Table 1. Balanced scorecard with measures, targets, and initiatives

4.1 Achieving Goal Targets

Financial & Customer

The financial targets we set will be met by introducing online service for theory exam, optimizing workflows for both exams, and using examiners more efficiently. For instance, they can participate in taking exams part-time at different process stages. Main expected results were decreasing costs of taking theory exam by 20% and adjusting human resources to the designed exam processes. Coming to customer goals, providing a possibility to take theory exam remotely, offering new customer feedback system, and measuring the time for TO-BE exam processes are initiatives to pursue. As a result, at least, 70% of customers are expected to be satisfied after taking exams and 30% of those who take theory exam are expected to do it online during one year. Also, time for conducting both exam processes will be reduced by 10%.

Internal & Learning

Internally, new work rules will be imposed on employees, TO-BE exam process models will be implemented, and time measurement system with bonuses for employees will be introduced. After these initiatives, half of theory examiners are expected to be able to conduct this exam online in one year, all real exam processes will correspond to TO-BE models in half a year, and 80% of resources will be adjusted to simulation results in a year. For instance, one or two additional examiners will be allocated at the stage of checking theory exams. Regarding learning, we will introduce a bonus system for passing training and provide gamification of employee skills. As a result, all employees are expected to pass re-accreditation training in one year, and five offices will launch online service for theory exam in half a year.

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Interview with Mrs. Imbi Kivi-Sild, Head of Infotechnology Department of Estonian Road Administration

Interviews with Mrs. Jekaterina (ex Beljajeva) Nesterenko, Chief Specialist of Examination Department of Estonian Road Administration

Interview with Mr. Tarmo Terreping, Chief Specialist of Examination Department of Estonian Road Administration

Object Management Group BPMN Technical Committee. (2010). *Business Process Model and Notation, Version 2.0*. Retrieved December 15, 2015, from http://www.omg.org/spec/BPMN/2.0/PDF/