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MASTER THESIS

ADMINISTRATIVE PROCESS REENGINEERING USING A BUSINESS PROCESS MANAGEMENT SYSTEM (BPMS)

Thesis submitted for the partial satisfaction of the requirements for obtaining a Postgraduate Specialization Diploma

by

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Dedicated to my father's memory who passed away in February 2015 when I had just started my Master Studies…

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ABSTRACT

At a time when companies and organizations are called to survive and improve in various areas (e.g. financial balance, certification by organizations, apply of innovative technologies, automation of operations, etc.), the proper management and utilization of their available resources (human potential, capital, equipment, etc.) is perhaps more necessary than ever before. The interaction of the above resources through events, tasks and decisions within a delimited framework in terms of sequence, constitutes a process. The concept of Process Management enters into various areas of the day-to-day operations of businesses and organizations and has evolved (in various forms) over the years. The science of Informatics and its new technological tools is a valuable help in the effort made for its further development in the present era.

The present dissertation aims to highlight the notion and value of the proper Business Process Management (BPM) through Business Process Management Systems (BPMS) and as a result, the consequent benefits for businesses and organizations. For this purpose, a detailed market research was conducted, focusing on open source software systems so as to make the best possible choice, which was finally proposed for pilot evaluation in the competent (for the Procurement Process of the Technical University of Crete) department. The software selected is called "Camunda BPM" and the name given to the system developed for Procurement Management is "PM SYSTEM". The whole administrative process is described through the Business Process Model & Notation Language (BPMN) which depicts step by step its stages in the form of a flowchart. Code development (via Camunda BPM) was necessary to make operational in this process the various modules of BPMN. The final goal was the implementation of the proposed system and its evaluation in a pilot framework for the execution of the Procurement Process at the Technical University of Crete. The conclusions drawn will be taken into account for possible further development and improvement of the existing way of implementation of the above process.

ΠΕΡΙΛΗΨΗ

Σε μια εποχή που οι επιχειρήσεις και οι οργανισμοί καλούνται να επιβιώσουν και να βελτιωθούν σε διάφορους τομείς (π.χ. οικονομικό ισοζύγιο, πιστοποιήσεις από οργανισμούς, εφαρμογή καινοτόμων τεχνολογιών, αυτοματοποίηση λειτουργιών κλπ), η σωστή διαχείριση και αξιοποίηση των διαθέσιμων πόρων τους (ανθρώπινο δυναμικό, κεφάλαια, εξοπλισμός, κλπ) κρίνεται ίσως πιο αναγκαία από κάθε άλλη φορά. Η αλληλεπίδραση των παραπάνω πόρων μέσω γεγονότων, εργασιών και αποφάσεων εντός ενός οριοθετημένου πλαισίου με όρους αλληλουχίας συνιστά μια Διαδικασία. Η έννοια της Διαχείρισης των Διαδικασιών υπεισέρχεται σε διάφορους τομείς της καθημερινής δραστηριότητας των επιχειρήσεων και των οργανισμών και έχει εξελιχθεί (υπό διάφορες μορφές) κατά το πέρασμα των χρόνων. Πολύτιμος αρωγός στην προσπάθεια που γίνεται για την περαιτέρω εξέλιξή της στη σημερινή εποχή αποτελεί η επιστήμη της Πληροφορικής και των νέων τεχνολογικών της μέσων.

Η παρούσα μεταπτυχιακή διατριβή έχει ως στόχο να αναδείξει την έννοια και την αξία της ορθής Διαχείρισης των Επιχειρηματικών Διαδικασιών (BPM) μέσω των Συστημάτων Διαχείρισης Επιχειρηματικών Διαδικασιών (BPMS) και ως αποτέλεσμα, τα επακόλουθα ωφέλη για τις επιχειρήσεις και τους οργανισμούς. Για το σκοπό αυτό, διεξήχθη επισταμένη έρευνα στην αγορά, επικεντρωμένη σε λογισμικά ανοιχτού κώδικα με σκοπό την καλύτερη δυνατή επιλογή η οποία και τελικά προτάθηκε για πιλοτική αξιολόγηση στο αρμόδιο (για την Διαδικασία Προμηθειών του Πολυτεχνείου Κρήτης) τμήμα. Το λογισμικό που επιλέχθηκε ονομάζεται "Camunda BPM" και το όνομα που δόθηκε στο Σύστημα που αναπτύχθηκε για την Διαχείριση Προμηθειών είναι το "PM SYSTEM". Το σύνολο της Διοικητικής Διαδικασίας περιγράφεται μέσω της Γλώσσας Μοντελοποίησης & Σημειογραφίας Επιχειρηματικών Διαδικασιών (BPMN) που απεικονίζει βήμα προς βήμα τα στάδιά της σε μορφή διαγράμματος ροής. Η ανάπτυξη κώδικα (μέσω του Camunda BPM) ήταν απαραίτητη για να καταστούν λειτουργικά τα διάφορα μέρη του BPMN σε αυτήν τη Διαδικασία. Ο τελικός στόχος ήταν η εφαρμογή του προτεινόμενου συστήματος και η αξιολόγησή του σε ένα πιλοτικό πλαίσιο υλοποίησης της Διαδικασίας Προμηθειών στο Πολυτεχνείο Κρήτης. Τα συμπεράσματα που εξήχθησαν θα ληφθούν υπόψη για πιθανή περαιτέρω ανάπτυξη και βελτίωση του υφιστάμενου τρόπου υλοποίησης της παραπάνω Διαδικασίας.

ACRONYMS

BPM	Business Process Management
BPMS	Business Process Management Systems
BPMN	Business Process Model & Notation
SOA	Service-Oriented Architecture
BPEL	Business Process Execution Language
UML	Unified Modeling Language
EPCs	Event-driven Process Chains
OMG	Object Management Group
IDEF3	Integrated DEFinition for Process Description Capture Method
REST	Representational State Transfer
API	Application Programming Interface
SOAP	Simple Object Access Protocol
HTML5	Hyper Text Markup Language 5
CMMN	Case Management Model & Notation
DMN	Decision Model & Notation
SaaS	Software as a Service
BAM	Business Activity Monitoring
UI	User Interface
IDE	Integrated Development Environment
GPU	Graphics Processing Unit
JVM	Java Virtual Machine
JMS	Java Message Service

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1 INTRODUCTION

Businesses as well as organizations are called upon to survive and thrive in an increasingly competitive and demanding business environment. One of the main factors responsible for the increasing complexity lies in the use of modern information and telecommunication technology. As a result of IT factor, the improvement and optimization of business processes becomes more necessary than ever before. As IBM (2018) reports, "business processes allow all the different parts of an organization to efficiently and effectively work together toward their common goal of serving customers better". Based on this notion, their proper management is of paramount importance regarding the way that nearly all organizations operate.

With the purpose of achieving business goals, mainly over the last decade, Business Process Management (BPM) has become a mature discipline including a well-established set of principles, methods and tools that combine knowledge from various fields such as Information Technology, Management Sciences and Industrial Engineering. The above necessity led to the creation at the implementation level of such tools, also known as Business Process Management Systems (BPMS). BPMs tools belong to a specific category of process-aware information systems (like CRMs and ERPs) with the difference that they make use of a business process described in a form of a graphical model so as to coordinate it. In that sense, BPMS tools can be tailored to specific processes of any kind. The purpose of BPMS tools is to coordinate an automated business process in such a way that all work is done at the right time by the right resource.

The present thesis aims to take into consideration all the above aspects so as to highlight the potential benefits from a specific implementation (named "PM SYSTEM") developed through a suggested BPMS tool (like "Camunda BPM") for the needs of improving the Procurement Process conducted in Technical University of Crete. According to the current state of Institute's process, some issues (regarding the specifications of products which differ depending on the needs of every Directorate or Faculty), need to be changed and improved. PM SYSTEM was designed so as to facilitate the employees of the above process in the attempt of resulting in orders of a wide range of products with as specific specifications as possible. By this way, Procurement Process will be reduced in cost (for Institute's budget) and time (for employees involved).

The present thesis makes an introduction in Chapter 2 with the theoretical meanings and historical background as far as Business Process Management and Business Process Management Systems are concerned. Chapter 3 describes in detail the current state of T.U.C's Procurement Process which is followed by a recent market research resulting in the selection of the suggested tool for the needs of the above administrative process. In addition, it explains the reasons why Camunda BPM tool was suggested. Camunda BPM core elements and the basic steps of process reengineering are described in Chapter 4. Chapter 5 cites the results and findings of the process's pilot execution and features feedback gained from the university members used the developed system. Any useful experience and lessons learned from this thesis project and possible suggestions for the future are referenced in Chapter 6 (Conclusion).

2 BACKGROUND

2.1 Business Processes: Meaning & Examples

Businesses and organizations set objectives to be achieved. In fact, in many cases, their survival is directly related to the outcome of these goals. Such objectives may relate to the production, packaging and distribution chain of a product in the market or the provision of data through a web portal, depending on the type of business activity.

In order to achieve these goals, a number of actions are required. These actions are usually done sequentially or in parallel, following a specific flow and are tasks or activities that take place within a company or organization. They can be performed either by some human factor or in some automated way. As Davenport (1993) reports, this structured, measured set of activities designed to produce a specific output for a particular customer or market, defines a business process. All the daily activities of a company or an organization, regardless of its type, consist of business processes. Some broader business processes may involve smaller ones. For example, manufacturing which is a general process may include some individual ones like the product assembly and quality assurance. Finance is considered to be the main process taken place in an accounting department but there are some other ones which are involved such as invoicing, billing and budgeting.

Therefore, a business process can be defined as a collection of inter-related events, activities and decision points that involve a number of actors and objects, and that collectively lead to an outcome that is of value to at least one customer (Dumas et all, 2013). This notion is depicted at Figure 1 below.

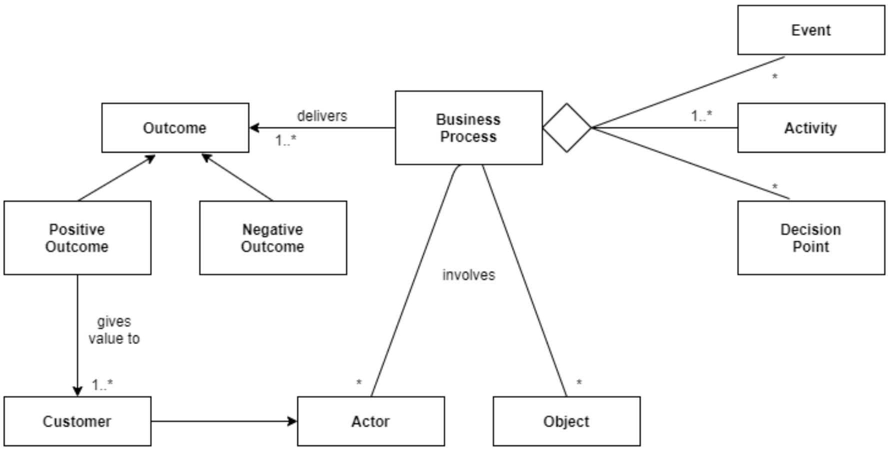


Figure 1 - Business Process Components

As a result, a need to manage business processes as correctly and efficiently as possible, has arisen. This is also considered necessary in cases of complicated processes consisting of multiple and repetitive tasks and activities which are executed by human actors. This necessity urges businesses and organizations to constantly improve their processes by following some standards during their execution. This is where Business Process Management comes to define and make clear these standards. The fundamentals of BPM are presented in the next paragraph of this thesis.

2.2 BPM: Its value for Businesses

Armed with the definition given for business processes above, this paragraph focuses on the definition and their importance for the proper management of organizations. Various definitions have been given in an attempt to clarify what is BPM throughout the years.

As reported by the BPM Institute, "Business Process Management is the definition, improvement and management of a firm's end-to-end enterprise business processes in order to achieve three outcomes crucial to a performance-based, customer-driven firm: 1) clarity on strategic direction, 2) alignment of the firm's resources, and 3) increased discipline in daily operations."

According to the Workflow Management Coalition, "Business Process Management (BPM) is a discipline involving any combination of modeling, automation, execution, control, measurement and optimization of business activity flows, in support of enterprise goals, spanning systems, employees, customers and partners within and beyond the enterprise boundaries."

As reported by the Association of Business Process Management Professionals, "Business Process Management (BPM) is a disciplined approach to identify, design, execute, document, measure, monitor, and control both automated and non-automated business processes to achieve consistent, targeted results aligned with an organization's strategic goals."

In other words, BPM oversees the way that an entire process including events, tasks and decisions is performed with the purpose of adding value to the business and its customers.

In addition, there is a series of factors which highlight the importance of BPM for businesses:

- BPM seeks to identify and exploit potential opportunities for optimization of processes within an organization. Optimization can mean various results and it always depends on the nature and goals of the organization. Such goals can be the increasing in productivity, reducing in costs, reducing in time to complete a task or an entire process, or even reducing errors due to human factor. When it comes to businesses, all of the above can lead to increased profits.

- When the processes and functions are properly aligned with the needs of customers, it can lead to better services and thus increase their satisfaction. By this way, the businesses earn not only more profit but also more reputation.

- BPM contributes to the monitoring and proper utilization of organization's resources. These resources can be the capital, the employees or any stuff used for their work. Avoiding unnecessary usage of these resources can lead to lower operating expenses for the businesses and at the same time to increase of productivity.

- BPM contributes to a clearer separation of roles and responsibilities between the staff and the departments within an organization. As a consequence, it helps in smooth operation of the organization by avoiding possible disagreements or conflicts regarding the responsibility of doing a task.

2.3 BPM: Historical Background

This paragraph aims to explore the reasons why BPM emerged and evolved over the years from a historical point of view.

According to the basic notion of BPM, processes are the focal point when it comes to the organizing and managing of work performed within an organization. It took several evolutionary periods to establish this notion in the work structures of organizations. Figure 2 provides the course of historical development of BPM.

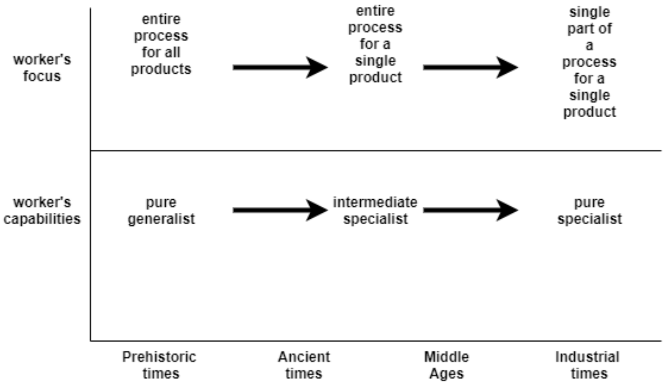


Figure 2 - The historical evolution of the concept of process

During prehistoric times, the notion of self-production and self-consumption prevailed. In those early societies, people who used to produce and consume a good such as food, tools and other items were usually the same. In industrial terms, people executed their own production processes. As a consequence, they carried out the same process for all products. In other words, the work structure was based on the notion of pure generality.

During ancient times, there has been a gradual transition from the notion of the pure generalism to the notion of the intermediate specialism. People began to produce and deliver one particular type of good, such as pottery, or providing one particular type of services, such as lodging for travelers. Therefore, they carried out a different process depending on the product or the service.

During the Middle Ages, the level of specialization of the workforce has risen even further. A typical example for this trend was the craftsmen's guilds. Those guilds consisted of merchants and artisans concerned with the same economic activity, such as barbers, shoemakers, masons, surgeons and sculptors. The workers were aware of the whole process in which they were involved but without knowing the processes of producing products and services that they acquired from others.

During the industrial times and more specifically at Second Industrial Revolution, occured between the second half of the 19th century and the First World War, this higher degree of specialization of the medieval worker shifted further towards a form of pure specialization. One of the proponents of pure specialization was Frederick W. Taylor (1856-1915), who is known as the father of scientific management. One of his four basic principles refers to the clear division of work and responsibilities between management and workers. It speaks of the fact that the workers should not deal with the whole production process except with the individual piece of work that concerns them. The notion of specialization was adopted very quickly and dominated not only in industry but also in administrative services. As a result of this notion workers would focus on only one part of the process for a single product and not the whole.

Thus, through Taylor's ideas, a substantial new category emerged in the workplace, that of managers. This resulted in the monitoring and control of the efficiency of the employees who were now divided into groups and each of them dealt with an individual part of the production process. The main responsibility of the managers was to set and ensure the productivity goals by the employees. But this does not necessarily mean that managers could perform the work they supervised, contrary to what was happening in the Middle Ages with the guild craftsmen who had a more complete knowledge of their duties. Their main purpose was to optimize the way a job is performed based on the resources available to them, under their supervision.

With the management of resources, the notion of division of labor in organizations and businesses was gradually introduced. The issue that arose later was how to differentiate the responsibilities of managers. The solution was to group the employees who were dealing with the same part of the production process in the new created functional units. Therefore, the responsibilities of managers were distributed based on the unit that they had to oversee. There was also a specific hierarchy regarding these units and their managers. In other words, below the business units were the departments and below the departments were the groups. This hierarchical structure formed the basis for businesses today with the organization chart of the responsibilities of directorates, departments and human staff.

2.4 BPM: Life Cycle

BPM life cycle constitutes the phases of managing processes in an organization. It essentially includes the steps from plan to implementation and from implementation to maintenance and improvement of a process within an organization. The life cycle must be practical and detailed where necessary in order for it to be understood by those involved in the process.

BPM life cycle has appeared in form of various models throughout the literature.

Therefore, the number of life cycle phases is determined in each model depending on the degree of detail given to it. This paragraph presents and describes BPM lifecycle phases based on their support by BPM systems. Armed with this criteria, the phases are the following ones: process modeling, process implementation, process execution and process analysis. The roles involved in the life cycle of BPM are two: the business analysts (or business managers) who plan and analyze the process models from a business point of view and the software engineers who are called upon to implement and execute those models.

- **Process Modeling**: In this phase, the process model is designed and the sequence of flow including events, tasks and decisions is determined. This can be done with the support of a modeling tool by the business analysts. Those tools typically support a modeling language so as to depict the process model in the respective graphical notation. By observing the model of the process, useful information can be extracted such as the type and object of each task, which person is responsible for carrying it out, etc. It should be noted that at this phase of the BPM life cycle the designed models are usually at a very high level of detail reading and they do not include any technical details. Therefore, they must be transformed into executable ones so as to be able to be executed by a process engine. This is something that occurs in the next phase, that of implementation.

- **Process Implementation**: In this phase, the designed process model is enriched with any required technical details by the software engineers and is converted to an executable model in a process engine. The executable model of a process cannot be created entirely from the theoretical one of the previous phase. It must also be described by the Web Services Business Process Execution Language (WS-BPEL), simply known as BPEL. This standard executable language uses web services so as to specify actions within the process model. Process Implementation phase is completed with process model deployment into a process engine.

- **Process Execution**: After process model deployment, the process engine executes process instances. The manual tasks are assigned to humans and the automated ones to Web services. In the context of

Service-Oriented Architecture (SOA), the process itself is exposed as a Web service and can be invoked by other processes or other clients.

- **Process Analysis**: Process analysis includes monitoring of running process instances and process mining. Monitoring may display information on the running process instances in form of dashboards. Such information may relate to at which spot of the flow the executed process is, what tasks have been completed and which ones are pending and by which users. Monitoring can also be done from business analysts, who are able to monitor and evaluate the key performance indicators of the business through the relevant information. Process mining uses some intelligent methods like algorithms so as to extract and provide useful information with the purpose of the potential process model optimization. During process execution some log files are automatically created by the process engine. These files record the details of the executed process instances. The way in which the process is executed is deduced from those files with the help of the process mining algorithms. As a result, business analysts are given the possibility of comparing and evaluating the deduced (from the algorithms) process model in relation to the initial one. In this way any deviations and optimization margins can be controlled. Process mining algorithms can also be used for performance analysis of processes.

BPM lifecycle with its included functionalities is depicted in Figure 3 below:

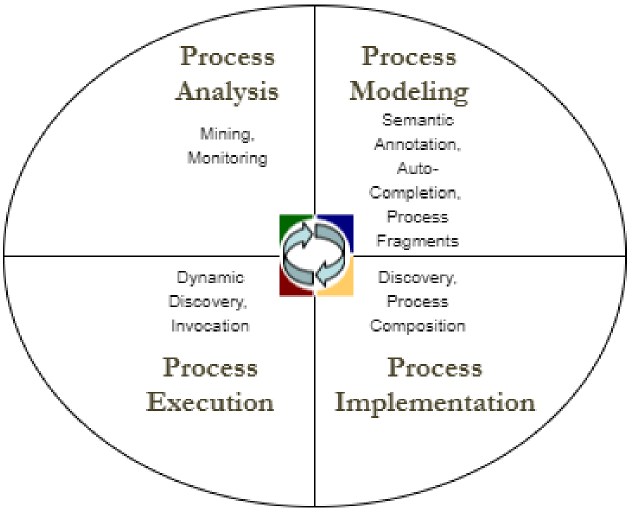

Process Analysis
Mining, Monitoring
Process Modeling
Semantic Annotation, Auto-Completion, Process Fragments
Dynamic Discovery, Invocation
Process Execution
Discovery, Process Composition
Process Implementation

Figure 3 - BPM Lifecycle

2.5 BPM & Modeling Languages

Business Process modeling comprises the graphical representation of the work done in an organization (events, tasks, decisions) in a form of flow charts. It is typically performed by business analysts who make clear their requirements and express their solutions. The model of a process acts as the communication bridge between business analysts and software engineers and provide the necessary information to manage all the included activities.

Over the years, various techniques for modeling business processes have been developed.

One of the oldest methods for representing process flow is the so-called flow chart. Flow charts typically consist of rectangles (representing tasks) and rhombuses (representing points in the process where a decision is made). Process modeling languages typically comprise three types of elements: "task" elements, "control" elements and "event" elements. Task elements describe units of work that may be performed by humans or software applications or a combination thereof. Control elements guide the flow of execution between tasks. Event elements inform us that something may or must happen within the process and requires a reaction. Such an example may be the arrival of a message from a customer informing us for an order's submission. There may be also other types of elements in a process model but the most basic ones are the 3 mentioned above.

There are various types of flow charts. One of them, the "cross-organizational" flow charts, are divided into so-called "swimlanes" that denote different organizational units (e.g. different roles or departments in a business).

Such flow charts are the so-called "UML Activity Diagrams". However, UML Activity Diagrams are even more sophisticated than a standard "cross-organizational" flow chart on the grounds that they include elements to capture data objects, signals and parallelism among other aspects.

Another type of flow charts is the EPCs (Event-driven Process Chains). An EPC is an ordered graph of events and functions. It provides various connectors that allow alternative and parallel execution of processes. Furthermore, it is specified by the usages of logical operators, such as OR, AND, and XOR. A major strength of EPC is claimed to be its simplicity and easy-to-understand notation. This makes EPC a widely acceptable technique to denote business processes (Anni Tsai et al. 2006).

Other process modeling languages include data-flow diagrams and IDEF3 (Integrated DEFinition for Process Description Capture Method).

Another widely used for business process modeling standard, based on flow charts and similar to UML Activity Diagrams, is Business Process Model and Notation (BPMN). The latest version of BPMN is BPMN 2.0 which was released by the Object Management Group (OMG) in January 2011. BPMN, comprises the following elements: "task" elements which are represented as rounded rectangles, "control" elements (called as "gateways") which are represented as rhombuses, "event" elements which are represented as circles and "sequence flows" which connect all of these elements and are represented as arcs. Sequence flows define the order in which the process is executed.

Figure 4 below, depicts a BPMN model representing a process order occurs in an e-shop including three roles of humans.

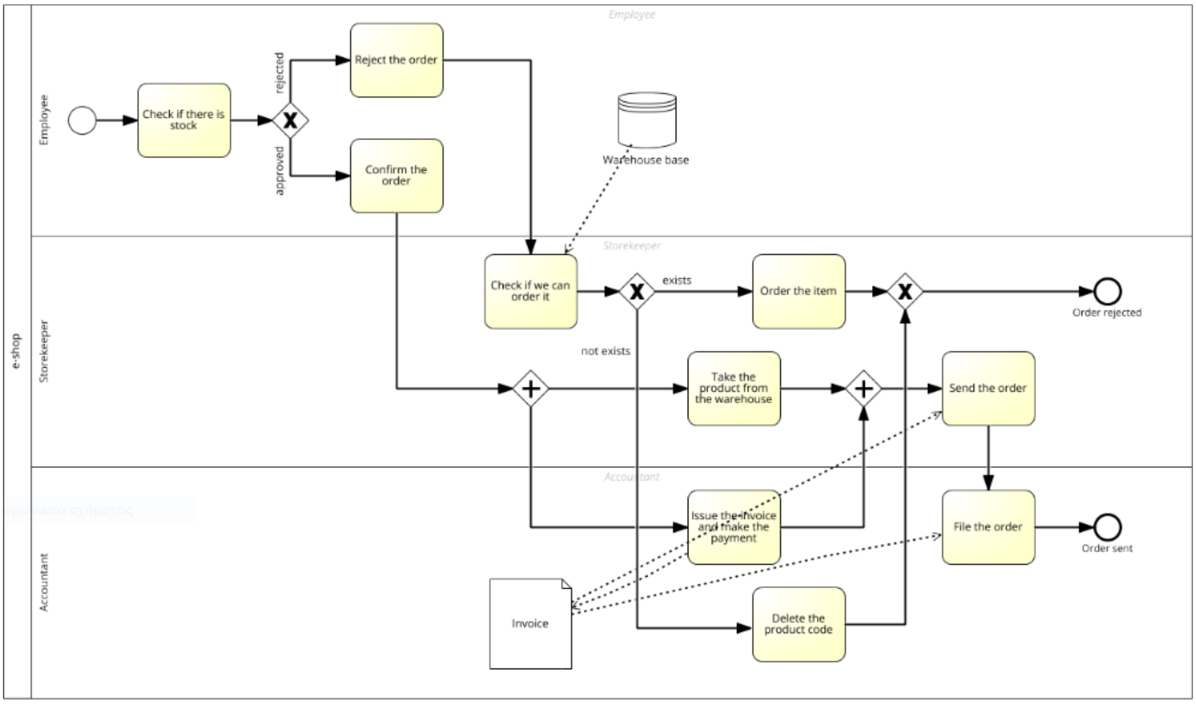


Figure 4 - Process model for the orders made in an e-shop

Two decision points are depicted in this model. In the first one, the process follows one of two paths depending on whether the order is approved or not. In the second one, the storekeeper checks for the presence or absence of an item in the warehouse. The model also shows the process participants involved. These are the "employee", the "storekeeper" and the "accountant". Each of these participants is shown as a separate "lane" containing the tasks performed by each one.

The above process model is at a high level of abstraction on the grounds that it presents the absolutely necessary information hiding any additional details. In other words, it summarizes the information of the process to an outside person. However, when details of the process concerning someone more specific, need to be revealed, then the model needs to be more detailed. In that case, the model should be at a lower level of abstraction.

BPMN happens to be an executable notation, but this doesn't mean it always has to be. In some cases, models' goal may be to reveal the theoretical details of the process to someone. In this case, attention to any technical details is not required. Therefore, such a model may include some additional text annotations so as to clarify the meaning of certain BPMN elements and help understand the high-level process.

In other cases (such as the measure of process performance), models have to be described in detail. As a result, further details may be required such as how much time each task takes (on average).

Finally, in a few cases, process models are intended to be deployed into a BPMS so as to coordinate the execution of the process (as we will see below in this dissertation). As a consequence, much more details regarding the inputs and outputs of the process and each its elements have to be included.

2.6 BPMS: Their value for BPM

So far we examined and presented the management of business processes from the management sciences aspect. This paragraph aims to look at business process management from the IT aspect. In other words, the ways in which business processes can gain in time and performance by using the BPM technology to document and support them. The use of BPM technology does not in itself guarantee that an organization or a business will be completely identified with the part of the management of its processes. A necessary condition is the adoption and implementation of the basic principles and values that govern process management.

When it comes to BPMS technology, the reference is made to the systems, usually called as Business Process Management Systems.

As Wil M. P. van der Aalst (2013) reports, BPM systems are generic software systems that are driven by explicit process designs to enact and manage operational business processes.

The key features and the capabilities offered by business process management systems are the following ones:

- Bridging the communication gap between business analysts and software engineers

As already mentioned in the paragraph that described the life cycle of business processes, the two directly involved human participants (i.e. business analysts and software engineers) look at how a process is executed from a different perspective. Business analysts study the model of a process from a business point of view whereas software engineers from a technical one. Therefore, it makes sense sometimes that there may not the most appropriate communication between them. BPMS provide the ability to design the model of a process with the least possible technical detail (as stated in the paragraph 4.5). What is more, sometimes the modeling tools offered by BPMS can automatically deploy the generated code into a process engine without the intervention of a specialized person. As a result, software engineers can embed the business logic to the designed (by business analysts) process model by using a scripting language supported by the BPMS.

- Integration with other applications and systems

BPMS offer integration capabilities with enterprise applications and systems (as displayed in Figure 5 below).

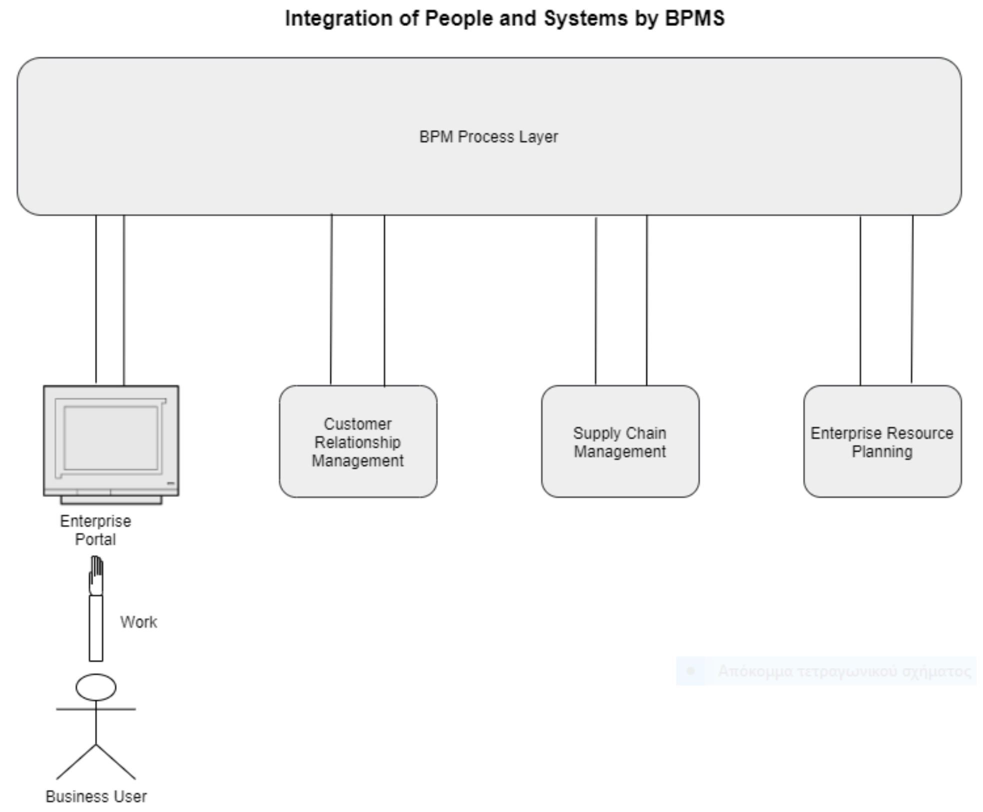

Integration of People and Systems by BPMS
BPM Process Layer
Enterprise Portal
Customer Relationship Management
Supply Chain Management
Enterprise Resource Planning
Work
Business User
Απόκομμα τετραγωνικού σχήματος

Figure 5 - Integration with other applications and systems

BPMS offer the capability of generating forms in a page accessible through an internet browser. These forms are displayed in a form of task lists to users involved in the process. These task lists can be integrated through BPMS with enterprise systems involved in the business process. Each user has access to a task list via the enterprise portal depending on the role and the tasks assigned to him. By completing and submitting the task form, the process proceeds to the next task which could result in a transaction created in an existing business system involved in the process.

- Process Simulation

Some BPMS also provide the ability to simulate a process. This can be done with the help of the modeling tool used by business analysts during the modeling phase. Therefore, business analysts can design the initial model of a process while running it in a simulation mode. By simulating the process model, the business analysts can see possible cost and execution time distributions for each task and human resource respectively. Once all the data is running in the simulator, it is possible to locate bottlenecks in the process flow as well as any possible design flaws. Based on the results of the simulation algorithm, the initial process model may or may not be modified accordingly. By this way, process model can be modified multiple times until its final version and its deployment to a process engine of a BPMS. This can lead to an overall process improvement.

- Process Management

BPMS serves as the supervisory system that oversees the business process. By this way, the business processes are constantly monitored, controlled and so they can be modified and improved. Since all the process steps are supervised, valuable information can be extracted and utilized by the organization. In particular, process data concerning the average execution time per task, the wait time before a task is performed by human participants and cost data can be extracted and evaluated by business analysts. Cost figures can be assigned to the required time for the completion of each task in the process and opportunity costs to the wait time while a process task is waiting in queue to be executed. These cost figures could be applied to a live process and they could be obtained in real time. In addition, business analysts could be notified for any possible abnormal events. One such event could be an unusual number of banking transactions where the bank manager could be notified in such a case. Process data could also be used to identify bottlenecks in the flow. For instance, if a customer service representative needs 50 percent longer on average to process a customer inquiry, business analysts can be informed about this abnormality and about the performance statistics (i.e., how much time for logging, researching and responding to an inquiry) of every task the customer service representative accomplished. Therefore, the possible causes for this abnormality could be investigated, located and resolved.

- Real-Time Process Improvement

Business processes can be improved in real time without requiring a change in the initial process model which already exists in the modeling tool offered by BPMS. This eliminates the need to gather current process information. By this way, corrective interventions could be made to the process using a modeling tool. Once these interventions take effect, any task that started on the initial process version can be completed with the initial process version parameters and any new task which is to be executed, can be completed with the improved process version parameters. In essence, BPMS allows both the initial and the improved processes versions to coexist until all work from the initial one is completed. As a consequence, business processes can be modified and improved while they are already in progress without affecting the work already done.

3 THESIS GOALS

3.1 The Procurement Process in T.U.C.

Periodically, the Institute conducts centralized competitions for electronic material such as computers, printers and peripherals. In the current situation of these competitions, the administrators of the Directorates and Schools of T.U.C. (Local Administrators) are asked to select products and send them along with their specifications to the procurement department so as to conduct the competition.

Nonetheless, the current way of carrying out the Procurements process raises some problems.

Very specific specifications make the above competition barren or do not allow many companies to bid. Also, in the end, the products are overpriced by the few suppliers that will go down in the competition on the grounds that it is extremely complicated to decode the specifications and this costs time.

The proposed solution is to create proposals from equipment that is common in the market in various grades. By this way, the Local Administrators will have to select from a range of default products. As a result, this will lead to multi-piece tenders in specific specifications and not many pieces with separate specifications each. This will lead to more suppliers who will make offers and cheaper pieces as large orders of the same products (bulk) will be placed.

The initial proposed BPMN 2.0 model of the Procurement process in T.U.C. is shown graphically in Figure 6 and is described below.

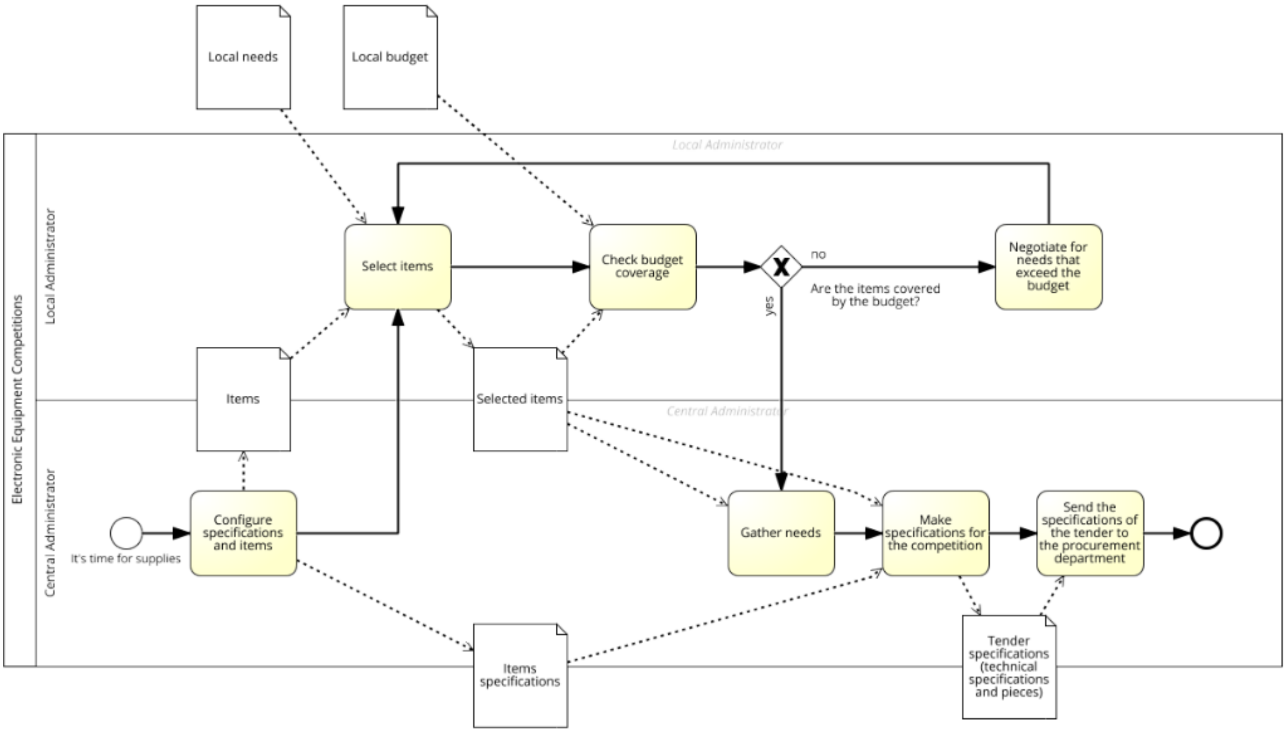

Local needs
Local budget
Local Administrator
Electronic Equipment Competitions
Local Administrator
Select items
Check budget coverage
no
Are the items covered by the budget?
yes
Negotiate for needs that exceed the budget
Items
Selected items
Central Administrator
Central Administrator
It's time for supplies
Configure specifications and items
Gather needs
Make specifications for the competition
Send the specifications of the tender to the procurement department
Items specifications
Tender specifications (technical specifications and pieces)

Figure 6 - The initial proposed BPMN 2.0 model for the Procurement Process in T.U.C.

This model had to be differentiated several times during the present dissertation according to the needs of the BPMN 2.0 standards, the selected BPM software (Camunda BPM) and discussions with people responsible for the Procurement Process in Technical University of Crete.

So, the final proposed BPMN 2.0 model for the Procurement Process in T.U.C is depicted in Figure 7 below.

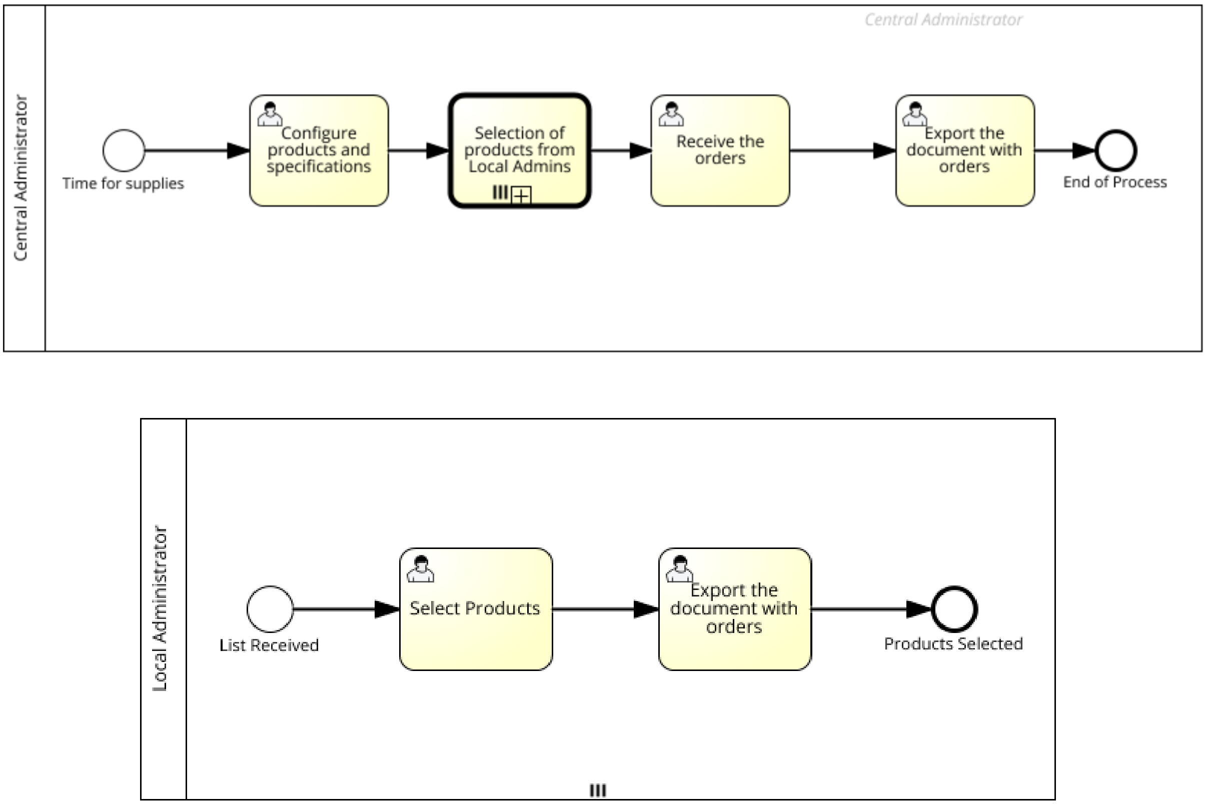


Figure 7 - The final proposed BPMN 2.0 model for the Procurement Process in T.U.C.

A Central Administrator creates specifications for item types that reflect the market supply for different item types. These item types are made available to Local Administrators along with the current market prices. Local Administrators are asked to select items according to the needs of their Faculty/Directorate and then system checks if they are within their available budget. If yes, they send back to the Central Administrator the number of tracks they want from each item. Since the Central Administrator has received the number of tracks for each item from all Local Administrators, a final exported (from the system) document has to be sent to the Procurement Department for the conduct of the competition.

3.2 Open-Source BPMS: A description based on a recent Market Research (conducted in 2016-2017 period)

Before selecting the BPMS within which the above Procurement Process has been executed, a market research was necessary to be carried out so as to focus on six different open-source software tools and compare each other in the field of BPM. This market research was conducted on the Internet (and more specifically in the official site of each BPMS), started on September of 2016 and finished on March of 2017 with the final suggestion of "Camunda BPM" as the software for the development, deployment and execution of the above process. Our criteria for this suggestion are cited in the next paragraph of this Thesis.

A brief description for each open-source BPMS is following below:

- **Process Maker BPM (3.1.3 version)**

  Having been founded in 2000, Process Maker BPM is entirely web-based and can be accessed through any web-browser. It can interact with other information systems like ERP and CRM. Its free version is available under dual license.

  Its open-source edition supports some key features like the following ones:

  - REST API

    Process Maker's API makes use of REST architecture thus allowing external scripts remote access and control of its functionality. Using the REST API creates custom interfaces that have access to the software. REST endpoints can also be accessed within Process Maker either via PHP code in triggers or JavaScript code in Dynaforms.

  - SOAP API

    The Web services of this software provide a programming interface for remote control and integration of software with external systems using compatible SOA protocols. WSDL Web Services allow remote access to software functionality through the Internet using W3C's Simple Object Access Protocol (SOAP) 1.2 and Web Services Description Language (WSDL) 1.1.

  - BPMN 2.0 Process Designer

    The software process design tool is entirely web-based and allows users to create and edit process diagrams using the BPMN 2.0 modeling language. It is possible to design more complex workflows that can be either imported or exported (from/to) other software that supports BPMN.

  - HTML5 Responsive Form Designer - Dynaform (Webform) Designer

    Electronic forms can be created without the need to write any code.

- Basic Dashboards

  Decision makers and managers are given the opportunity to have a complete "picture" of the execution of the various procedures by employees.

- Output Document Builder

  Output documents are files created from HTML templates during the execution of a case and which are intended to be printed or stored digitally outside the software.

- User Portal & Cases Inbox

  The user portal consists of Cases Inbox, Search and Document Management.
  Users can see the progress of applications they have submitted or requests that require their input.

- User Management

  The creation of roles, groups and departments is supported, in order to adapt the procedures for the unique structure, reporting requirements and hierarchy in the organization.

- **Camunda BPM (7.6.0 version)**

Having been founded in 2008, Camunda BPM is a Java-based software that provides the ability to model and execute in BPMN 2.0 for fully structured activities, in CMMN 1.1 for less structured (compared to BPMN) activities and in DMN 1.1 for automation of business rules through the plug-in of decision tables. It is written in Java. A Java Virtual Machine (JVM) is used so as to design, implement and operate business processes and workflows. This software also provides a REST API architecture to provide interoperability between computer systems on the Internet, thus allowing the user to create applications that can connect to a remote process execution machine. Camunda BPM can be used either as a standalone process engine server or integrated into custom Java applications.

Its open-source edition supports some key features like the following ones:

- Design powered by Camunda Modeler

  Camunda Modeler is an application for creating BPMN process diagrams and DMN decision tables. It also allows developers to combine it with the IDE of their choice (such as Eclipse, Netbeans, Intellij) as long as it can work directly with XML files (BPMN & DMN).

- Operation & Execution

  It can run on any Java Virtual Machine. Its core engine is accessible through its REST API architecture or through the Java API architecture.

- Running

  - Camunda BPM includes three sub-applications which are the following ones:

1. Camunda Tasklist where users can implement their tasks.
2. Camunda Cockpit which provides the ability to monitor the processes during their operation, their current status, their history as well as the immediate intervention of the user if necessary.
3. Camunda Admin which provides the ability to manage users and join groups.

- Performance

  Its process engine can handle a large number of transactions (process instances) in a short period of time. This is accomplished in a variety of ways, including reducing database interaction to the minimum necessary and separating runtime data from historical data.

- Scalability

  This software can also act as a cluster. With this feature, a process instance is installed on each node that has access to the same database as the other nodes.

- Multi-Tenancy

  Different clients can work with this software. A typical scenario for this feature is the operation of Camunda in a cloud environment (e.g. as part of a SaaS application).

- Environment

  This software is designed so that it can "run" in different technical environments. This makes the process easier as it is not necessary to run a specific application server or database, especially for Camunda.

- Analysis

  - Cockpit

    All process instances can be entered into the software and tracked through the Cockpit. This applies to the steps that have been taken as well as to the information regarding when a change in the data took place, by whom and in what ways.

  - Individual extensions for BAM

    For Business Activity Monitoring, the user can either develop their own cockpit extensions (so-called plug-ins) or rely on plug-ins that have been developed, either by Camunda or others customers and are available to the general public.

  - Combination with other tools

    This software can be configured to move all log files to an alternate destination. This destination can be a separate database or an external system (e.g. a data warehouse or a business intelligence system).

- **Bonita O.S. (7.3.3 version)**

Having been founded in 2009, Bonita O.S. consists of the following two components:

- The development environment, Bonita BPM Studio which is a graphical environment for creating processes, applications and data models.

- The execution environment, Bonita BPM Platform which includes the following:

    - Apache Tomcat web server applications
    - User Interface Designer
    - Bonita BPM Portal (visible to users, who can view their work as well as take action on all the processes involved, thanks to a general to-do list - also used by the administrator to install, develop and manage processes as well as for creating applications)
    - Bonita BPM engine. It can be installed on a Java Virtual Machine, in any web/Java Enterprise Edition container or it can be used as a simple Java library
    - H2 Database

Its open-source version is licensed under the GNU General Public License, version 2.

Bonita O.S. includes the following features:

- Process Modeling

    - Use of the BPMN 2.0 modeling language
    - Assigning roles to users
    - Management of complex data
    - Sharing repository for process models

- Connection and integration with external systems

    - Ability to connect to enterprise systems (e.g. CRMs, ECMs, ERPs, databases, etc.)
    - Create user links with extensible framework and tools
    - Integration with open and scalable REST & Java API architectures
    - Automatic synchronization of the organization for more efficient management of users

- Easy adjustment

    - Ability to make changes to applications in real time without interruption
    - Ability to create "ad-hoc" tasks to improve process flexibility
    - Immediate handling of errors with the possibility of repairing, replacing or skipping failed activities

- Scale applications

    - Ability to fully monitor with integrated dashboards and graphical case visualization
    - Monitoring of business performance indicators (KPIs) with user-defined reports

- **<u>Activiti BPM (5.22.0 version)</u>**

Having been founded in 2010, Activiti BPM is a lightweight Java-based BPM workflow management software platform for business people, developers and system administrators. This software supports the BPMN 2.0 modeling language and is written in Java. It is distributed under the Apache Software License 2.0 license. It can run in any Java application, on a server, in multiple nodes as a cluster since all its services are stateless and in the cloud.
Its process design tools include an Eclipse-based and Web-Based BPMN Editor.
This software consists of 2 different components, each of which performs a separate purpose:

1. Runtime

   - Activiti Engine

   It is the core element of the software. It is written in Java and runs procedures described in BPMN 2.0.
   The basis of its architecture consists of Process Virtual Machine.

   Some of its basic properties relate to the following ones:

   - Java Event listeners

     It practically allows developers to enrich a process with additional technical details that do not appear in the diagram. Therefore, non-technically skilled business users do not need to know the technical aspects of the chart.

   - Customized activities

     Allows even non-technical users to create an extended description with a specific activity that does not fit any type of activity. In this case, the developer has 2 options:
     The first, to suggest to the user a different model based on an existing type of activity. The second (which is also the uniqueness of Activiti), to write a custom activity in Java code that implements the complex behavior described by the user. In this case, the diagram will remain as given by the user.

   - BPMN shortcuts

     Finally, another innovation of this software is the use of shortcuts (BPMN shortcuts) which contrasts the issue of great detail that exists in some parts of the BPMN 2.0 language.

2. Management & Modeling

   - Activiti Explorer

     It is a web application that provides all users of the system with access to the Activiti Engine runtime. It includes task management, inspection of process instances, management features, and viewing reports based on statistical historical data.

- Activiti Modeler

  It is used to write compatible (BPMN 2.0) procedures using a browser. Process files are stored by the server in a database. Activity Modeler is no longer under active development by the main software team but remains available as part of the Activity Explorer web application.

- Activiti Eclipse Designer

  It is an Eclipse plugin that allows users to model, test and deploy processes in BPMN 2.0 from their application IDE environment.

- **JBoss jBPM (6.5.0 version)**

Having been founded in 2014, JBoss jBPM is a lightweight and fully open-source software written in Java that allows to model, execute and monitor business processes using the latest BPMN 2.0 specifications throughout their life cycle. It can run in any Java environment, either embedded in the user application or deployed as a service.
It is distributed under the Apache Software License 2.0 license.

The main components of this software are described below:

- Core Engine

  It is the main component of the software. It is a "light" business process engine that can be integrated, either as part of the user application or deploy as a service (possibly cloud).

- Process Designer

  The web-based Designer makes it possible to design business processes. It is aimed at business users and offers a GPU for viewing and editing business processes, which looks like the Eclipse plugin. Process simulation is supported.

- Data Modeler

  It enables non-technically trained users to view, edit and create the type of data contained in the processes. This tool provides an easy, direct and visual aid for creating both logical and physical data models.

- Form Modeler

  It is a form editor that allows users to create forms to "capture" and display information during the process or execution of a task.

- Process Instance & Task Management

  Through a web-based management console, business users can manage business processes.

- Business Activity Monitoring

  Provides the opportunity to non-technically trained users of the visual composition of business dashboards.

- Workbench

  It is a web-based application that combines all the aforementioned web-based tools into one configurable solution.

- Eclipse Developer Tools

  They provide the ability to integrate business processes into the user development environment. They address to developers. They include a graphical processor for creating business processes (drag & drop) and many testing and debugging capabilities.

- **YAWL (4.1 version)**

Developed by Will van der Aalst (Eindhoven University of Technology, Netherlands) and Arthur ter Hofstede (Queensland University of Technology, Australia) in 2002, this fully open-source language is based on Petri Nets on the one hand and Workflow Patterns on the other. These patterns form a commonly accepted reference point for the suitability or not of the specifications of a process language. It has open interfaces based on Internet standards, thus enabling developers to plug-in existing applications as well as extend and customize the system in many ways. It also provides a GPU with a built-in verification feature, helping developers "capture" workflow models and automate timely detection of errors.
It is distributed under the LGPL license.

This language features the following capabilities:

- Support for workflow patterns (standards) and in particular those related to control and resources

- Present and handle all data as XML documents (XML Schema, XPath and XQuery)

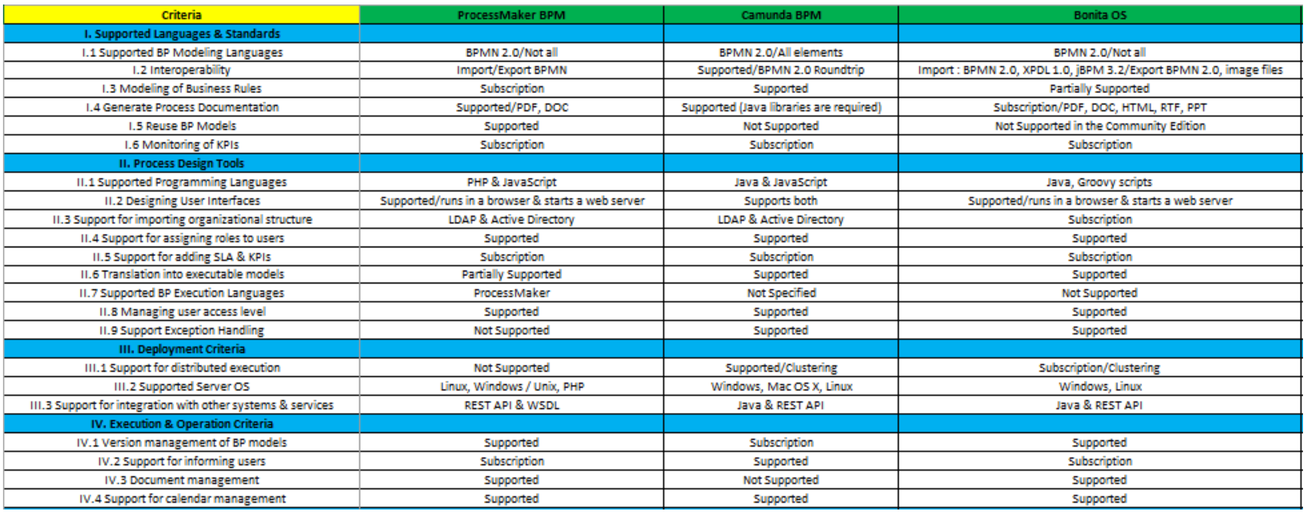
- Clear specifications and automatic verification. There are 2 different approaches regarding the verification. One is based on reset nets and the other one on transition constants via the wofYAWL editor plug-in. This determines whether a workflow is correct at design time

- Setting timers for tasks

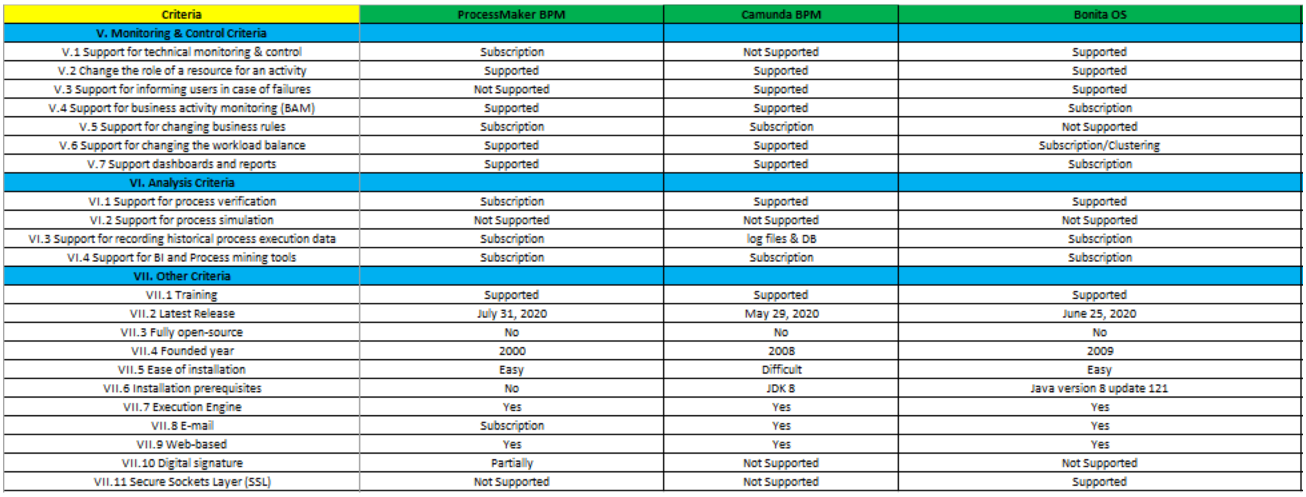
- Automated support for creating screens through JavaServer Faces technology. Ability to connect user screens to tasks

- This language can be run with the following (at least) databases: PostgreSQL, MySQL, Apache Derby, ORACLE and HSQLDB
- Exception handling (handling of events or incidents which for some reason were not defined in the process model)
- Support for dynamic workflow through the Worklets approach. Workflows can thus evolve over time to meet new and changing demands
- Simple deployment. It offers a number of automated installers as well as an intuitive graphical design interface
- Service-oriented architecture that can therefore replace existing components with its own or expand the design environment with new components
- Support for automatic creation of electronic forms
- Tasks can be assigned to people, Web Services, external applications, or Java classes
- Support for simulation (via a link) with the process mining environment

To sum-up, two aggregate tables (Figure 8 and Figure 9) with the supported features of the Business Process Management Lifecycle as far as the above described 6 open-source BPM tools is concerned, are following below:

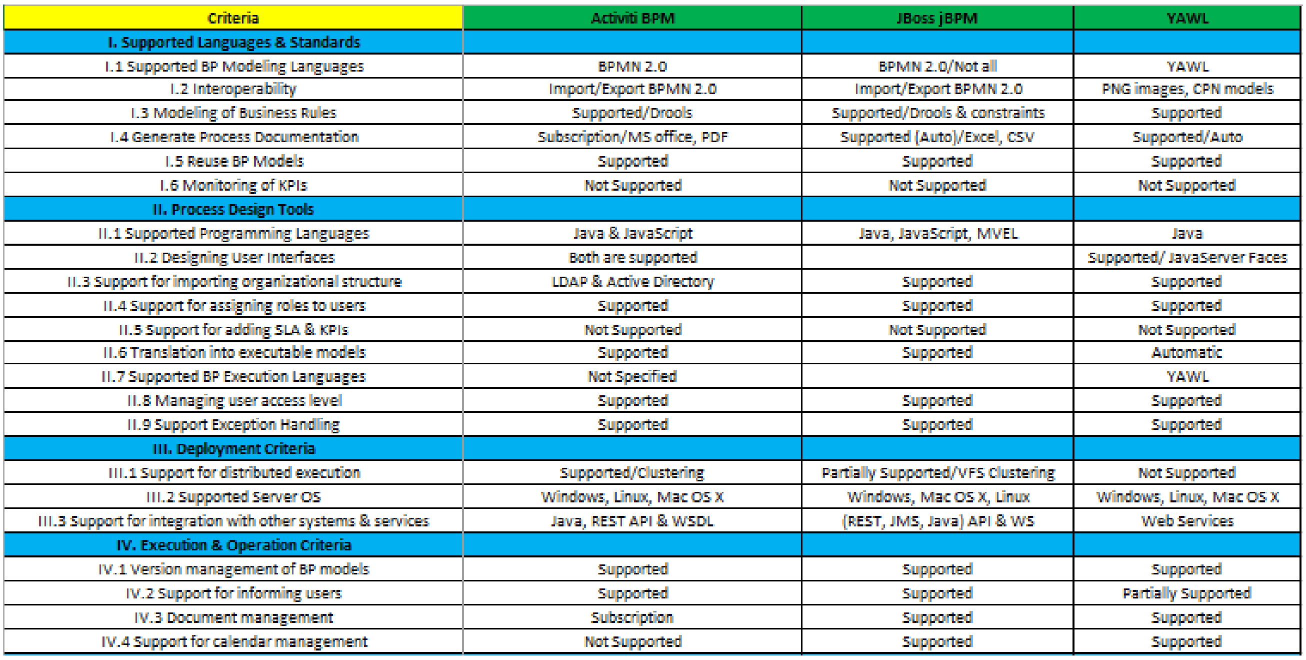


Criteria	ProcessMaker BPM	Camunda BPM	Bonita OS
I. Supported Languages & Standards			
I.1 Supported BP Modeling Languages	BPMN 2.0/Not all	BPMN 2.0/All elements	BPMN 2.0/Not all
I.2 Interoperability	Import/Export BPMN	Supported/BPMN 2.0 Roundtrip	Import : BPMN 2.0, XPDL 1.0, jBPM 3.2/Export BPMN 2.0, image files
I.3 Modeling of Business Rules	Subscription	Supported	Partially Supported
I.4 Generate Process Documentation	Supported/PDF, DOC	Supported (Java libraries are required)	Subscription/PDF, DOC, HTML, RTF, PPT
I.5 Reuse BP Models	Supported	Not Supported	Not Supported in the Community Edition
I.6 Monitoring of KPIs	Subscription	Subscription	Subscription
II. Process Design Tools			
II.1 Supported Programming Languages	PHP & JavaScript	Java & JavaScript	Java, Groovy scripts
II.2 Designing User Interfaces	Supported/runs in a browser & starts a web server	Supports both	Supported/runs in a browser & starts a web server
II.3 Support for importing organizational structure	LDAP & Active Directory	LDAP & Active Directory	Subscription
II.4 Support for assigning roles to users	Supported	Supported	Supported
II.5 Support for adding SLA & KPIs	Subscription	Subscription	Subscription
II.6 Translation into executable models	Partially Supported	Supported	Supported
II.7 Supported BP Execution Languages	ProcessMaker	Not Specified	Not Supported
II.8 Managing user access level	Supported	Supported	Supported
II.9 Support Exception Handling	Not Supported	Supported	Supported
III. Deployment Criteria			
III.1 Support for distributed execution	Not Supported	Supported/Clustering	Subscription/Clustering
III.2 Supported Server OS	Linux, Windows / Unix, PHP	Windows, Mac OS X, Linux	Windows, Linux
III.3 Support for integration with other systems & services	REST API & WSDL	Java & REST API	Java & REST API
IV. Execution & Operation Criteria			
IV.1 Version management of BP models	Supported	Subscription	Supported
IV.2 Support for informing users	Subscription	Supported	Subscription
IV.3 Document management	Supported	Not Supported	Supported
IV.4 Support for calendar management	Supported	Supported	Supported

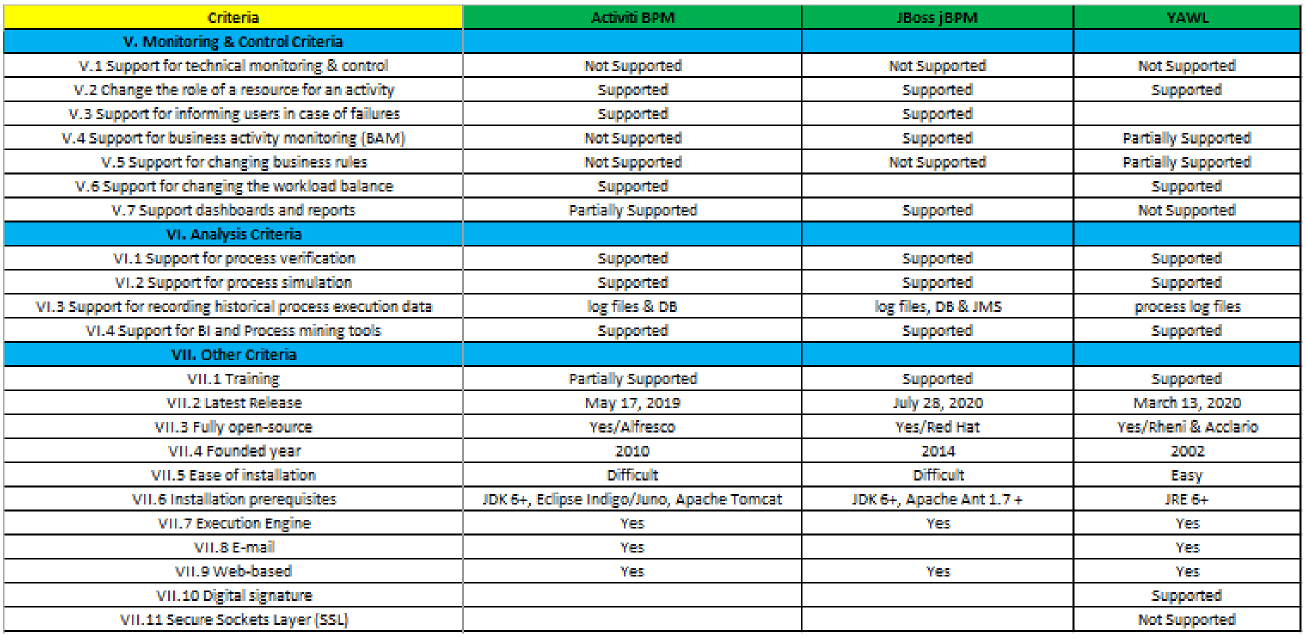


Criteria	ProcessMaker BPM	Camunda BPM	Bonita OS
V. Monitoring & Control Criteria			
V.1 Support for technical monitoring & control	Subscription	Not Supported	Supported
V.2 Change the role of a resource for an activity	Supported	Supported	Supported
V.3 Support for informing users in case of failures	Not Supported	Supported	Supported
V.4 Support for business activity monitoring (BAM)	Supported	Supported	Subscription
V.5 Support for changing business rules	Subscription	Subscription	Not Supported
V.6 Support for changing the workload balance	Supported	Supported	Subscription/Clustering
V.7 Support dashboards and reports	Supported	Supported	Subscription
VI. Analysis Criteria			
VI.1 Support for process verification	Subscription	Supported	Supported
VI.2 Support for process simulation	Not Supported	Not Supported	Not Supported
VI.3 Support for recording historical process execution data	Subscription	log files & DB	Subscription
VI.4 Support for BI and Process mining tools	Subscription	Subscription	Subscription
VII. Other Criteria			
VII.1 Training	Supported	Supported	Supported
VII.2 Latest Release	July 31, 2020	May 29, 2020	June 25, 2020
VII.3 Fully open-source	No	No	No
VII.4 Founded year	2000	2008	2009
VII.5 Ease of installation	Easy	Difficult	Easy
VII.6 Installation prerequisites	No	JDK 8	Java version 8 update 121
VII.7 Execution Engine	Yes	Yes	Yes
VII.8 E-mail	Subscription	Yes	Yes
VII.9 Web-based	Yes	Yes	Yes
VII.10 Digital signature	Partially	Not Supported	Not Supported
VII.11 Secure Sockets Layer (SSL)	Not Supported	Not Supported	Supported

Figure 8 - Comparing the supported features of BPM Lifecycle for each BPMS tool



Criteria	Activiti BPM	JBoss jBPM	YAWL
I. Supported Languages & Standards			
I.1 Supported BP Modeling Languages	BPMN 2.0	BPMN 2.0/Not all	YAWL
I.2 Interoperability	Import/Export BPMN 2.0	Import/Export BPMN 2.0	PNG images, CPN models
I.3 Modeling of Business Rules	Supported/Drools	Supported/Drools & constraints	Supported
I.4 Generate Process Documentation	Subscription/MS office, PDF	Supported (Auto)/Excel, CSV	Supported/Auto
I.5 Reuse BP Models	Supported	Supported	Supported
I.6 Monitoring of KPIs	Not Supported	Not Supported	Not Supported
II. Process Design Tools			
II.1 Supported Programming Languages	Java & JavaScript	Java, JavaScript, MVEL	Java
II.2 Designing User Interfaces	Both are supported		Supported/ JavaServer Faces
II.3 Support for importing organizational structure	LDAP & Active Directory	Supported	Supported
II.4 Support for assigning roles to users	Supported	Supported	Supported
II.5 Support for adding SLA & KPIs	Not Supported	Not Supported	Not Supported
II.6 Translation into executable models	Supported	Supported	Automatic
II.7 Supported BP Execution Languages	Not Specified		YAWL
II.8 Managing user access level	Supported	Supported	Supported
II.9 Support Exception Handling	Supported	Supported	Supported
III. Deployment Criteria			
III.1 Support for distributed execution	Supported/Clustering	Partially Supported/VFS Clustering	Not Supported
III.2 Supported Server OS	Windows, Linux, Mac OS X	Windows, Mac OS X, Linux	Windows, Linux, Mac OS X
III.3 Support for integration with other systems & services	Java, REST API & WSDL	(REST, JMS, Java) API & WS	Web Services
IV. Execution & Operation Criteria			
IV.1 Version management of BP models	Supported	Supported	Supported
IV.2 Support for informing users	Supported	Supported	Partially Supported
IV.3 Document management	Subscription	Supported	Supported
IV.4 Support for calendar management	Not Supported	Supported	Supported



Criteria	Activiti BPM	JBoss jBPM	YAWL
V. Monitoring & Control Criteria			
V.1 Support for technical monitoring & control	Not Supported	Not Supported	Not Supported
V.2 Change the role of a resource for an activity	Supported	Supported	Supported
V.3 Support for informing users in case of failures	Supported	Supported	
V.4 Support for business activity monitoring (BAM)	Not Supported	Supported	Partially Supported
V.5 Support for changing business rules	Not Supported	Not Supported	Partially Supported
V.6 Support for changing the workload balance	Supported		Supported
V.7 Support dashboards and reports	Partially Supported	Supported	Not Supported
VI. Analysis Criteria			
VI.1 Support for process verification	Supported	Supported	Supported
VI.2 Support for process simulation	Supported	Supported	Supported
VI.3 Support for recording historical process execution data	log files & DB	log files, DB & JMS	process log files
VI.4 Support for BI and Process mining tools	Supported	Supported	Supported
VII. Other Criteria			
VII.1 Training	Partially Supported	Supported	Supported
VII.2 Latest Release	May 17, 2019	July 28, 2020	March 13, 2020
VII.3 Fully open-source	Yes/Alfresco	Yes/Red Hat	Yes/Rheni & Acclario
VII.4 Founded year	2010	2014	2002
VII.5 Ease of installation	Difficult	Difficult	Easy
VII.6 Installation prerequisites	JDK 6+, Eclipse Indigo/Juno, Apache Tomcat	JDK 6+, Apache Ant 1.7 +	JRE 6+
VII.7 Execution Engine	Yes	Yes	Yes
VII.8 E-mail	Yes		Yes
VII.9 Web-based	Yes	Yes	Yes
VII.10 Digital signature			Supported
VII.11 Secure Sockets Layer (SSL)			Not Supported

Figure 9 - Comparing the supported features of BPM Lifecycle for each BPMS tool

Having analyzed the 2 tables above, we can mention the following for each feature of the BPM lifecycle:

I. Supported Languages and Standards

- **Supported BP Modeling Languages**: BPMN 2.0 is supported by all the above BPM tools except of YAWL which supports its own modeling language.

- **Interoperability**: The import as well as the export of BPMN models is supported by all the above BPM tools except of YAWL. It is worth mentioning the interoperability capabilities of Bonita OS as it seems to support the import of additional models except of BPMN.

- **Modeling of Business Rules**: This feature is supported by all the above BPM tools. It is worth mentioning that Process Maker BPM only supports this in its enterprise edition and that Bonita OS partially supports it.

- **Generate Process Documentation**: This feature is supported by all the above BPM tools. It is worth mentioning that Bonita OS which supports this in its enterprise edition can generate multiple types of documents. Camunda BPM supports the manual generation of documents (e.x. PDF) with the invoke of custom libraries (e.x. in Java).

- **Reuse BP Models**: This feature is supported by all the above BPM tools except of Camunda BPM. It is worth mentioning that Bonita OS does not support this feature in its community edition.

- **Monitoring of KPIs**: Monitoring of key performance indicators which are measurable values that denote how effectively a business achieves its key business objectives, is only supported by the enterprise edition of Process Maker BPM, Camunda BPM and Bonita OS.

II. Process Design Tools

- **Supported Programming Languages**: It is worth mentioning that Java programming language is supported by all the above BPM tools except of Process Maker BPM. The second most usable programming language as far as these BPMS is concerned is Javascript.

- **Designing User Interfaces**: This feature is supported by all the above BPM tools. It is worth mentioning that in the majority a web browser is used which starts a web server. No data found for JBoss jBPM.

- **Support for importing organizational structure**: LDAP and Microsoft Active Directory servers are offered for connection with the majority of the above BPM tools.

- **Support for assigning roles to users**: This feature is supported by all the above BPM tools.

- **Support for adding SLAs & KPIs**: Service Level Agreements (SLAs) and Key Performance Indicators (KPIs) are only supported by the enterprise edition of Process Maker BPM, Camunda BPM and Bonita OS.

- **Translation into executable models**: This feature is supported by all the above BPM tools. It is worth mentioning that Process Maker partially supports the translation of designed models into executable ones and that YAWL automatically supports this feature.

- **Supported BP Execution Languages**: Process Maker and YAWL support their own execution languages. Bonita OS does not support this feature. It was not specified from the current market research if the rest of BPM tools support this feature.

- **Managing user access level**: This feature is supported by all the above BPM tools.

- **Support Exception Handling**: Mechanisms of handling the runtime errors so that normal flow can be maintained is supported by all the above BPM tools except of Process Maker BPM. Camunda BPM handles these errors depending on their type (technical malfunctions, business errors) and raises them as Java exceptions by including five different methods for handling. A usual handling method is to throw the exceptions to the client (e.x. an error dialog which states the cause of problem appears on user's frontend).

III. Deployment Criteria

- **Support for distributed execution**: Clustering is offered by all the above BPM tools as the supported method for distributed execution. By this way, the process engine can be distributed to different nodes in a cluster (each one connected to a shared database) leading to scale-up or fail-over capabilities. It is worth mentioning that Process Maker BPM and YAWL do not support this feature.

- **Supported Server OS**: Microsoft Windows and Linux operating systems are supported by all the above BPM tools.

- **Support for integration with other systems and services**: REST API, Java API and Web Services are the most common methods offered by the above BPM tools for integration with other systems and services.

IV. Execution & Operation Criteria

- **Version management of BP models**: This feature is supported by all the above BPM tools. It is worth mentioning that Camunda BPM only supports this in its enterprise edition.

- **Support for informing users**: This feature is supported by all the above BPM tools. It is worth mentioning that Process Maker BPM and Bonita OS only support this in their enterprise edition.

- **Document management**: This feature refers to case files which incorporate documents processed by a Document Management System. It is supported by all the above BPM tools except of Camunda BPM.

- **Support for calendar management**: This feature refers to the use of Business Calendars so as to make date calculations (e.x. next available date) per task. It is supported by all the above BPM tools except of Activiti BPM.

V. Monitoring & Control Criteria

- **Support for technical monitoring & control**: This feature refers to monitoring of system's technical aspects (e.x. system's response time, system's load, server's issues, connection problems). The aspect of control concerns the execution logged data so as to gather information about KPIs. It is only supported by Process Maker BPM and Bonita OS.

- **Change the role of a resource for an activity**: This feature refers to the management of authorizations for each human resource (user/group) on a task. It is supported by all the above BPM tools.

- **Support for informing users in case of failures**: This feature is supported by all the above BPM tools except of Process Maker which does not support it and YAWL for which no any data found.

- **Support for Business Activity Monitoring (BAM)**: This feature refers to the monitoring of business operations (e.x. monitoring log files, calculating KPIs, requesting information about the running process instances) so as to identify successes (e.x. milestone dates) or problems (e.x. process bottlenecks). It is supported by all the above BPM tools except of Activiti BPM. It is worth mentioning that Bonita OS only supports this feature in its enterprise edition. In addition, YAWL supports partially this feature.

- **Support for changing business rules**: This feature refers to the dynamic (without the need for deploying a new instance in software's engine) update of formulated constraints based on organization's descriptions and facts. It is not fully supported in any community edition of the above BPM tools. Process Maker BPM and Camunda BPM support this in their enterprise edition and YAWL partially supports it. Especially for Camunda BPM, business rules can be encapsulated (and being automated) in a DMN model which is bound to a Business Rule task of the BPMN model.

- **Support for changing the workload balance**: This feature refers to the capability of reassigning tasks or shift/defer users' responsibilities in case of their overload. It is supported by all the above BPM tools. It is worth mentioning that Bonita OS only supports this in its enterprise edition. No data found for JBoss jBPM. Especially for Camunda BPM, two patterns of task assignment are supported. The simplest one (based on "Pull" technique) which allows the user to claim for a task in a common Group. And the more sophisticated one (based on "Push" technique) in which specific tasks are allocated (by the system) to specific users based on their authorizations.

- **Support dashboards and reports**: This feature is supported by all the above BPM tools except of YAWL. It is worth mentioning that Bonita OS only supports this in its enterprise edition and that Activiti BPM only supports the reports.

VI. <u>Analysis Criteria</u>

- **Support for process verification**: This feature refers to ways that ensure the proper execution of the process (e.x. inspection of process's data is done in databases and "Cockpit" webapp in the case of Camunda BPM). It is supported by all the above BPM tools. It is worth mentioning that Process Maker BPM does not support it in its community edition.

- **Support for process simulation**: This feature is supported by half of the above BPM tools and more specifically by Activiti BPM, JBoss jBPM and YAWL.

- **Support for recording historical process execution data**: This feature is supported by all the above BPM tools. It is worth mentioning that Process Maker BPM and Bonita OS only support this in their enterprise edition. Log files and database are used for the recording of historical process execution data in almost all of these tools.

- **Support for Business Intelligence and Process Mining tools**: This feature is supported by all the above BPM tools. It is worth mentioning that Process Maker BPM, Camunda BPM and Bonita OS only support this in their enterprise edition.

VII. <u>Other Criteria</u>

- **Users Training**: Users training can be provided by all of the above BPM tool companies.

- **Latest Release**: All of the above BPM tools have released their last update version during current year (2020) except of Activiti BPM which has released its last version during previous year (2019). The majority of these tools are updated every six months.

- **Fully open-source**: Half of the above BPM tools are fully open-source and more specifically the Activiti BPM, the JBoss jBPM and YAWL.

- **Founded year**: All of the above BPM tools have been founded during the last 20 years. Process Maker BPM is considered the oldest one as it has been founded on 2000 and JBoss jBPM the newest one as it has been founded on 2014.

- **Ease of installation**: Half of the above BPM tools are considered to have an easy way of installation and the rest of tools a difficult one. More specifically, Process Maker BPM, Bonita OS and YAWL are considered easy in their installation and the rest are considered a bit difficult.

- **Installation prerequisites**: Java environment (JRE or JDK) is required in almost all of the above BPM tools except of Process Maker which has no specific requirements.

- **Execution Engine**: All of the above BPM tools feature an execution engine for the technical execution of the designed models.

- **E-mail**: The ability to send emails is supported by all of the above BPM tools. It is worth mentioning that Process Maker only supports this capability in its enterprise edition. No data found for JBoss jBPM.

- **Web-based**: All of the above BPM tools are offered through the browser.

- **Digital signature**: Digital signature is only offered by YAWL. Process Maker partially supports this capability. No data found for Activiti BPM and JBoss jBPM.

- **Secure Sockets Layer (SSL)**: SSL is only supported by Bonita OS. No data found for Activiti BPM and JBoss jBPM.

3.3 Camunda BPM: Selection Criteria for T.U.C.'s Use Case

Having completed with the market research on each official site of every of the above BPM tools, we had to come up with our final suggestion for the use case of T.U.C.

Based on the above aggregated table by recording the supported (by each BPM tool) features of Business Process Management Lifecycle, Camunda BPM was our suggested choice.

The criteria that affected our decision were the following ones:

- **General Criteria**
  - Frequent update and release of Camunda BPM product (every 6 months).
  - Product's installation prerequisites are lightweight (180 MB usage of computer's disk).
  - Web-based console (access from any device connected to Web).
  - Rich documentation in product's official site and public Forum where software's team and community's users answer all kinds of questions.
- **Modeling Criteria**
  - BPMN 2.0 standard is supported and what is more, all of its elements were found in our use case's process diagram since Camunda Modeler is said to include all BPMN 2.0 elements.
- **Design Criteria**
  - Users and Groups Management and more specifically the assignment of roles and authorizations (such as access rights) can be done very quickly and easily through Camunda Admin webapp.
- **Execution & Operation Criteria**
  - Camunda BPM can be well integrated with other systems and services.
  - Camunda BPM provides the ability of automated tasks and services (such as the notification of users and groups).
- **Monitoring & Control Criteria**
  - Business Process flow and user's activities are displayed through a basic and simple Dashboard inside Camunda Cockpit webapp.

4 PROCUREMENT PROCESS REENGINEERING

4.1 Software Architecture

As said above, the chosen BPM software for this thesis is Camunda BPM. Camunda BPM is a Java-based framework. It is developed in Java and its scope is focused on designing, implementing and running business processes and workflows on a JVM. This software also provides a REST API architecture so as to allow technical users to create applications that can connected to a remote process execution machine. Camunda BPM can be used either as a standalone application or embedded in Java applications.

The architecture of main components of Camunda BPM is briefly described below:

- **Process Engine Architecture**

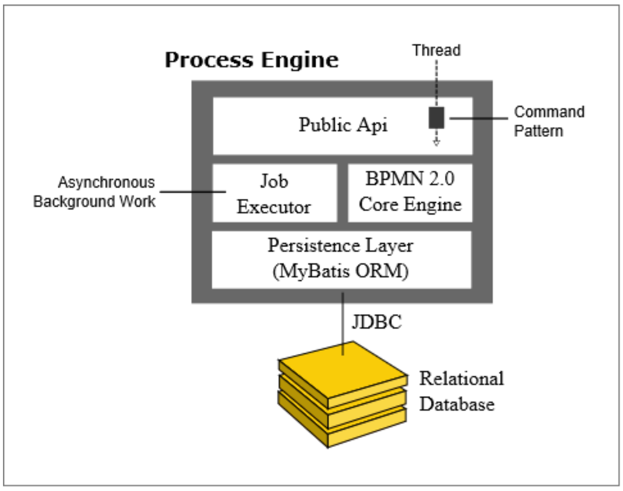


Figure 10 - Camunda's Process Engine Architecture (Camunda Documentation)

The process engine consists of the following components:

- **Process Engine Public API**

  It allows the interaction between Java applications and process engine based on its service-oriented API. Process engine delegates its different responsibilities to individual services. The public API features a command-style access pattern. A command interceptor, used for setting up thread context, routes the threads which enter the process engine.

- **BPMN 2.0 Core Engine**

  This is the core of the process engine. It comprises an execution engine for graph structures (PVM - Process Virtual Machine), a BPMN 2.0 parser which transforms BPMN 2.0 XML files into Java objects and a set of BPMN Behavior implementations (providing the implementation for elements like gateways or service tasks).

- **Job Executor**

  The Job Executor processes asynchronous background work such as timers or asynchronous continuations in a process.

- **The Persistence Layer**

  The process engine comprises a persistence layer which persists the status of the process instance to a relational database. "MyBatis" mapping engine is used for object relational mapping.

- **Camunda BPM Platform Architecture**

Camunda BPM platform is a framework which can be deployed in different ways.
A brief description of the most common deployment ways is following:

- **Embedded Process Engine**

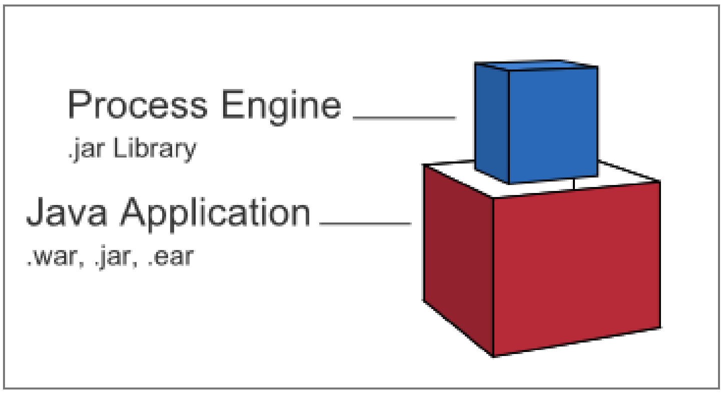


Figure 11 - Embedded Process Engine (Camunda Documentation)

The process engine is added as an application library to a Java application. This way, the process engine can easily be started and stopped with the application lifecycle. Multiple embedded process engines can run on top of a shared database.

- **Shared, Container-Managed Process Engine**

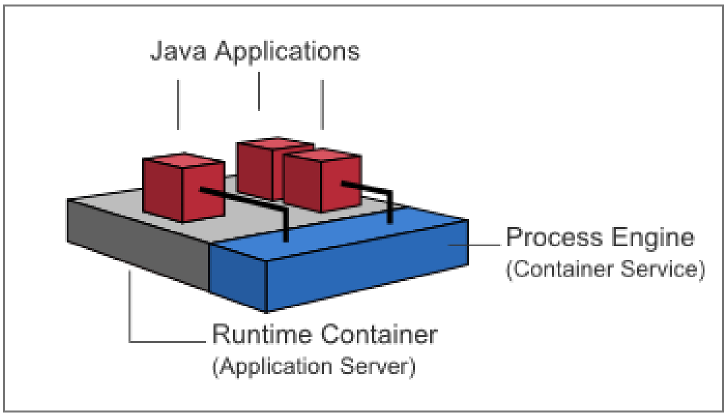


Figure 12 - Shared, Container-Managed Process Engine (Camunda Documentation)

The process engine is started inside the runtime container (e.x. application server). The process engine is provided as a container service and can be used by all applications deployed inside the container. The concept can be compared to a JMS Message Queue which is provided by the runtime and can be shared by all applications. There is a one-to-one mapping between process deployments and applications. The process definitions which are deployed by an application, are monitored by the process engine, which delegates execution to the application in question.

It must be noted that this distribution of Camunda BPM platform was chosen for our installation case.

- **Standalone (Remote) Process Engine Server**

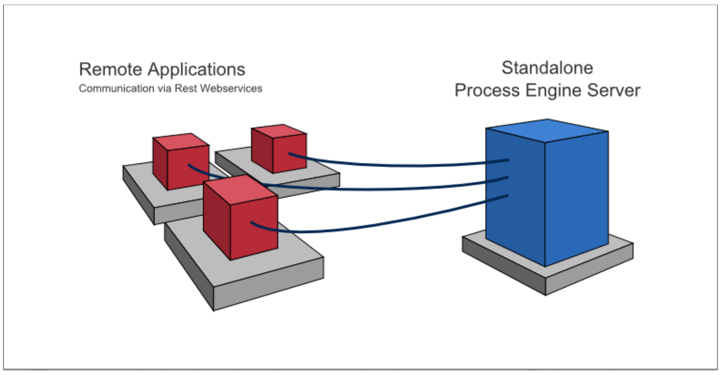


Figure 13 - Standalone (Remote) Process Engine Server (Camunda Documentation)

The process engine is provided as a network service and can interact with different applications running on the network via a remote communication channel. REST API can be used so as to make the process engine accessible remotely. Except for REST API, different communication channels can be used (like SOAP Webservices or JMS) but need to be implemented by users.

4.2 Programming

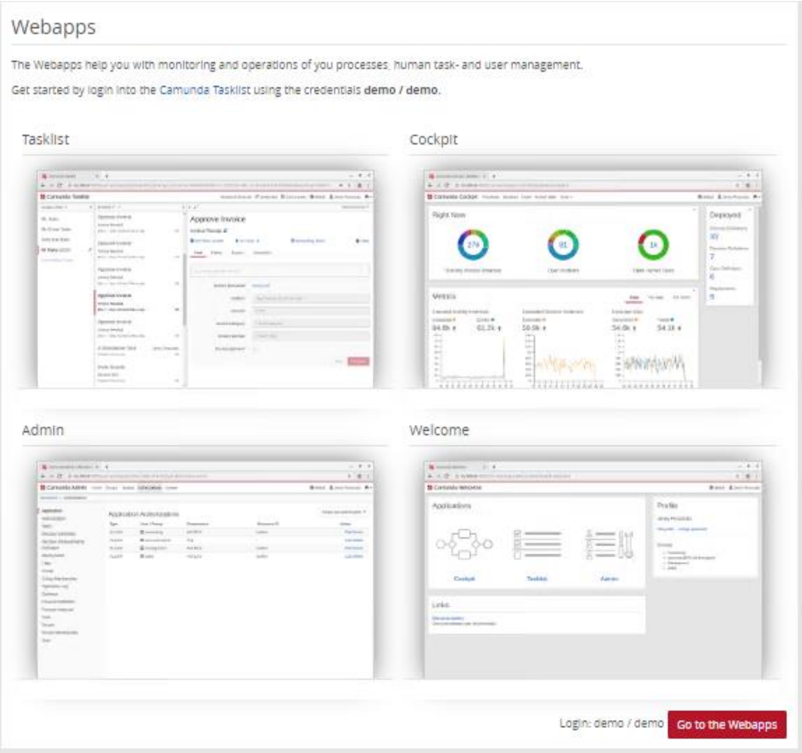
In this paragraph, the implementation of the thesis project using Camunda BPM 7.12.0 is described. For the purpose of the thesis, a system was developed, which will be extensively described and will be referred as "PM SYSTEM".

Before starting PM SYSTEM's development, it was necessary to be guided through Camunda's BPM initial steps. For this purpose, we had to examine and move based on the "Get Started with Camunda and BPMN 2.0" steps of Camunda's official site. The site provided a basic BPMN 2.0 tutorial example so as to get acquainted with software's environment and any special requirements.

Get Started steps are described below:

- **Download and Installation**

  First, we had to install a set of prerequisite tools (like Java Development Kit 1.8+) and an Eclipse IDE. After, we had to download a distribution of the Camunda BPM Platform. We had to choose from different distributions for various application servers. In our thesis project, we used the Apache Tomcat-based distribution. After having downloaded the selected distribution, we had to unzip it inside a directory folder of our choice. We named that directory folder as "triantis". Then, we executed the script file, named "start-camunda.bat" (since we used Windows O.S.) so as to start up the application server and open a welcome screen (http://localhost:8080/camunda-welcome/index.html) in our web browser as depicted in Figure 14 below.



Webapps

The Webapps help you with monitoring and operations of you processes, human task- and user management.

Get started by login into the Camunda Tasklist using the credentials **demo / demo**.

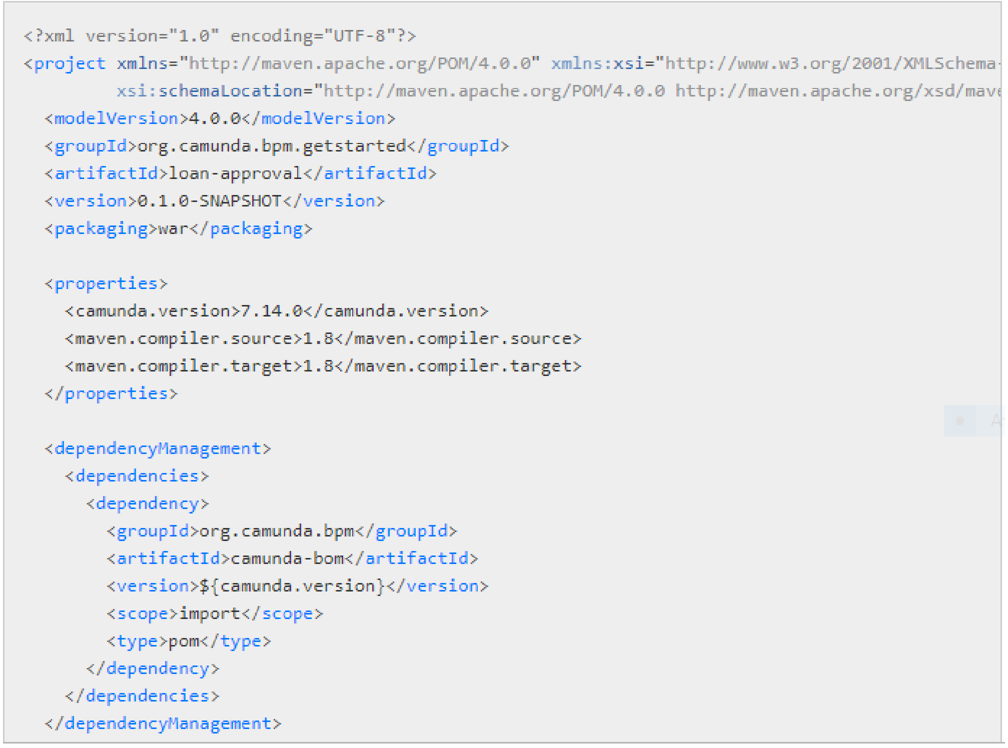
Figure 14 - The initial web page of Camunda BPM Platform

Similarly, we downloaded and installed the Camunda Modeler and unzipped it in the same directory folder ("triantis").

Once we successfully unzipped the application, we ran it via the executable "camunda-modeler.exe" file (since we used Windows O.S.).

- **<u>Project Setup</u>**

The setup of our project in the IDE of our choice (Eclipse IDE Neon 2 Package for Java EE Developers) is described here. First, we had to create a new Maven project (named "electronic_equipment_competitions") and more specifically a WAR project. Next, we had to set up the Maven dependencies for our new process application. So, we added the following dependencies (Figure 15) to the "pom.xml" file of our project and performed the first build by selecting this file in the Package Explorer, performing a right click and selecting "Run As/Maven Install".



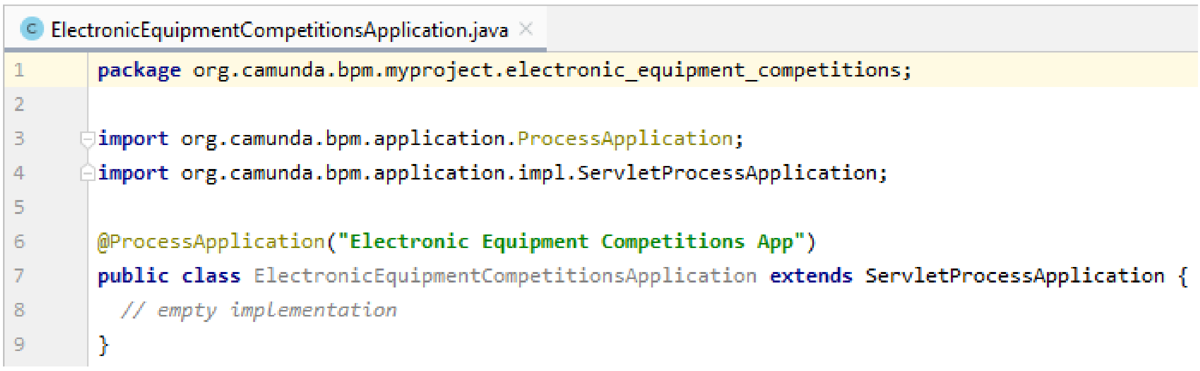
```
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-
         xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 http://maven.apache.org/xsd/mave
  <modelVersion>4.0.0</modelVersion>
  <groupId>org.camunda.bpm.getstarted</groupId>
  <artifactId>loan-approval</artifactId>
  <version>0.1.0-SNAPSHOT</version>
  <packaging>war</packaging>

  <properties>
    <camunda.version>7.14.0</camunda.version>
    <maven.compiler.source>1.8</maven.compiler.source>
    <maven.compiler.target>1.8</maven.compiler.target>
  </properties>

  <dependencyManagement>
    <dependencies>
      <dependency>
        <groupId>org.camunda.bpm</groupId>
        <artifactId>camunda-bom</artifactId>
        <version>${camunda.version}</version>
        <scope>import</scope>
        <type>pom</type>
      </dependency>
    </dependencies>
  </dependencyManagement>
```

Figure 15 - Camunda Maven Dependencies

Next, we needed to create a package “org.camunda.bpm.myproject.electronic_equipment_competitions” and add a process application Java class file (Figure 16) named “ElectronicEquipmentCompetitionsApplication” inside it. This file constitutes the interface between our application and the process engine.



ElectronicEquipmentCompetitionsApplication.java

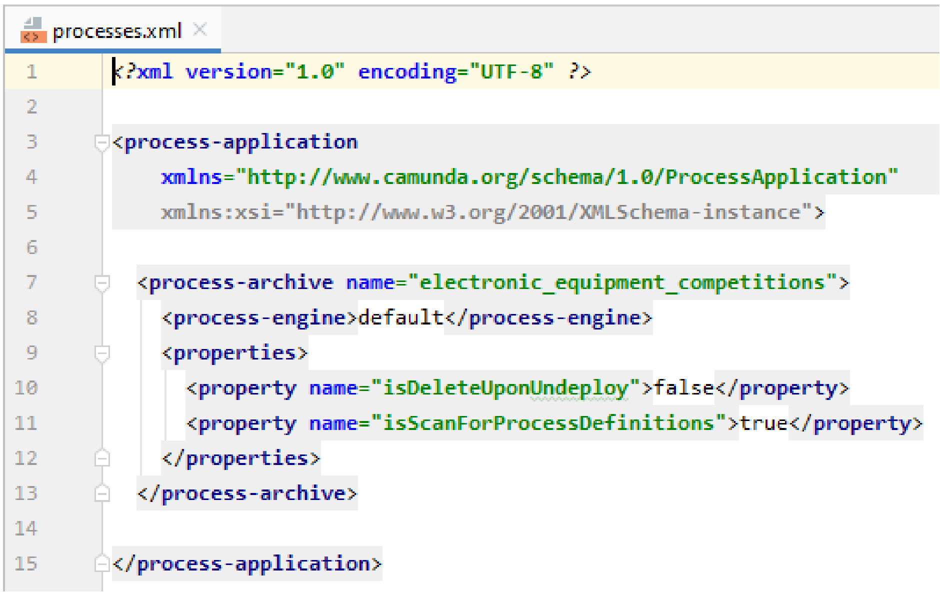
```
package org.camunda.bpm.myproject.electronic_equipment_competitions;

import org.camunda.bpm.application.ProcessApplication;
import org.camunda.bpm.application.impl.ServletProcessApplication;

@ProcessApplication("Electronic Equipment Competitions App")
public class ElectronicEquipmentCompetitionsApplication extends ServletProcessApplication {
  // empty implementation
}
```

Figure 16 - Process Application Java Class File

Last, we had to add the “META-INF/processes.xml” deployment descriptor file (Figure 17). This file allowed us to provide a declarative configuration of the deployments this process application makes to the process engine. This file had to be added to the "src/main/resources/META-INF" directory folder of our Maven project.



```xml
<?xml version="1.0" encoding="UTF-8" ?>

<process-application
    xmlns="http://www.camunda.org/schema/1.0/ProcessApplication"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">

  <process-archive name="electronic_equipment_competitions">
    <process-engine>default</process-engine>
    <properties>
      <property name="isDeleteUponUndeploy">false</property>
      <property name="isScanForProcessDefinitions">true</property>
    </properties>
  </process-archive>

</process-application>
```

Figure 17 - META-INF/processes.xml File

- <u>**Process Modeling**</u>

In the use case of electronic equipment procurement, two flow charts were designed: The Main Process which starts (with the products entry on system) and ends (with the export of the final document of orders) by the admin. And the Subprocess which is called by the Main one. The rest of users are involved here and they select their desired products from admin's pre-configured list.

As stated above, Camunda BPM comes with a modeling tool (Camunda Modeler) for designing BPMN 2.0 workflows. Apart from visual modeling, this tool allows users to edit all properties necessary for technical execution of the model.

The whole process is depicted and described below:

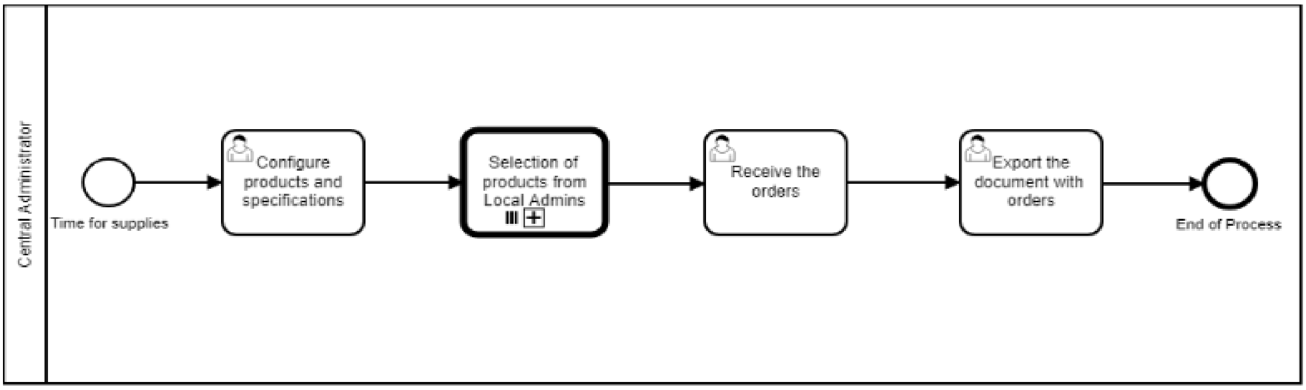

Central Administrator
Time for supplies
Configure products and specifications
Selection of products from Local Admins
Receive the orders
Export the document with orders
End of Process

Figure 18 - Main Process of Electronic Equipment Competition

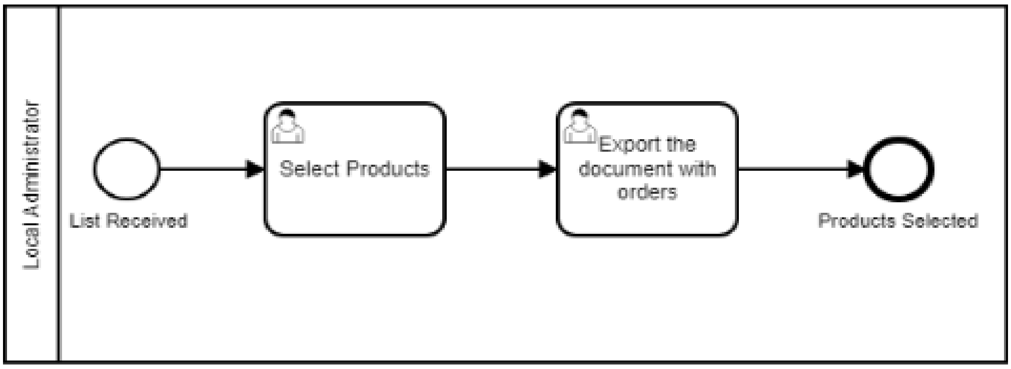
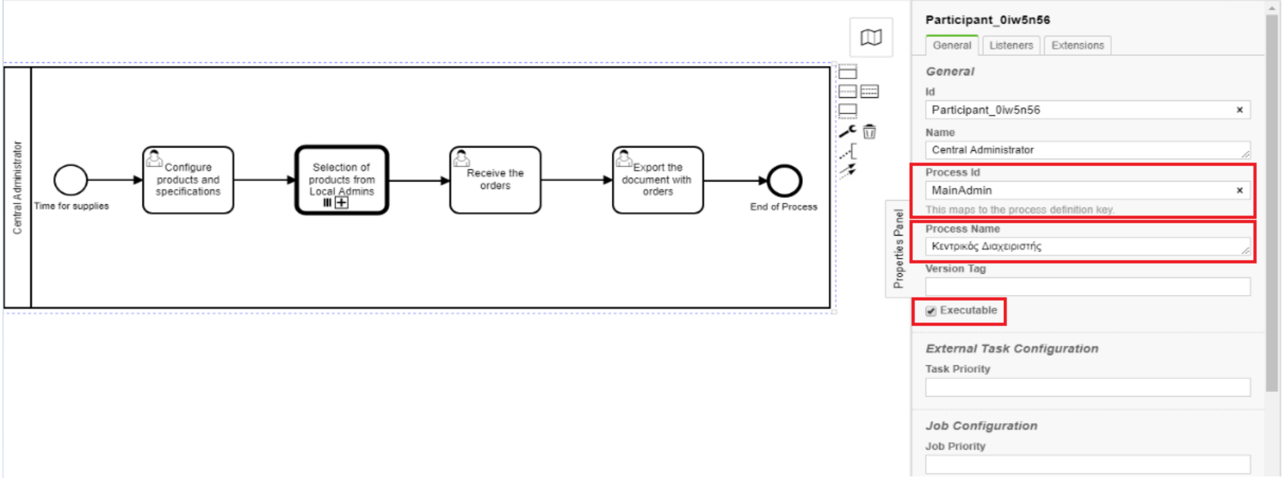


Figure 19 - Subprocess of Electronic Equipment Competition

The Main Process (Figure 18) starts with a Start Event ("Time for supplies") represented by a circle. It is up to admin when to start a new process instance. It is followed by a User Task ("Configure products and specifications") represented by a rounded rectangle and is executed by the admin. In this task, the admin adds the products (with their respective specifications) to an items list. Once this list is filled-in and the task form is successfully submitted, the process execution arrives at a parallel multi-instance Call Activity ("Selection of products from Local Admins") represented by a rounded rectangle with a thick border. Then, this element automatically calls the Subprocess of the Electronic Equipment Competition (Figure 19) and at the same time, a number of local instances for the User Task ("Select Products") are created, who are also the assignee users. It must be noted that this User Task is executed on parallel by the assignee users. From now on, the Main Process waits until the Subprocess is completely ended and continues afterwards. At this stage of the process, assignee users for the orders have to select a number of products (with their specifications) from the preconfigured admin's list, based on the budget and the needs of their Faculty/Directorate. During their selections, the system automatically checks "on-the-fly" the available balance of their orders. Once their order's cost is covered by their budget and the task form is successfully completed, each user moves on the next task form ("Export the document with orders") where the possibility of a pdf file export (with the submitted choices) is provided. Once all local instances of the Subprocess have been successfully completed, the Main Process continues. Then, admin receives and views in the User Task form ("Receive the orders") the aggregated list of the users' orders and moves on the last step of the process by exporting this list in a form of a pdf document ("Export the document with orders"). The whole process is completed with an End Event ("End of Process") represented by a thick circle.

Since we have modelled two executable flow charts, we had to configure some property fields like the "ID" (used by the process engine as identifier for the executable flow chart), the "Name" and set the "isExecutable" property to "true" (because otherwise the process definition is ignored by the process engine) as depicted in Figures 20 and 21 below.

On the right-hand side of the modelling canvas, we view the Properties Panel for each of the described flow charts respectively. It must be noted that the two bpmn files were saved in the "src/main/resources" folder of the Eclipse workspace path in the electronic_equipment_competitions application project.



Participant_0iw5n56

General

Id: Participant_0iw5n56

Name: Central Administrator

Process Id: MainAdmin

This maps to the process definition key.

Process Name: Κεντρικός Διαχειριστής

Version Tag:

☑ Executable

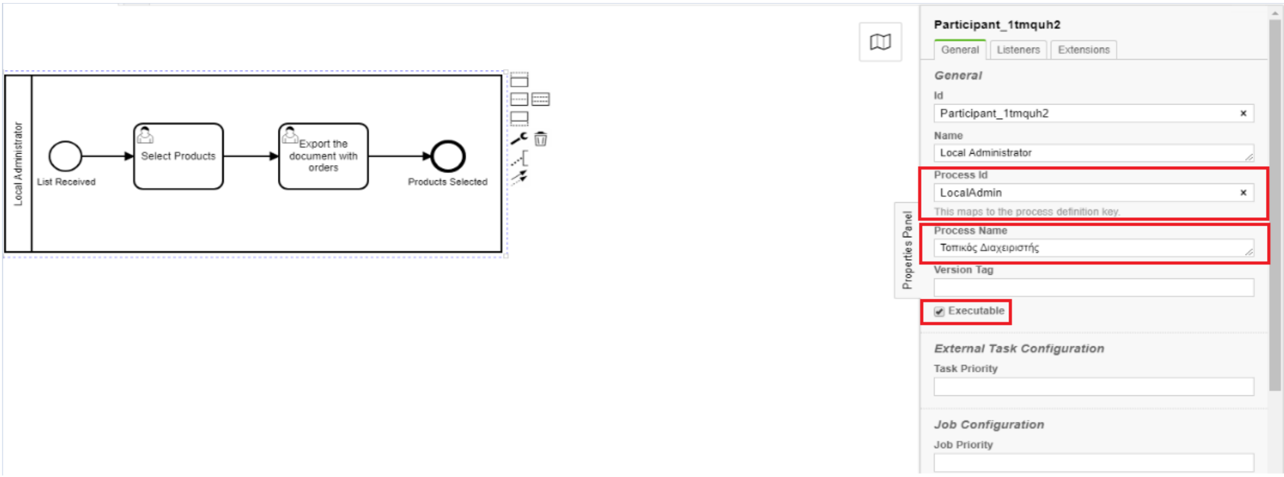
External Task Configuration

Task Priority:

Job Configuration

Job Priority:

Figure 20 - Properties Panel View of Main Process



Participant_1tmquh2

General

Id: Participant_1tmquh2

Name: Local Administrator

Process Id: LocalAdmin

This maps to the process definition key.

Process Name: Τοπικός Διαχειριστής

Version Tag:

☑ Executable

External Task Configuration

Task Priority:

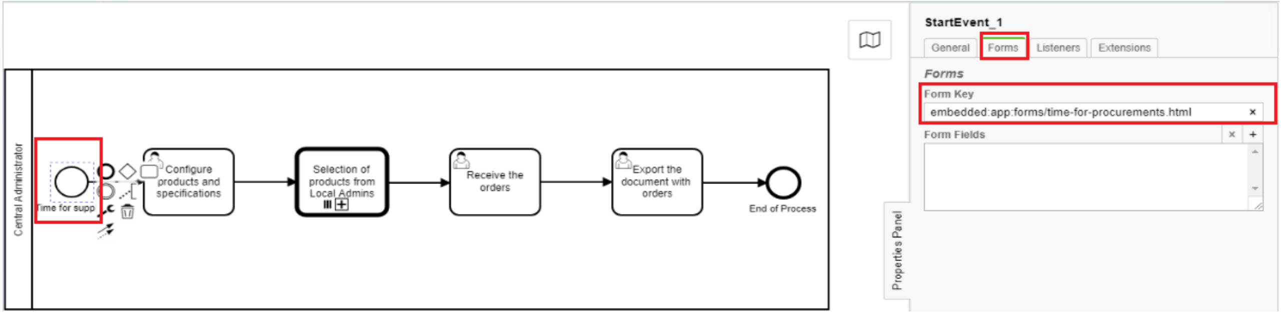
Job Configuration

Job Priority:

Figure 21 - Properties Panel View of Subprocess

- **HTML Forms**

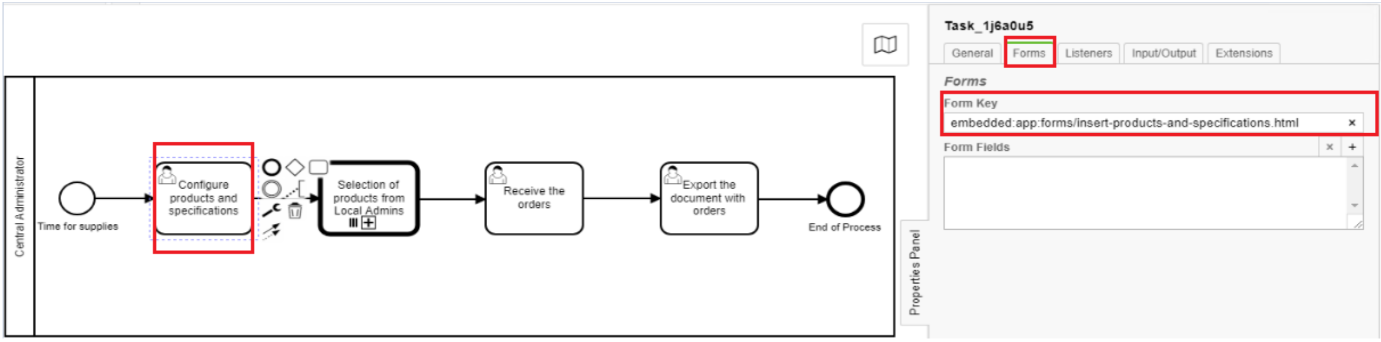
Visual modeling is followed by the technical execution of the two above BPMN 2.0 workflow diagrams. Since the Camunda Modeler works directly on the BPMN 2.0 XML files, it could be combined with our installed Eclipse IDE. So, the created (in Camunda Modeler) BPMN 2.0 XML files were deployed to the Camunda Platform and executed by its BPMN engine. The main issue here was that we had to give the corresponding functionality to the designed BPMN 2.0 elements so as to display the relevant content and make interactive the users task forms in Tasklist. This was done by connecting form's resources (in Eclipse IDE) with the respective BPMN 2.0 element from the designed process diagram. PM SYSTEM's forms are called by the Start Event and the User Tasks. From the four supported (by Camunda) different kinds of task forms, the "embedded" ones were developed for the needs of our system. "Embedded" task forms are HTML5 and JavaScript forms which are displayed directly within Tasklist. To create and add these forms to our system, we had to create one HTML file (for each task form respectively) and refer to this file from the respective BPMN 2.0 element in our process models (Start Event or User Task). This was done by adding the file in the "src/main/webapp/forms" directory folder of our development project in Eclipse IDE. Each HTML file was packaged into our deployment artifact (which is a WAR archive). So, during runtime, each form's file is loaded from there (the application). Form's configuration in our process is done by opening the process diagram with the Camunda Modeler and selecting the desired BPMN 2.0 element (Start Event or User Task). On the right-hand side of the diagram (in Properties Panel) and more specifically in "Forms" tab, the "Form Key" property field has the html file's reference (i.e. embedded:app:forms/FORM_NAME.html) as a value (see Figures 22 and 23 below).



Forms

Form Key: embedded:app:forms/time-for-procurements.html

Figure 22 - HTML file's reference in Camunda Modeler for a Start Form



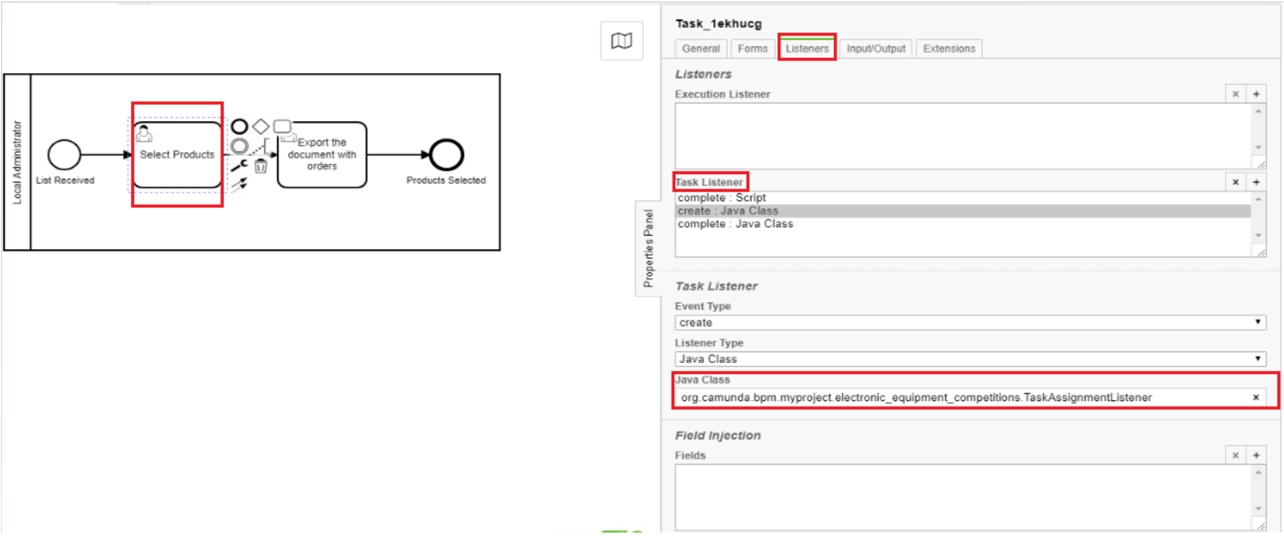
Forms

Form Key: embedded:app:forms/insert-products-and-specifications.html

Figure 23 - HTML file's reference in Camunda Modeler for a Task Form

- **Automated actions**

Some actions in the running of the above two workflow diagrams were needed to be automatically executed. Those actions mainly concerned the notifications of users via email from PM SYSTEM and the generation of pdf documents with their orders. To make PM SYSTEM execute those actions in an automatic way, it was necessary to invoke some Java class files from the respective BPMN 2.0 elements of our diagrams. In other words, we had to execute external Java code when those events occurred during process execution. To do so, we had to create and add these Java class files into the package "org.camunda.bpm.myproject.electronic_equipment_competitions" of our Eclipse project. As previously mentioned for the HTML forms, it was needed to connect the designed (in Camunda Modeler) process diagrams with the IDE and the Java code written there. So, we had to configure and reference each class file in the Properties Panel View of our process. To do so, we had to provide the fully qualified name of each class in the "Java class" property field of a Task Listener (see Figures 24 and 25 below).



Task_1ekhucg

Listeners

Execution Listener

Task Listener
complete : Script
create : Java Class
complete : Java Class

Task Listener

Event Type: create

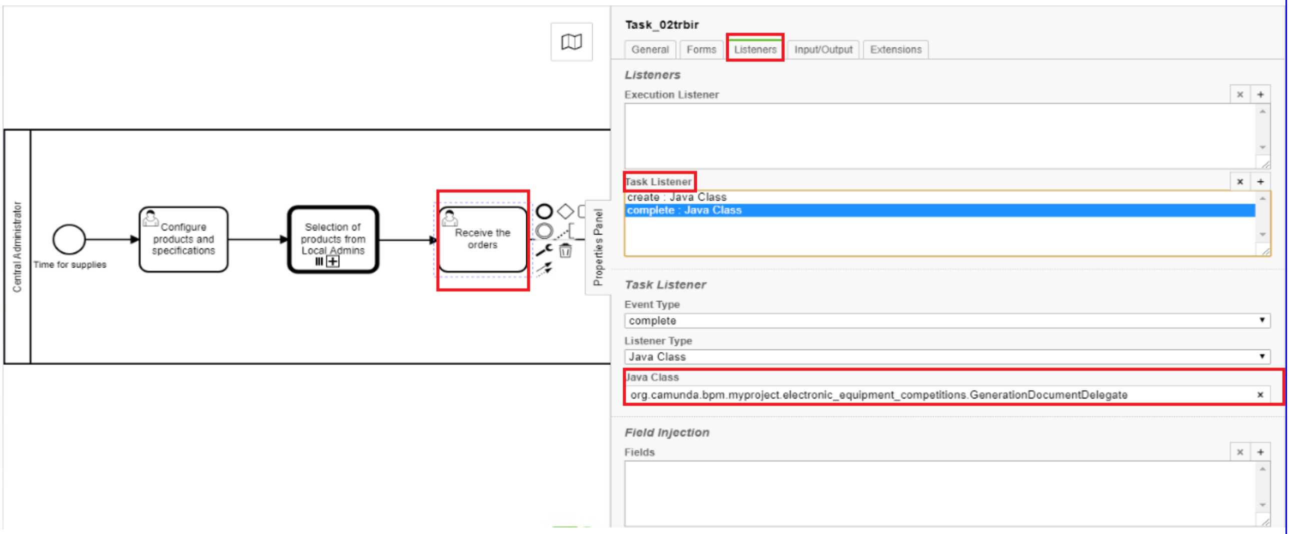
Listener Type: Java Class

Java Class: org.camunda.bpm.myproject.electronic_equipment_competitions.TaskAssignmentListener

Field Injection

Fields

Figure 24 - Java Class file's reference in Camunda Modeler for the assignment of a Task



Task_02trbir

Listeners

Execution Listener

Task Listener
create : Java Class
complete : Java Class

Task Listener

Event Type: complete

Listener Type: Java Class

Java Class: org.camunda.bpm.myproject.electronic_equipment_competitions.GenerationDocumentDelegate

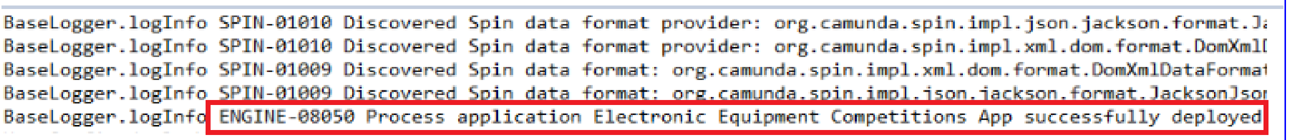
Field Injection

Fields

Figure 25 - Java Class file's reference in Camunda Modeler for the generation of a document

- **Process Deployment**

This step consists of building, deploying and testing our Maven project in the application server (Tomcat) of our installed Camunda BPM distribution. First, we had to build the web application with Maven. To do so, we had to select the "pom.xml" file in the Package Explorer of Eclipse IDE, perform a right click and select "Run as/Maven Install". By this way, a WAR file named "electronic_equipment_competitions-0.1.0-SNAPSHOT.war" was generated in the "target" folder of our Maven project. Since our two bpmn files were saved in the "src/main/resources" directory folder, they were also included there. Next, we had to deploy our process application to Apache Tomcat server so as to run there all the resource files. To do so, we had to copy and paste the "electronic_equipment_competitions-0.1.0-SNAPSHOT" folder (including all the resource files) and its respective war file (as previously mentioned) from our Maven project to the directory folder of Camunda's web applications (triantis/ camunda-bpm-tomcat-7.12.0/server/apache-tomcat-9.0.24/webapps). To make sure that the deployment of our process application was successful, we had to check inside the directory folder of the Apache Tomcat server (triantis/camunda-bpm-tomcat-7.12.0/server/apache-tomcat-9.0.24/logs) and more specifically the most recent from catalina.yy-mm-dd.log files. Scrolling down to the end of this file, we could see the relative log message for the successful deployment (see Figure 26 below).

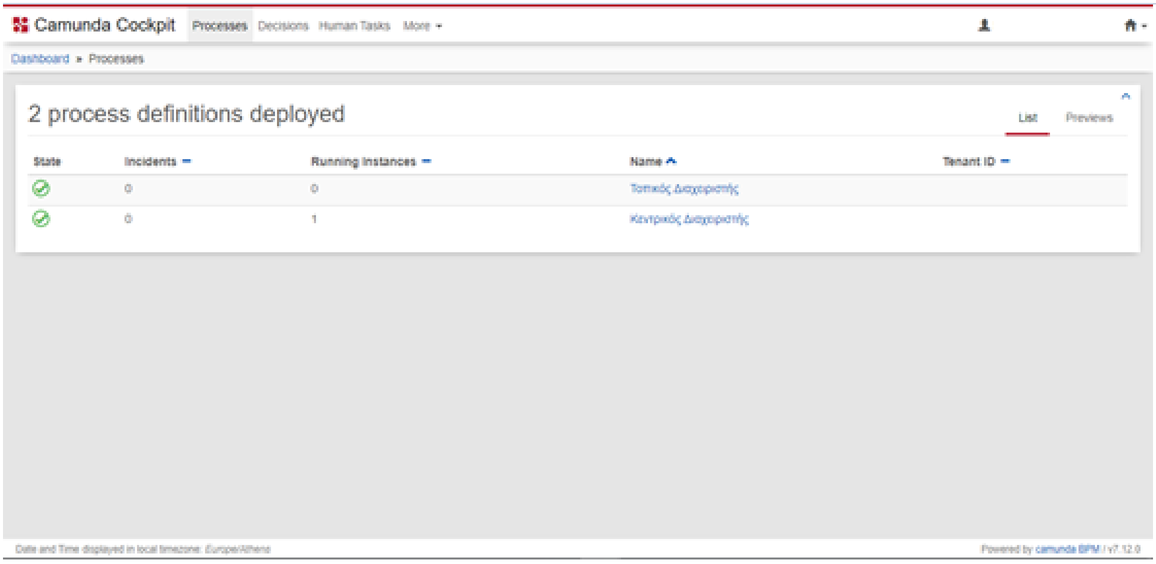


```
BaseLogger.logInfo SPIN-01010 Discovered Spin data format provider: org.camunda.spin.impl.json.jackson.format.J
BaseLogger.logInfo SPIN-01010 Discovered Spin data format provider: org.camunda.spin.impl.xml.dom.format.DomXml
BaseLogger.logInfo SPIN-01009 Discovered Spin data format: org.camunda.spin.impl.xml.dom.format.DomXmlDataForma
BaseLogger.logInfo SPIN-01009 Discovered Spin data format: org.camunda.spin.impl.json.jackson.format.JacksonJso
BaseLogger.logInfo ENGINE-08050 Process application Electronic Equipment Competitions App successfully deployed
```

Figure 26 - Tomcat's server log message for the successful deployment of our process application

- **Process Display and Running in Camunda BPM Platform**

Apart from server's log files, we also had to verify in software's environment that our processes were successfully deployed. This had to be done in Camunda Cockpit when we logged into the application. Our two process definitions were visible on the Main Dashboard of Cockpit (http://localhost:8080/camunda/app/cockpit) as we can see in Figure 27 below.



2 process definitions deployed

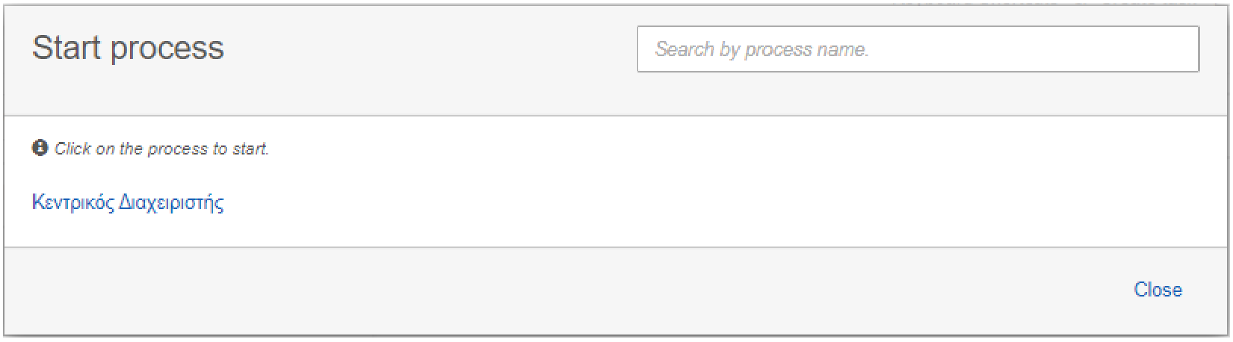
State	Incidents	Running Instances	Name	Tenant ID
✓	0	0	Τοπικός Διαχειριστής	
✓	0	1	Κεντρικός Διαχειριστής	

Date and Time displayed in local timezone: *Europe/Athens*

Powered by camunda BPM / v7.12.0

Figure 27 - Camunda's Cockpit Main Dashboard screen

To run the deployed form resources of our processes, we had to move on Camunda Tasklist (http://localhost:8080/camunda/app/tasklist) and start a new process instance. This opened a dialog where we had to click on our Main Process («Κεντρικός Διαχειριστής») to start (see Figure 28 below).

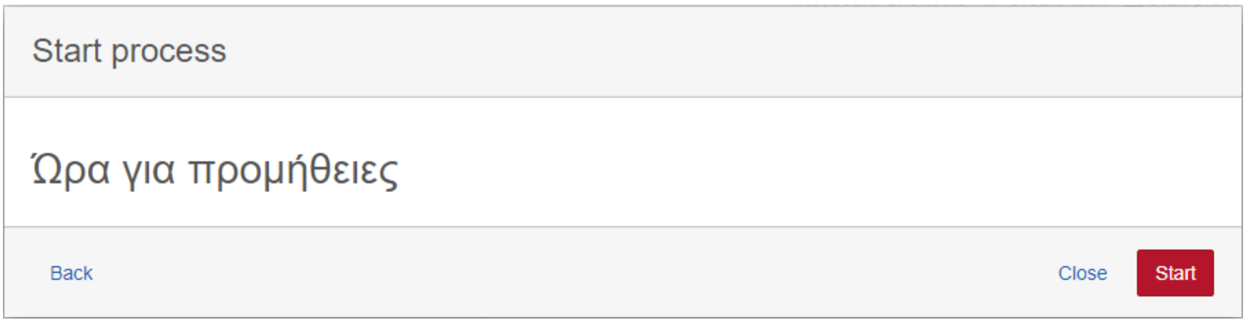


Click on the process to start.

Κεντρικός Διαχειριστής

Figure 28 - Start a new process instance in Camunda Tasklist

Since we had added a dedicated form for the Start Event ("Time for supplies"), we saw the following message on our screen as depicted in Figure 29 below:

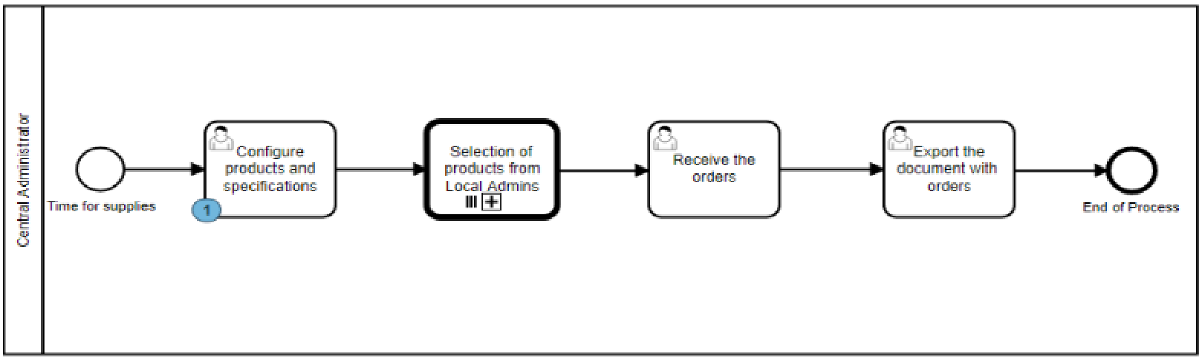


Start process

Ώρα για προμήθειες

Figure 29 - Start Event message on Tasklist's screen

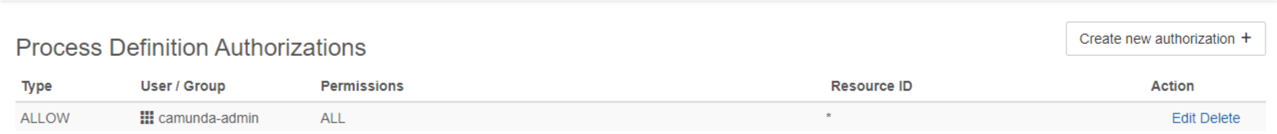
Going back to Camunda Cockpit, we could see the newly created process instance that was waiting in the first User Task "Configure products and specifications" (see Figure 30 below).



Central Administrator
Time for supplies
1
Configure products and specifications
Selection of products from Local Admins
Receive the orders
Export the document with orders
End of Process

Figure 30 - Main Process's start up

Since the respective user or group (i.e. admin in this case) was granted [via Camunda Admin (http://localhost:8080/camunda/app/admin/default/#/authorization?resource=6)] all permissions on the deployed process definition «Κεντρικός Διαχειριστής» (see Figure 31 below), he was able to work on his first task ("Configure products and specifications").

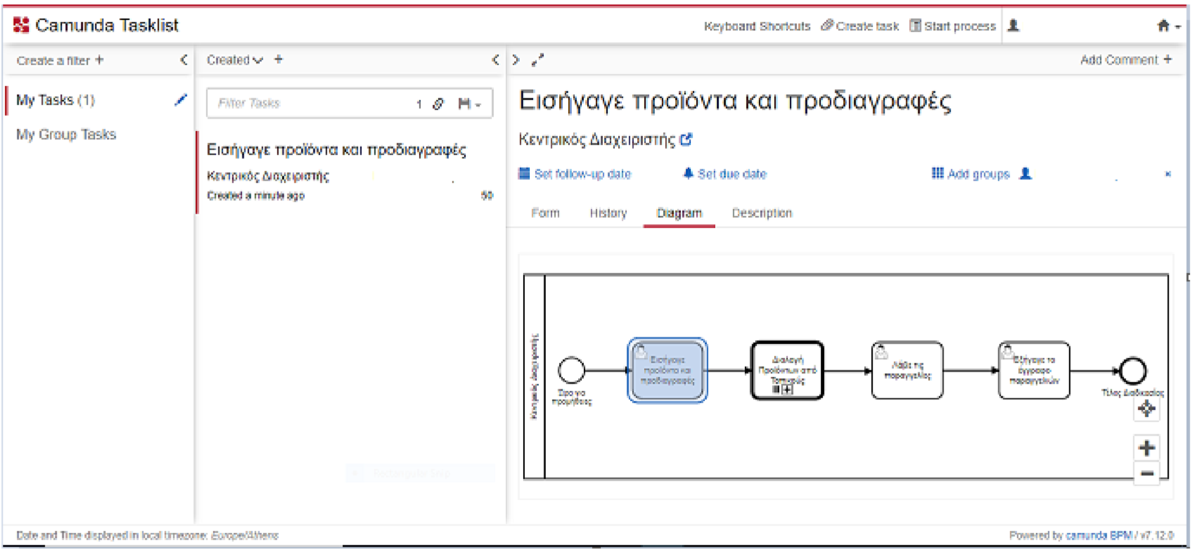


Process Definition Authorizations

Type	User / Group	Permissions	Resource ID	Action
ALLOW	camunda-admin	ALL	*	Edit Delete

Figure 31 - Process Definition Authorizations in Camunda Admin

To do so, he had to move on Tasklist, select his task on the left-hand side and click on the "Diagram" tab. This displayed the process diagram highlighting the respective task waiting for him to work on it (see Figure 32 below).



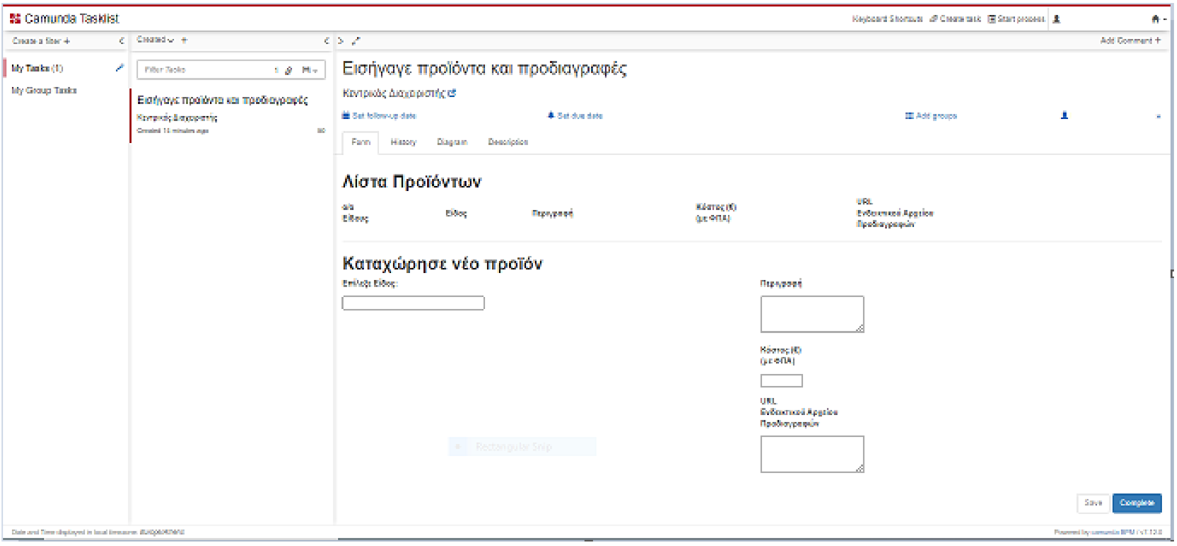
Εισήγαγε προϊόντα και προδιαγραφές

Κεντρικός Διαχειριστής

Created a minute ago

Figure 32 - Display of the first task form in Camunda Tasklist

To work on his task, the user had to select the "Form" tab (see Figure 33 below).



Εισήγαγε προϊόντα και προδιαγραφές

Κεντρικός Διαχειριστής

Λίστα Προϊόντων

α/α Είδους	Είδος	Περιγραφή	Κόστος (€) (με ΦΠΑ)	URL Ενδεικτικού Αρχείου Προδιαγραφών

Καταχώρησε νέο προϊόν

Επιλέξτε Είδος:

Περιγραφή

Κόστος (€) (με ΦΠΑ)

URL Ενδεικτικού Αρχείου Προδιαγραφών

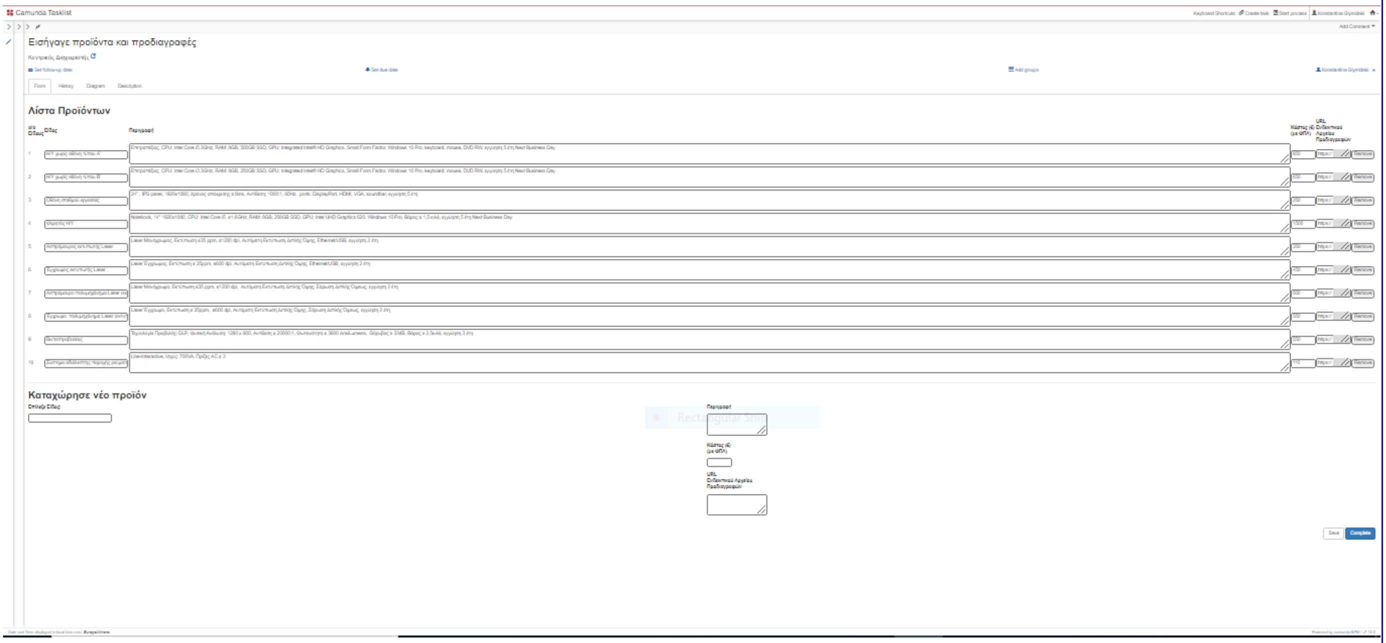
Figure 33 - Working on the first task form in Camunda Tasklist

5 PILOT EVALUATION IN T.U.C.

5.1 Process's Details: Users, Groups, Roles, Time Period

The completion of PM SYSTEM's development in Camunda BPM Platform was followed by its trial use for the purpose of the evaluation by various members of Technical University of Crete. The pilot test was conducted in collaboration with the Directorate of Telecommunications, Networks & Computer Infrastructure and more specifically with the Department of Administrative Computing Infrastructure where the person in charge of the procurements was given the role of the admin. It was initially agreed that 17 members of the university's community would take part as pilot users via the PM SYSTEM for the procurement process. From them, 14 users participated in the pilot process eventually. The groups were two: The systemic one (default by the system), where the admin was the unique member. And the custom one (created by us), where the rest of users (including admin also, who had dual role in this process) were registered. So, process's roles were two: Central admin and Local admin. The pilot test took place in the university between July 9th 2020 and July 29th 2020 (i.e. 20 days). Users with the role of "Local Admin" had an initial deadline for their task ("Select Products") until July 14th 2020. Nevertheless, they had the ability of logging in the system, making their choices and submitting their task forms after this deadline. As far as the meetings with people in charge of the procurements is concerned, the first one took place on January 16th 2020 for the purpose of presenting the initial development of PM SYSTEM and discussing any possible system's modifications or improvements. In addition, two user manuals were written and given for the purpose of system's better understanding. One with the whole setup (from the beginning) which targeted admin's needs and another one with the specific details regarding making and exporting Local Admin's orders. A general description of the pilot process's execution is following below:

First, the central admin entered the 10 recorded (in advance) products for the competition by filling in the list in the first task form "Configure products and specifications" (see Figure 34 below).



Εισήγαγε προϊόντα και προδιαγραφές

Κεντρικός Διαχειριστής

Λίστα Προϊόντων

α/α Είδους	Είδος	Περιγραφή	Κόστος (€) (με ΦΠΑ)	URL Ενδεικτικού Αρχείου Προδιαγραφών
1	ΗΥ χωρίς οθόνη τύπου Α'	Επιτραπέζιος, CPU: Intel Core i5 3GHz, RAM: 8GB, 500GB SSD, GPU: Integrated Intel® HD Graphics, Small Form Factor, Windows 10 Pro, keyboard, mouse, DVD RW, εγγύηση 5 έτη Next Business Day	650	https://
2	ΗΥ χωρίς οθόνη τύπου Β'	Επιτραπέζιος, CPU: Intel Core i3 3GHz, RAM: 8GB, 250GB SSD, GPU: Integrated Intel® HD Graphics, Small Form Factor, Windows 10 Pro, keyboard, mouse, DVD RW, εγγύηση 5 έτη Next Business Day	650	https://
3	Οθόνη σταθμού εργασίας	24" , IPS panel, 1920x1080, Χρόνος απόκρισης ≤ 8ms, Αντίθεση: 1000:1, 60Hz, ports: DisplayPort, HDMI, VGA, soundbar, εγγύηση 5 έτη	250	https://
4	Φορητός ΗΥ	Notebook, 14" 1920x1080, CPU: Intel Core i5 ≥1.6GHz, RAM: 8GB, 250GB SSD, GPU: Intel UHD Graphics 620, Windows 10 Pro, Βάρος ≤ 1,5 κιλά, εγγύηση 5 έτη Next Business Day	1500	https://
5	Ασπρόμαυρος εκτυπωτής Laser	Laser Μονόχρωμος, Εκτύπωση ≥35 ppm, ≥1200 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Ethernet/USB, εγγύηση 2 έτη	350	https://
6	Έγχρωμος εκτυπωτής Laser	Laser Έγχρωμος, Εκτύπωση ≥ 25ppm, ≥600 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Ethernet/USB, εγγύηση 2 έτη	450	https://
7	Ασπρόμαυρο πολυμηχάνημα Laser (εκ	Laser Μονόχρωμο, Εκτύπωση ≥35 ppm, ≥1200 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Σάρωση Διπλής Όψεως, εγγύηση 2 έτη	500	https://
8	Έγχρωμο πολυμηχάνημα Laser (εκτυ	Laser Έγχρωμο, Εκτύπωση ≥ 25ppm, ≥600 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Σάρωση Διπλής Όψεως, εγγύηση 2 έτη	550	https://
9	Βιντεοπροβολέας	Τεχνολογία Προβολής: DLP, Φυσική Ανάλυση: 1280 x 800, Αντίθεση ≥ 20000:1, Φωτεινότητα ≥ 3000 AnsiLumens, Θόρυβος ≤ 33dB, Βάρος ≤ 2,5κιλά, εγγύηση 3 έτη	550	https://
10	Σύστημα αδιάλειπτης παροχής ρευμ	Line-Interactive, Ισχύς: 700VA, Πρίζες AC ≥ 3	110	https://

Καταχώρησε νέο προϊόν

Επίλεξε Είδος

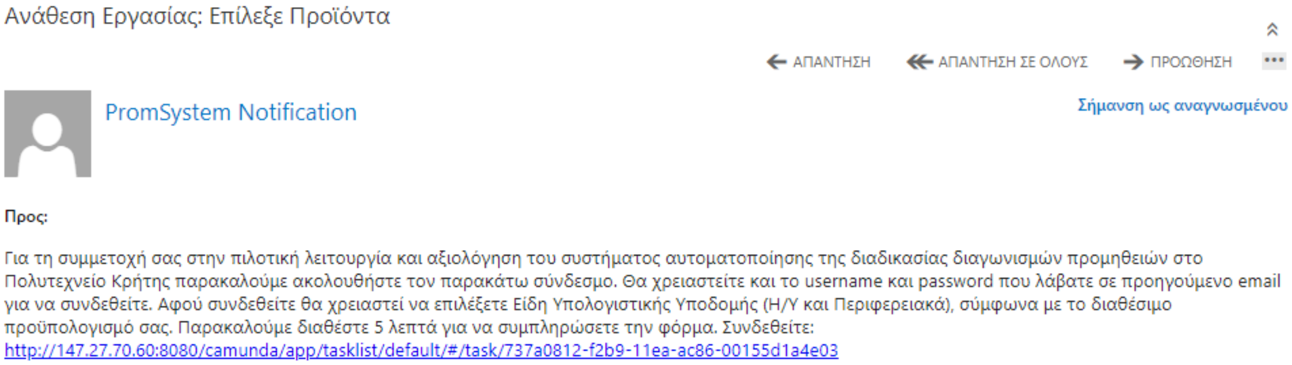
Περιγραφή

Κόστος (€) (με ΦΠΑ)

URL Ενδεικτικού Αρχείου Προδιαγραφών

Figure 34 - Filling in the list of products in the 1st task form

On admin's form submission, 17 instances of the task ("Select Products") were automatically created and at the same time an email notification for the task assignment was sent by the system to the 17 assignee users (see Figure 35 below).



Ανάθεση Εργασίας: Επίλεξε Προϊόντα

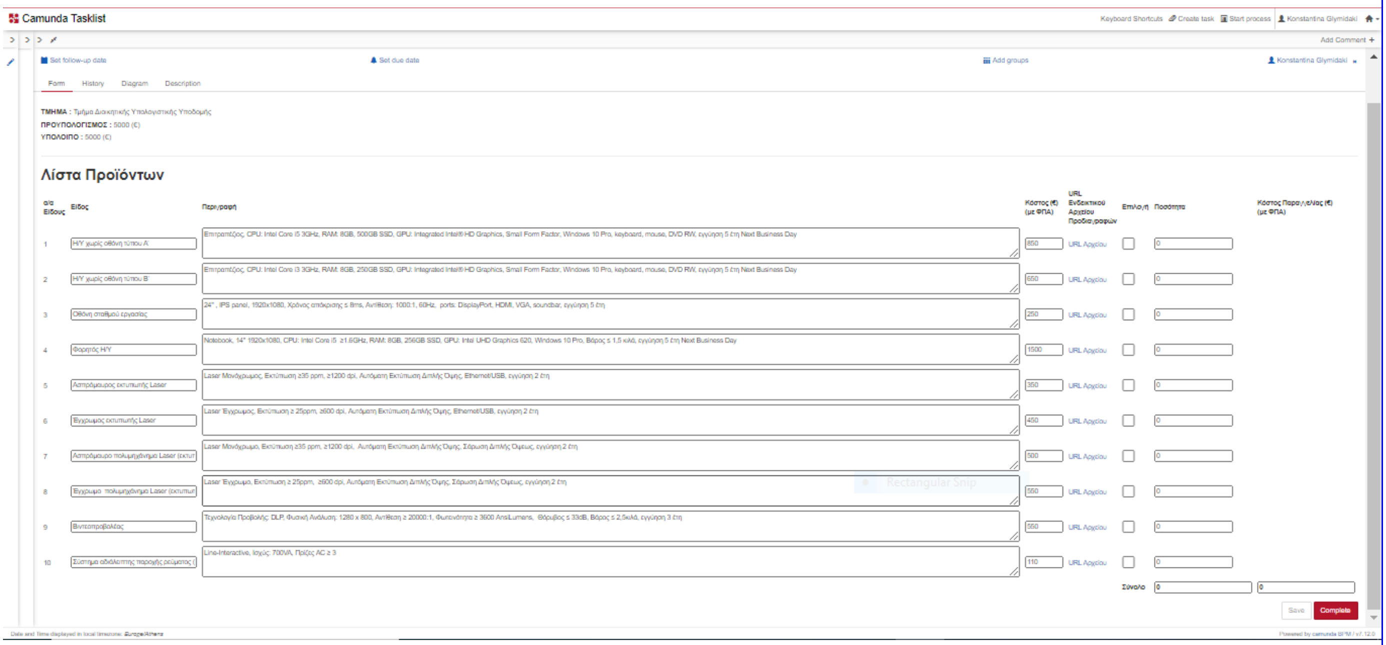
PromSystem Notification

Προς:

Για τη συμμετοχή σας στην πιλοτική λειτουργία και αξιολόγηση του συστήματος αυτοματοποίησης της διαδικασίας διαγωνισμών προμηθειών στο Πολυτεχνείο Κρήτης παρακαλούμε ακολουθήστε τον παρακάτω σύνδεσμο. Θα χρειαστείτε και το username και password που λάβατε σε προηγούμενο email για να συνδεθείτε. Αφού συνδεθείτε θα χρειαστεί να επιλέξετε Είδη Υπολογιστικής Υποδομής (Η/Υ και Περιφερειακά), σύμφωνα με το διαθέσιμο προϋπολογισμό σας. Παρακαλούμε διαθέστε 5 λεπτά για να συμπληρώσετε την φόρμα. Συνδεθείτε:
http://147.27.70.60:8080/camunda/app/tasklist/default/#/task/737a0812-f2b9-11ea-ac86-00155d1a4e03

Figure 35 - System's email notification for user's task assignment

So, each of the 17 users had access to the following form on their logging in the system (see Figure 36 below):



ΤΜΗΜΑ : Τμήμα Διοικητικής Υπολογιστικής Υποδομής
ΠΡΟΥΠΟΛΟΓΙΣΜΟΣ : 5000 (€)
ΥΠΟΛΟΙΠΟ : 5000 (€)

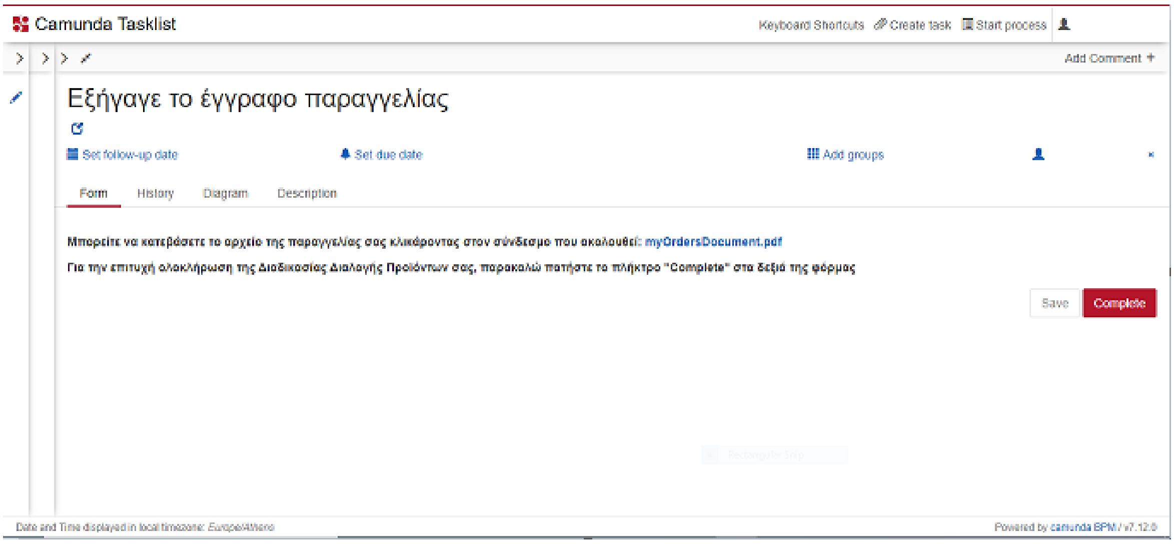
Λίστα Προϊόντων

α/α Είδους	Είδος	Περι/γραφή	Κόστος (€) (με ΦΠΑ)	URL Ενδεικτικού Αρχείου Προδια/γραφών	Επιλο/ή	Ποσότητα	Κόστος Παραγ/γελίας (€) (με ΦΠΑ)
1	Η/Υ χωρίς οθόνη τύπου Α'	Επιτραπέζιος, CPU: Intel Core i5 3GHz, RAM: 8GB, 500GB SSD, GPU: Integrated Intel® HD Graphics, Small Form Factor, Windows 10 Pro, keyboard, mouse, DVD RW, εγγύηση 5 έτη Next Business Day	850	URL Αρχείου	☐	0	
2	Η/Υ χωρίς οθόνη τύπου Β'	Επιτραπέζιος, CPU: Intel Core i3 3GHz, RAM: 8GB, 250GB SSD, GPU: Integrated Intel® HD Graphics, Small Form Factor, Windows 10 Pro, keyboard, mouse, DVD RW, εγγύηση 5 έτη Next Business Day	650	URL Αρχείου	☐	0	
3	Οθόνη σταθμού εργασίας	24" , IPS panel, 1920x1080, Χρόνος απόκρισης ≤ 8ms, Αντίθεση: 1000:1, 60Hz, ports: DisplayPort, HDMI, VGA, soundbar, εγγύηση 5 έτη	250	URL Αρχείου	☐	0	
4	Φορητός Η/Υ	Notebook, 14" 1920x1080, CPU: Intel Core i5 ≥1.6GHz, RAM: 8GB, 256GB SSD, GPU: Intel UHD Graphics 620, Windows 10 Pro, Βάρος ≤ 1,5 κιλά, εγγύηση 5 έτη Next Business Day	1500	URL Αρχείου	☐	0	
5	Ασπρόμαυρος εκτυπωτής Laser	Laser Μονόχρωμος, Εκτύπωση ≥35 ppm, ≥1200 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Ethernet/USB, εγγύηση 2 έτη	350	URL Αρχείου	☐	0	
6	Έγχρωμος εκτυπωτής Laser	Laser Έγχρωμος, Εκτύπωση ≥ 25ppm, ≥600 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Ethernet/USB, εγγύηση 2 έτη	450	URL Αρχείου	☐	0	
7	Ασπρόμαυρο πολυμηχάνημα Laser (εκτυπ	Laser Μονόχρωμο, Εκτύπωση ≥35 ppm, ≥1200 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Σάρωση Διπλής Όψεως, εγγύηση 2 έτη	500	URL Αρχείου	☐	0	
8	Έγχρωμο πολυμηχάνημα Laser (εκτυπω	Laser Έγχρωμο, Εκτύπωση ≥ 25ppm, ≥600 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Σάρωση Διπλής Όψεως, εγγύηση 2 έτη	550	URL Αρχείου	☐	0	
9	Βιντεοπροβολέας	Τεχνολογία Προβολής: DLP, Φυσική Ανάλυση: 1280 x 800, Αντίθεση ≥ 20000:1, Φωτεινότητα ≥ 3600 AnsiLumens, Θόρυβος ≤ 33dB, Βάρος ≤ 2,5κιλά, εγγύηση 3 έτη	550	URL Αρχείου	☐	0	
10	Σύστημα αδιάλειπτης παροχής ρεύματος (	Line-Interactive, Ισχύς: 700VA, Πρίζες AC ≥ 3	110	URL Αρχείου	☐	0	
					Σύνολο	0	0

Save
Complete
Date and Time displayed in local timezone: Europe/Athens
Powered by camunda BPM / v7.12.0

Figure 36 - Local Admin's pre-configured list of products in the 2nd task form

Order's total cost was checked anytime by the system and as a consequence each user made choices covered by his available budget. Otherwise, the system did not permit form's submission. On the successful submission of this form, the ability of exporting a pdf document (with user's choices) was given as depicted in the following Figures (37 and 38) below:



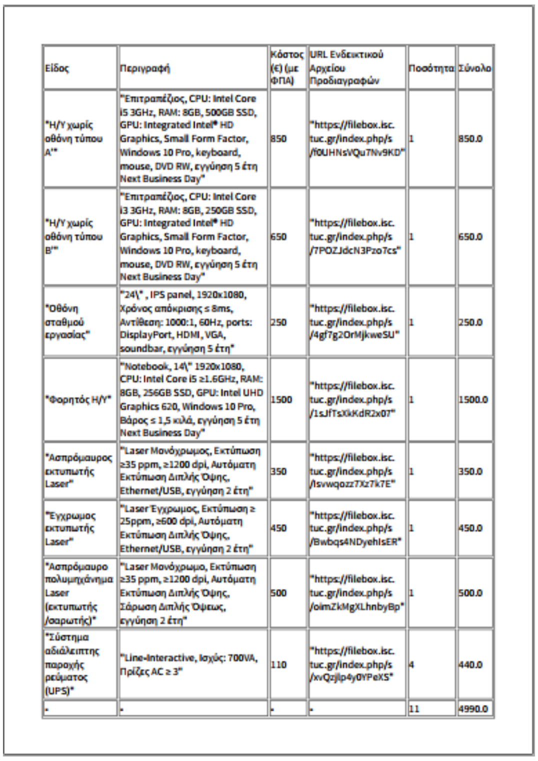
Εξήγαγε το έγγραφο παραγγελίας

Μπορείτε να κατεβάσετε το αρχείο της παραγγελίας σας κλικάροντας στον σύνδεσμο που ακολουθεί: myOrdersDocument.pdf

Για την επιτυχή ολοκλήρωση της Διαδικασίας Διαλογής Προϊόντων σας, παρακαλώ πατήστε το πλήκτρο "Complete" στα δεξιά της φόρμας

Save
Complete
Date and Time displayed in local timezone: Europe/Athens
Powered by camunda BPM / v7.12.0

Figure 37 - Exporting the pdf document with user's choices

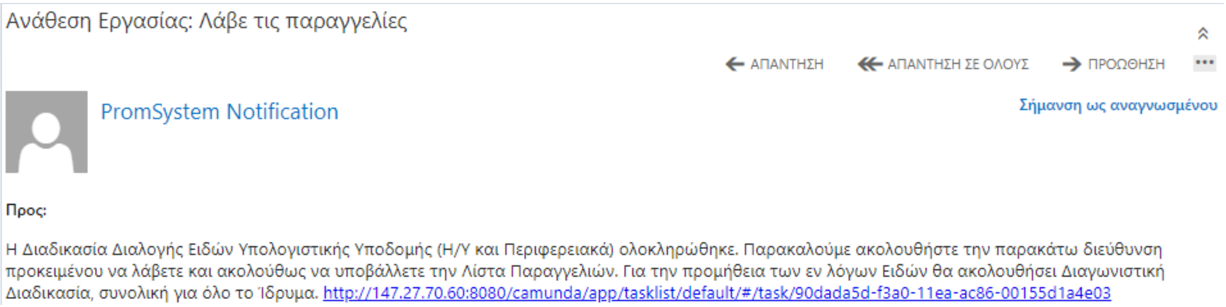


Είδος	Περιγραφή	Κόστος (€) (με ΦΠΑ)	URL Ενδεικτικού Αρχείου Προδιαγραφών	Ποσότητα	Σύνολο
"Η/Υ χωρίς οθόνη τύπου Α'"	"Επιτραπέζιος, CPU: Intel Core i5 3GHz, RAM: 8GB, 500GB SSD, GPU: Integrated Intel® HD Graphics, Small Form Factor, Windows 10 Pro, keyboard, mouse, DVD RW, εγγύηση 5 έτη Next Business Day"	850	"https://filebox.isc.tuc.gr/index.php/s/f0UHNsVQu7Nv9KD"	1	850.0
"Η/Υ χωρίς οθόνη τύπου Β'"	"Επιτραπέζιος, CPU: Intel Core i3 3GHz, RAM: 8GB, 250GB SSD, GPU: Integrated Intel® HD Graphics, Small Form Factor, Windows 10 Pro, keyboard, mouse, DVD RW, εγγύηση 5 έτη Next Business Day"	650	"https://filebox.isc.tuc.gr/index.php/s/7POZJdcN3Pzo7cs"	1	650.0
"Οθόνη σταθμού εργασίας"	"24\" , IPS panel, 1920x1080, Χρόνος απόκρισης ≤ 8ms, Αντίθεση: 1000:1, 60Hz, ports: DisplayPort, HDMI , VGA, soundbar, εγγύηση 5 έτη"	250	"https://filebox.isc.tuc.gr/index.php/s/4gf7g2OrMjkweSU"	1	250.0
"Φορητός Η/Υ"	"Notebook, 14\" 1920x1080, CPU: Intel Core i5 ≥1.6GHz, RAM: 8GB, 256GB SSD, GPU: Intel UHD Graphics 620, Windows 10 Pro, Βάρος ≤ 1,5 κιλά, εγγύηση 5 έτη Next Business Day"	1500	"https://filebox.isc.tuc.gr/index.php/s/1sJfTsXkKdR2x07"	1	1500.0
"Ασπρόμαυρος εκτυπωτής Laser"	"Laser Μονόχρωμος, Εκτύπωση ≥35 ppm, ≥1200 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Ethernet/USB, εγγύηση 2 έτη"	350	"https://filebox.isc.tuc.gr/index.php/s/lsvwqozz7Xz7k7E"	1	350.0
"Έγχρωμος εκτυπωτής Laser"	"Laser Έγχρωμος, Εκτύπωση ≥ 25ppm, ≥600 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Ethernet/USB, εγγύηση 2 έτη"	450	"https://filebox.isc.tuc.gr/index.php/s/Bwbqs4NDyehIsER"	1	450.0
"Ασπρόμαυρο πολυμηχάνημα Laser (εκτυπωτής /σαρωτής)"	"Laser Μονόχρωμο, Εκτύπωση ≥35 ppm, ≥1200 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Σάρωση Διπλής Όψεως, εγγύηση 2 έτη"	500	"https://filebox.isc.tuc.gr/index.php/s/oimZkMgXLhnbyBp"	1	500.0
"Σύστημα αδιάλειπτης παροχής ρεύματος (UPS)"	"Line-Interactive, Ισχύς: 700VA, Πρίζες AC ≥ 3"	110	"https://filebox.isc.tuc.gr/index.php/s/xvQzjlp4y0YPeXS"	4	440.0
-	-	-	-	11	4990.0

Figure 38 - An exported pdf document with user's choices

For some reason, 3 assignees (for the above task) did not submit their forms and as a result process's flow could not continue. This led to further discussions with the admin and thesis's supervisor so as to find a possible solution for the continuing of the pilot test. The solution which was suggested was to delete those 3 open local instances of Subprocess so as to move on the next step of the process. Although, the respective instances closed by us, the process flow got stuck. This led to further search on Camunda's public forum so as to investigate the reasons for this problem and any possible solutions. After one week of search, we concluded that the most feasible scenario was to delete the whole process instance and run it again from the beginning.

Therefore, with 14 of the 17 orders completed, the process continued with the display of the final aggregate list in admin's next task form (see Figure 40 below). At the same time, a new email notification by the system was sent to admin's mail so as to inform him for the successful completion of the Subprocess (see Figure 39 below).



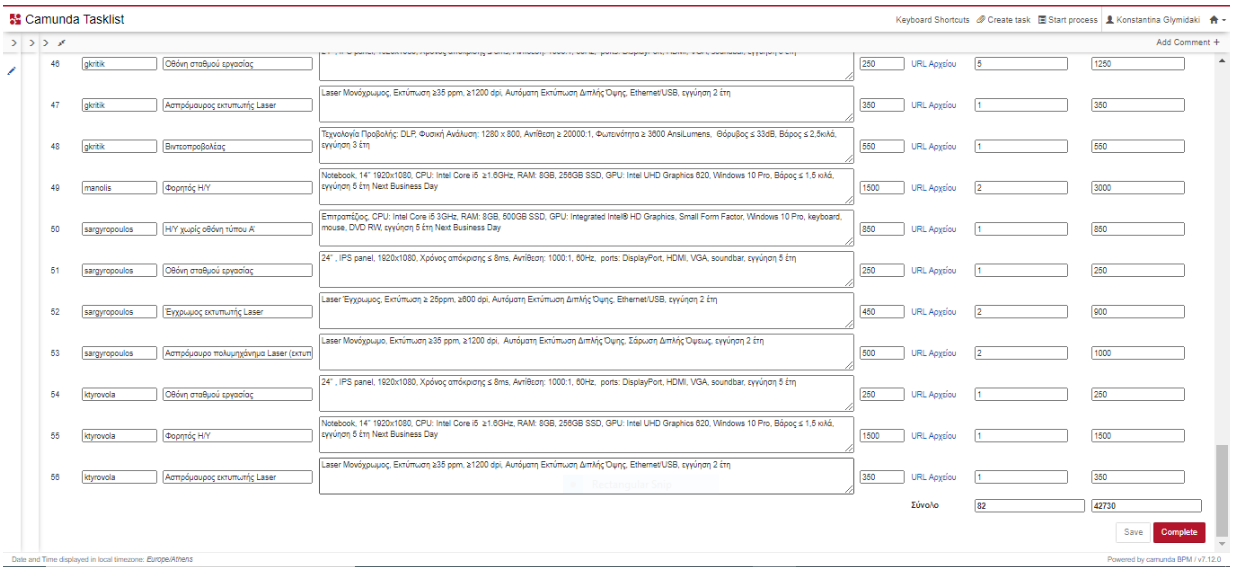
Ανάθεση Εργασίας: Λάβε τις παραγγελίες

PromSystem Notification

Προς:

Η Διαδικασία Διαλογής Ειδών Υπολογιστικής Υποδομής (Η/Υ και Περιφερειακά) ολοκληρώθηκε. Παρακαλούμε ακολουθήστε την παρακάτω διεύθυνση προκειμένου να λάβετε και ακολούθως να υποβάλλετε την Λίστα Παραγγελιών. Για την προμήθεια των εν λόγων Ειδών θα ακολουθήσει Διαγωνιστική Διαδικασία, συνολική για όλο το Ίδρυμα. http://147.27.70.60:8080/camunda/app/tasklist/default/#/task/90dada5d-f3a0-11ea-ac86-00155d1a4e03

Figure 39 - System's email notification for Subprocess's successful completion

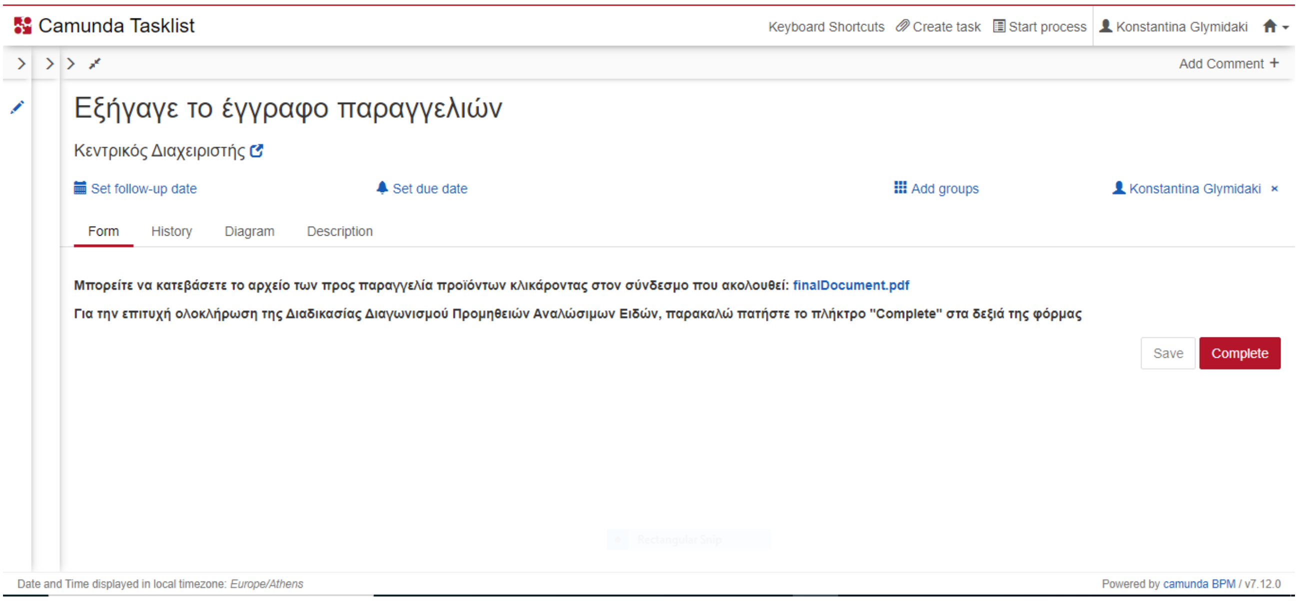


46	gkritik	Οθόνη σταθμού εργασίας	24" , IPS panel, 1920x1080, Χρόνος απόκρισης ≤ 8ms, Αντίθεση: 1000:1, 60Hz, ports: DisplayPort, HDMI, VGA, soundbar, εγγύηση 5 έτη	250	URL Αρχείου	5	1250
47	gkritik	Ασπρόμαυρος εκτυπωτής Laser	Laser Μονόχρωμος, Εκτύπωση ≥35 ppm, ≥1200 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Ethernet/USB, εγγύηση 2 έτη	350	URL Αρχείου	1	350
48	gkritik	Βιντεοπροβολέας	Τεχνολογία Προβολής: DLP, Φυσική Ανάλυση: 1280 x 800, Αντίθεση ≥ 20000:1, Φωτεινότητα ≥ 3600 AnsiLumens, Θόρυβος ≤ 33dB, Βάρος ≤ 2,5κιλά, εγγύηση 3 έτη	550	URL Αρχείου	1	550
49	manolis	Φορητός Η/Υ	Notebook, 14" 1920x1080, CPU: Intel Core i5 ≥1.6GHz, RAM: 8GB, 256GB SSD, GPU: Intel UHD Graphics 620, Windows 10 Pro, Βάρος ≤ 1,5 κιλά, εγγύηση 5 έτη Next Business Day	1500	URL Αρχείου	2	3000
50	sargyropoulos	Η/Υ χωρίς οθόνη τύπου Α'	Επιτραπέζιος, CPU: Intel Core i5 3GHz, RAM: 8GB, 500GB SSD, GPU: Integrated Intel® HD Graphics, Small Form Factor, Windows 10 Pro, keyboard, mouse, DVD RW, εγγύηση 5 έτη Next Business Day	850	URL Αρχείου	1	850
51	sargyropoulos	Οθόνη σταθμού εργασίας	24" , IPS panel, 1920x1080, Χρόνος απόκρισης ≤ 8ms, Αντίθεση: 1000:1, 60Hz, ports: DisplayPort, HDMI, VGA, soundbar, εγγύηση 5 έτη	250	URL Αρχείου	1	250
52	sargyropoulos	Έγχρωμος εκτυπωτής Laser	Laser Έγχρωμος, Εκτύπωση ≥ 25ppm, ≥600 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Ethernet/USB, εγγύηση 2 έτη	450	URL Αρχείου	2	900
53	sargyropoulos	Ασπρόμαυρο πολυμηχάνημα Laser (εκτυπ	Laser Μονόχρωμο, Εκτύπωση ≥35 ppm, ≥1200 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Σάρωση Διπλής Όψεως, εγγύηση 2 έτη	500	URL Αρχείου	2	1000
54	ktyrovola	Οθόνη σταθμού εργασίας	24" , IPS panel, 1920x1080, Χρόνος απόκρισης ≤ 8ms, Αντίθεση: 1000:1, 60Hz, ports: DisplayPort, HDMI, VGA, soundbar, εγγύηση 5 έτη	250	URL Αρχείου	1	250
55	ktyrovola	Φορητός Η/Υ	Notebook, 14" 1920x1080, CPU: Intel Core i5 ≥1.6GHz, RAM: 8GB, 256GB SSD, GPU: Intel UHD Graphics 620, Windows 10 Pro, Βάρος ≤ 1,5 κιλά, εγγύηση 5 έτη Next Business Day	1500	URL Αρχείου	1	1500
56	ktyrovola	Ασπρόμαυρος εκτυπωτής Laser	Laser Μονόχρωμος, Εκτύπωση ≥35 ppm, ≥1200 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Ethernet/USB, εγγύηση 2 έτη	350	URL Αρχείου	1	350
					Σύνολο	82	42730

Save
Complete
Date and Time displayed in local timezone: Europe/Athens
Powered by camunda BPM / v7.12.0

Figure 40 - The final aggregate list of orders in admin's task form

The admin, having all the orders displayed on his form, was able to export this list in a new pdf document (see Figures 41 and 42 below) which was about to be sent in the Procurement Department for the competition in the university. It is worth mentioning that this list had totally 82 products whose cost amounted to 42.730 €.



Εξήγαγε το έγγραφο παραγγελιών

Κεντρικός Διαχειριστής

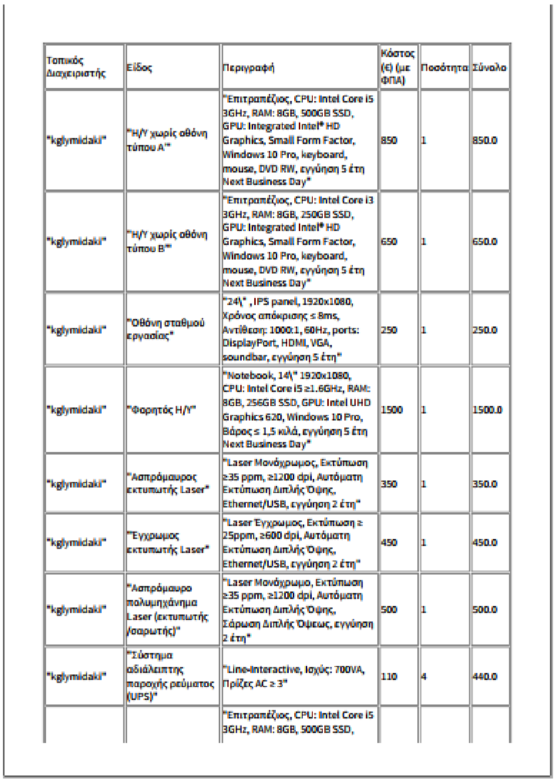
Μπορείτε να κατεβάσετε το αρχείο των προς παραγγελία προϊόντων κλικάροντας στον σύνδεσμο που ακολουθεί: finalDocument.pdf

Για την επιτυχή ολοκλήρωση της Διαδικασίας Διαγωνισμού Προμηθειών Αναλώσιμων Ειδών, παρακαλώ πατήστε το πλήκτρο "Complete" στα δεξιά της φόρμας

Date and Time displayed in local timezone: *Europe/Athens*

Powered by camunda BPM / v7.12.0

Figure 41 - Exporting the final pdf document for the competition



Τοπικός Διαχειριστής	Είδος	Περιγραφή	Κόστος (€) (με ΦΠΑ)	Ποσότητα	Σύνολο
"kglymidaki"	"Η/Υ χωρίς οθόνη τύπου Α"	"Επιτραπέζιος, CPU: Intel Core i5 3GHz, RAM: 8GB, 500GB SSD, GPU: Integrated Intel® HD Graphics, Small Form Factor, Windows 10 Pro, keyboard, mouse, DVD RW, εγγύηση 5 έτη Next Business Day"	850	1	850.0
"kglymidaki"	"Η/Υ χωρίς οθόνη τύπου Β"	"Επιτραπέζιος, CPU: Intel Core i3 3GHz, RAM: 8GB, 250GB SSD, GPU: Integrated Intel® HD Graphics, Small Form Factor, Windows 10 Pro, keyboard, mouse, DVD RW, εγγύηση 5 έτη Next Business Day"	650	1	650.0
"kglymidaki"	"Οθόνη σταθμού εργασίας"	"24\" , IPS panel, 1920x1080, Χρόνος απόκρισης ≤ 8ms, Αντίθεση: 1000:1, 60Hz, ports: DisplayPort, HDMI, VGA, soundbar, εγγύηση 5 έτη"	250	1	250.0
"kglymidaki"	"Φορητός Η/Υ"	"Notebook, 14\" 1920x1080, CPU: Intel Core i5 ≥1.6GHz, RAM: 8GB, 256GB SSD, GPU: Intel UHD Graphics 620, Windows 10 Pro, Βάρος ≤ 1,5 κιλά, εγγύηση 5 έτη Next Business Day"	1500	1	1500.0
"kglymidaki"	"Ασπρόμαυρος εκτυπωτής Laser"	"Laser Μονόχρωμος, Εκτύπωση ≥35 ppm, ≥1200 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Ethernet/USB, εγγύηση 2 έτη"	350	1	350.0
"kglymidaki"	"Έγχρωμος εκτυπωτής Laser"	"Laser Έγχρωμος, Εκτύπωση ≥ 25ppm, ≥600 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Ethernet/USB, εγγύηση 2 έτη"	450	1	450.0
"kglymidaki"	"Ασπρόμαυρο πολυμηχάνημα Laser (εκτυπωτής /σαρωτής)"	"Laser Μονόχρωμο, Εκτύπωση ≥35 ppm, ≥1200 dpi, Αυτόματη Εκτύπωση Διπλής Όψης, Σάρωση Διπλής Όψεως, εγγύηση 2 έτη"	500	1	500.0
"kglymidaki"	"Σύστημα αδιάλειπτης παροχής ρεύματος (UPS)"	"Line-Interactive, Ισχύς: 700VA, Πρίζες AC ≥ 3"	110	4	440.0
		"Επιτραπέζιος, CPU: Intel Core i5 3GHz, RAM: 8GB, 500GB SSD,			

Figure 42 - The final exported pdf document with all orders

5.2 Evaluation Method: Questionnaire for Users based on System Usability Scale

On the completion of the pilot process's execution, it was important for us to get a feedback about users' experience with PM SYSTEM. For this purpose, a questionnaire (including 23 questions of various types) was created and sent to university's members took part in the pilot test so as to perform a satisfaction survey.

This questionnaire consisted of four sections:

The first one which included general questions like user's age, sex, role in university, experience and time of day when participated in the pilot test.

The second one which included quantitative data. This section targeted to make a quantitative comparison as far as the time duration is concerned between process's execution without (and with) a BPMS's support.

The third section which included qualitative data. This section consisted of a 10 item questionnaire with five response options for respondents; from "Strongly agree" to "Strongly disagree". It is based on a method for measuring the usability of a system and had been used with success in T.U.C. in the past. This method is called "System Usability Scale" (S.U.S.).

Last, the fourth section which included four questions for conclusion. This section consisted of two questions with five response options for respondents; from "Strongly agree" to "Strongly disagree" (like the previous one) and two questions which targeted to get any positive or negative comments of users' regarding their experience with PM SYSTEM.

All the results and useful findings concluded from the questionnaire are presented in the next paragraph of this Thesis.

5.3 Useful Results & Findings in comparison with Process's Current Situation

From the initial sample of 14 participants who interacted with PM SYSTEM, 10 of them submitted their responses on the above questionnaire eventually. The results concluded from the pilot test are discussed in this paragraph.

As mentioned above, the first part of the questionnaire referred to demographics.

The first question referred to the participants' age, where the majority of the participants (60%) were born in the 1970s (between 42-46 years old), 20% were born in the 1960s (between 53-54 years old) and another 20% in the 1980s (between 34-39 years old) as depicted in Figure 43 below.

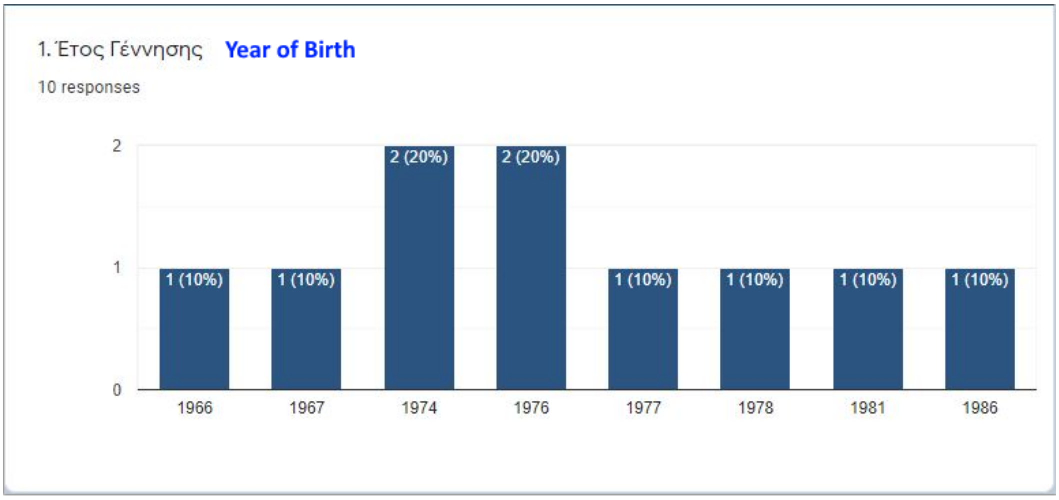


Figure 43 - Year of birth of the participants

The second question was about the sex of the participants. As shown in Figure 44, females represented 60% of the sample, while males 40%.

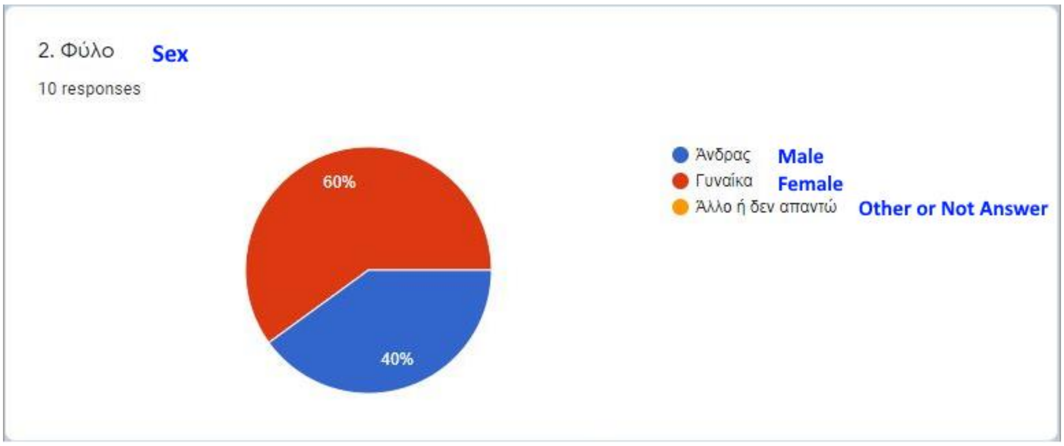


Figure 44 - Sex of participants

Referring to the participants' role in the T.U.C. (see Figure 45 below), the majority of the sample (60%) were Laboratory Teaching Staff Members (referred as EDIP), followed by the administrative staff with a percentage of 30%. Furthermore, 10% of the sample declared an undefined answer in this question.

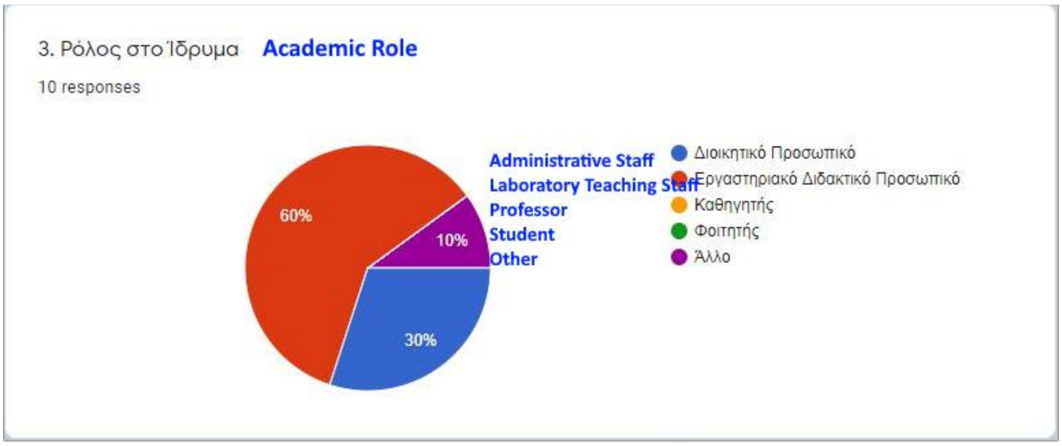


Figure 45 - Academic role of the participants

The following question referred to previous experience in using similar software systems (BPMS, management platforms, etc.). From Figure 46 one could say that there is a relative balance in the answers given here on the grounds that all participants had been involved with a similar system in the past. More specifically, 30% of the sample had little experience and 20% moderate. So, the less experienced users amounted to the half (50%) of the whole. On the other hand, 20% of the respondents were experienced enough in similar systems whereas 30% were too experienced.

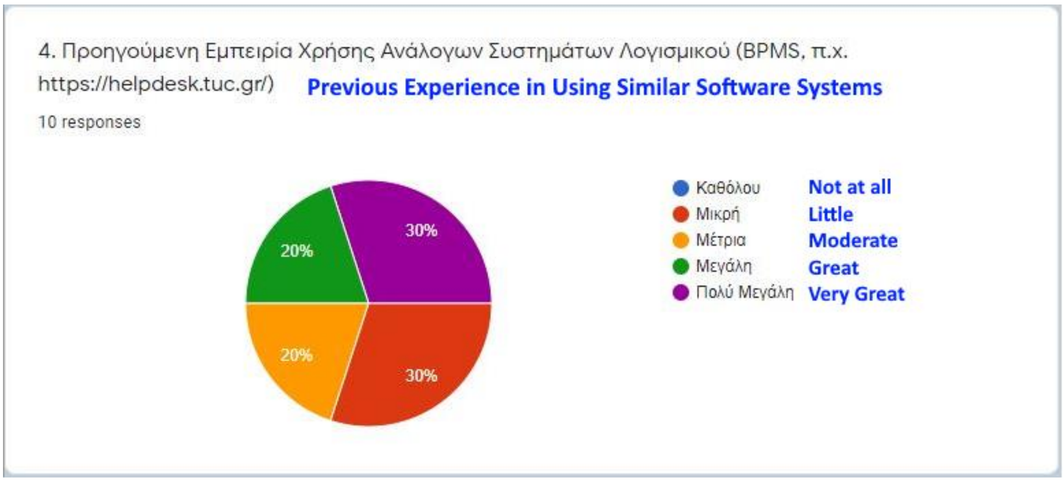


Figure 46 - Previous experience in using similar systems

Last, as far as the general information section is concerned, participants had to answer about the time of day when they interacted with PM SYSTEM. As depicted in Figure 47 below, all of them (100%) took part on their daily working hours.

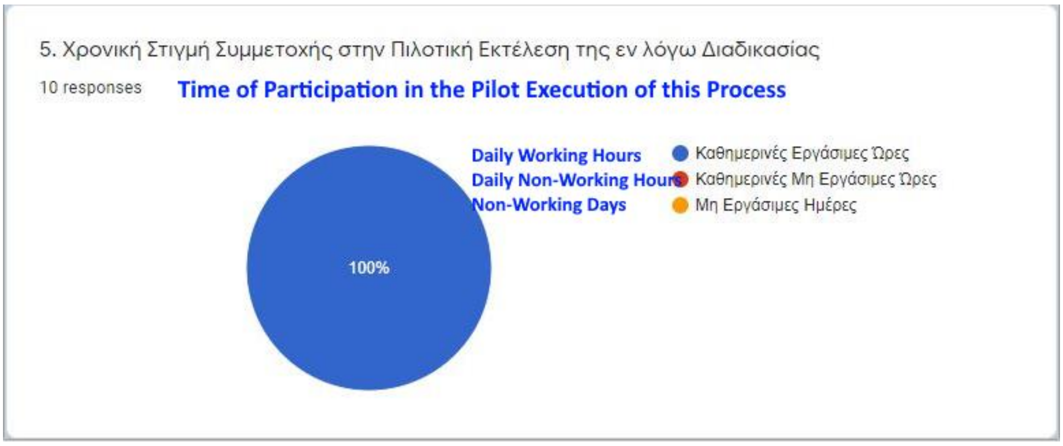
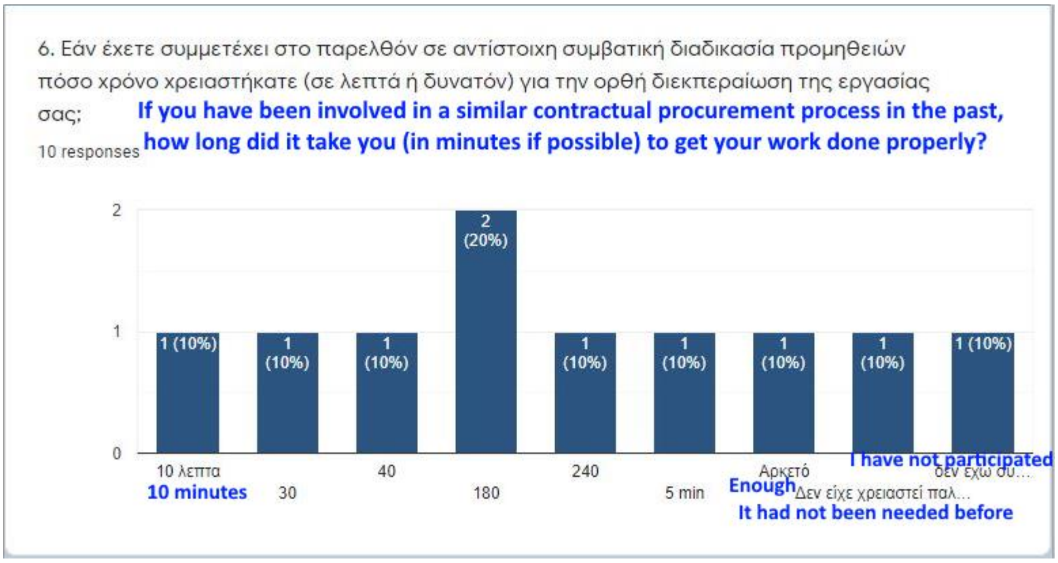


Figure 47 - Time of day when participated in the pilot test

Moving on to the next part of the questionnaire and the quantitative data included here, participants were asked to compare the time needed to complete a task in the case of a process where there wasn't a BPMS support and in the recent case of the pilot test, where they had PM SYSTEM's support.

So, first they answered on how much time took to them so as to complete a similar task without any system's support in the past (see Figure 48 below). From the given answers it was concluded that in 30% of participants, 3-4 hours were needed to do a similar task while 40% answered that less than 1 hour took to them. It is worth mentioning that 10% declared that enough time was needed (without however declaring a number) and 20% answered that they had not any similar experience in the past.



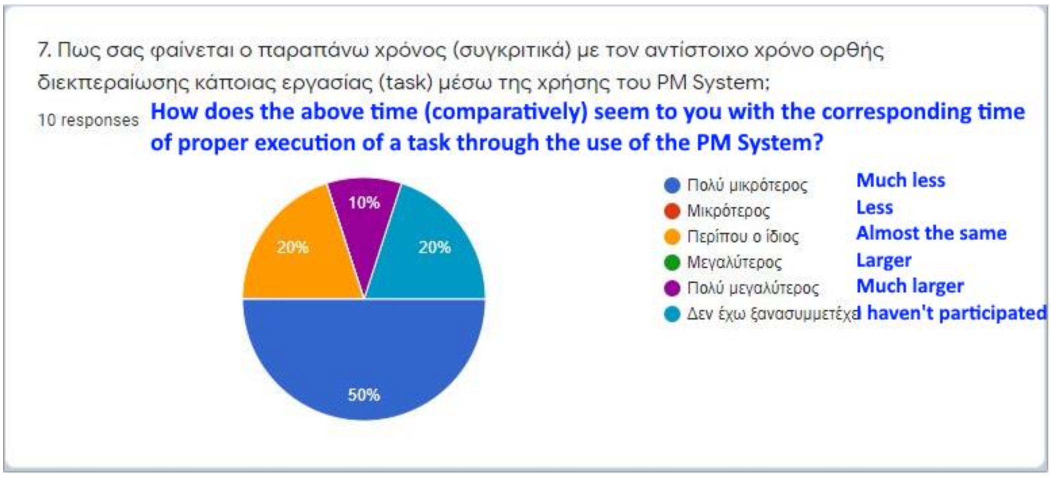
6. Εάν έχετε συμμετέχει στο παρελθόν σε αντίστοιχη συμβατική διαδικασία προμηθειών πόσο χρόνο χρειαστήκατε (σε λεπτά ή δυνατόν) για την ορθή διεκπεραίωση της εργασίας σας;

If you have been involved in a similar contractual procurement process in the past, how long did it take you (in minutes if possible) to get your work done properly?

10 responses

Figure 48 - Time required for doing a task without any system's support in the past

The comparison of this time with the respective one of pilot's test followed afterwards. As shown in the Figure 49, half of the whole (50%) answered that the time needed for doing a task without system's support seemed much smaller to them compared to the time needed with PM SYSTEM's support. In 20% of the sample, the required time seemed about the same whereas only 10% declared that found much more the time in the case of no any system's support.



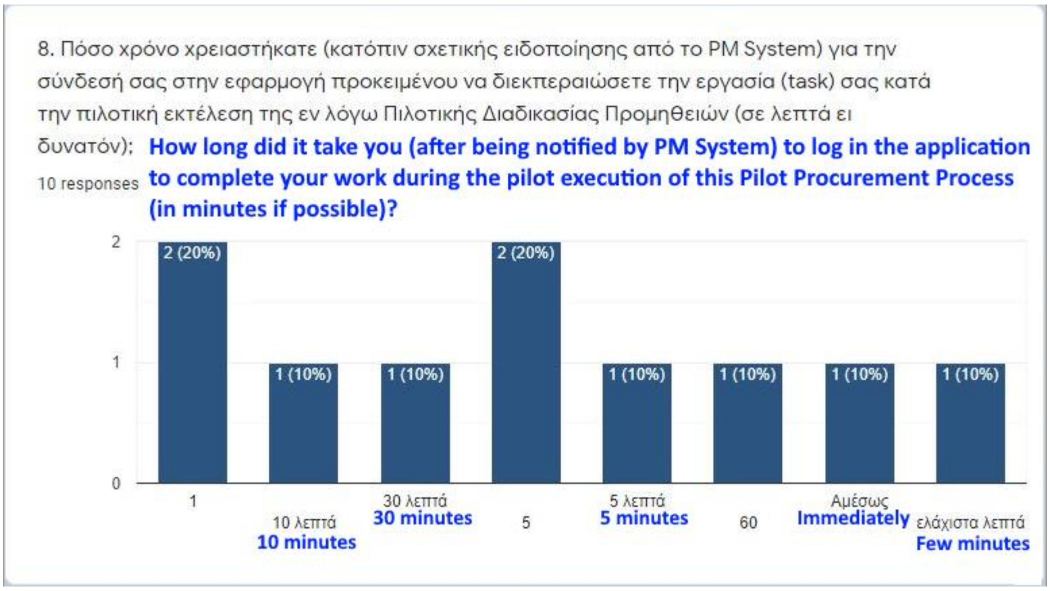
7. Πως σας φαίνεται ο παραπάνω χρόνος (συγκριτικά) με τον αντίστοιχο χρόνο ορθής διεκπεραίωσης κάποιας εργασίας (task) μέσω της χρήσης του PM System;

How does the above time (comparatively) seem to you with the corresponding time of proper execution of a task through the use of the PM System?

10 responses

Figure 49 - Comparing the time required in both cases

The next two questions of this section concerned the time needed for users to login the application and do their task after PM SYSTEM's notification. More specifically, participants were asked to answer how much time took to them so as to login and do their task on platform (see Figure 50 below). From the answers given here, we notice that the vast majority of users needed few minutes. Actually, 80% of respondents needed until 10 minutes. From the rest of respondents, 10% declared that they needed half an hour (30 minutes) and another 10% needed 1 hour (60 minutes).



8. Πόσο χρόνο χρειαστήκατε (κατόπιν σχετικής ειδοποίησης από το PM System) για την σύνδεσή σας στην εφαρμογή προκειμένου να διεκπεραιώσετε την εργασία (task) σας κατά την πιλοτική εκτέλεση της εν λόγω Πιλοτικής Διαδικασίας Προμηθειών (σε λεπτά ει δυνατόν);

How long did it take you (after being notified by PM System) to log in the application to complete your work during the pilot execution of this Pilot Procurement Process (in minutes if possible)?

10 responses

Figure 50 - Time required for logging in and doing a task in platform

Their impressions on this required time, was requested on the next (and last) question of this section (see Figure 51 below). 30% of participants found "very short" the above time duration while 40% considered it "short". The above time was considered as "normal" by the rest (30%) of users.

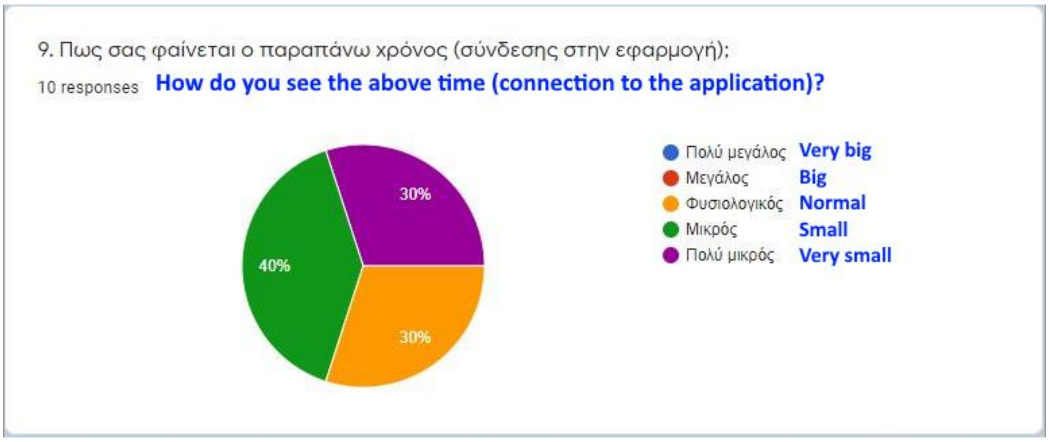


Figure 51 - Participants' impression on the time needed for logging in and doing a task

The third part of the questionnaire used an evaluation method known as "System Usability Scale" as previously mentioned. In this section, participants were asked to answer whether they agreed/disagreed with the following 10 statements. So, their score in each question ranged from "Strongly Disagree" to "Strongly Agree" by following a numeric scale from 1 to 5.

In the first question, the participants had to answer if they think that they would like to use PM SYSTEM frequently (see Figure 52 below). The vast majority of users was positive at this statement on the grounds that half of the whole (50%) agreed and another 30% strongly agreed with. A percentage of 20% was somewhat modest as they neither agreed nor disagreed with this statement.

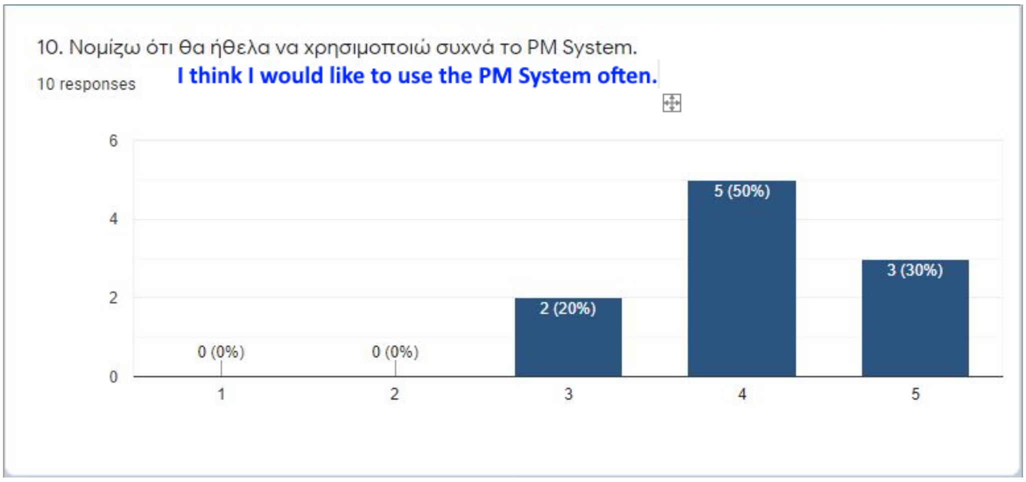


Figure 52 - Desire of frequent use of PM SYSTEM

Next, users had to declare their opinion on PM SYSTEM's complexity (see Figure 53 below). 20% of the sample stated that they didn't find the system complicated and 40% found it a bit complex. The rest of respondents (40%) were probably somewhere in the middle as they neither agreed nor disagreed with system's complexity.

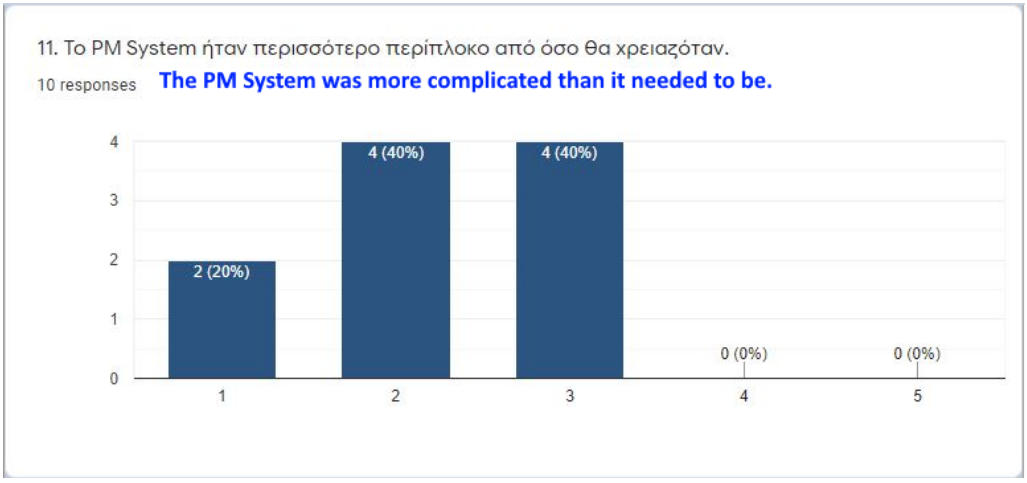
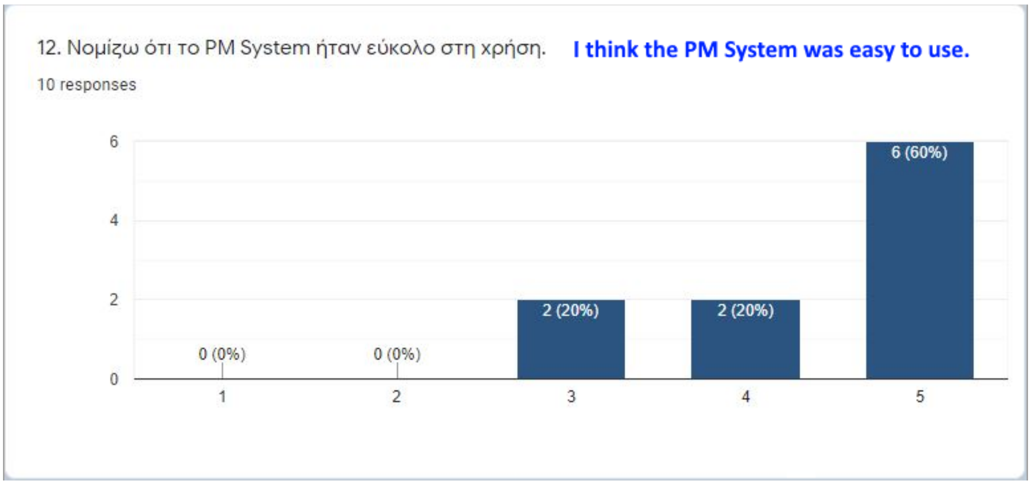


Figure 53 - PM SYSTEM's complexity

Next question had to do with the ease in the use of system (see Figure 54 below). The majority of respondents (60%) found it very easy while in 20% of the sample the system seemed easy. The rest of respondents (20%) were probably somewhere in the middle as they neither agreed nor disagreed with system's ease.

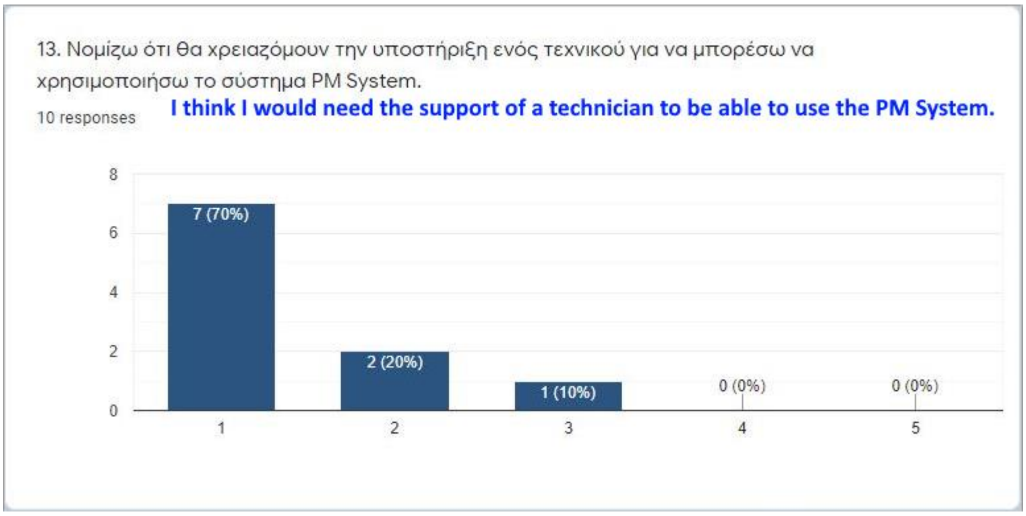


12. Νομίζω ότι το PM System ήταν εύκολο στη χρήση. I think the PM System was easy to use.

10 responses

Figure 54 - PM SYSTEM's ease

Next, participants had to answer if they thought that they would need the support of a technical person to be able to use PM SYSTEM (see Figure 55 below). The majority of them (70%) considered that they wouldn't need technical support at all. Also, 20% replied that they would need minimal support and only 10% was somewhere in the middle as they neither agreed nor disagreed with a potential technical support.



13. Νομίζω ότι θα χρειαζόμουν την υποστήριξη ενός τεχνικού για να μπορέσω να χρησιμοποιήσω το σύστημα PM System.

I think I would need the support of a technician to be able to use the PM System.

10 responses

Figure 55 - Need of technical support for PM SYSTEM

At next question users had to answer how well-integrated they found PM SYSTEM's functions (see Figure 56 below). 60% of users were positive on this statement as 30% of them strongly agreed with and 30 % simply agreed with. From the rest of answers, 30% were neutral on this and only 10% simply disagreed with.

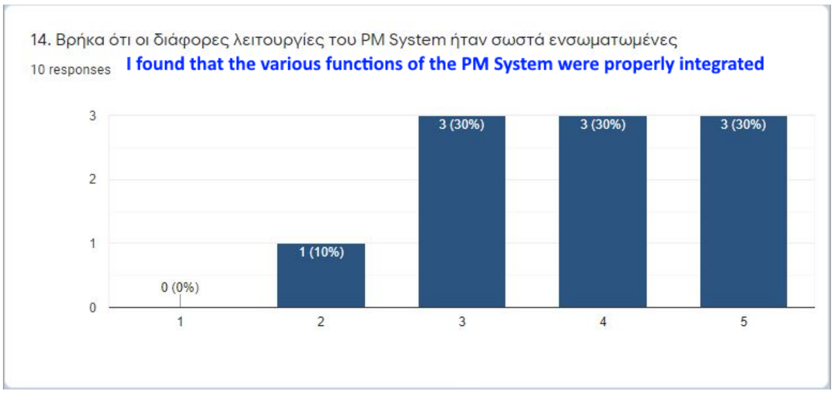


Figure 56 - Well-integration of PM SYSTEM's functions

To continue with any possible inconsistency in PM SYSTEM, the majority of users (60%) strongly disagreed with any possible inconsistency and 30% simply disagreed with. Only 10% were neutral with this statement as shown in Figure 57 below.

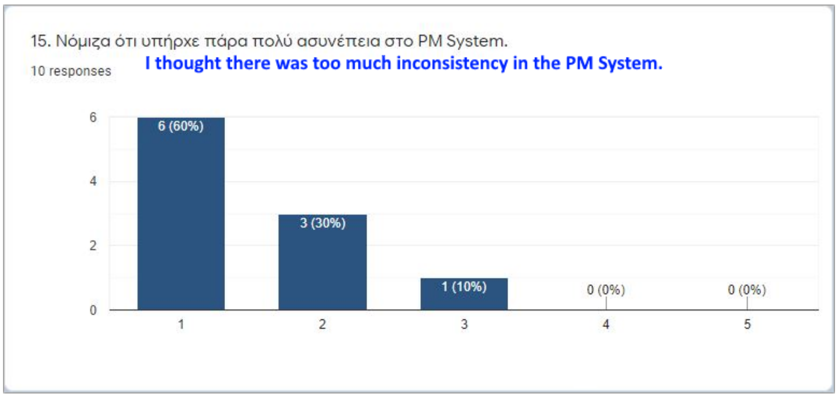


Figure 57 - Inconsistency in PM SYSTEM

Next, users were asked to answer whether they thought most people could quickly learn how to use the system. As we see in Figure 58 below, most of the participants strongly agreed with this statement and 30% simply agreed with. Only 10% were neutral on this.

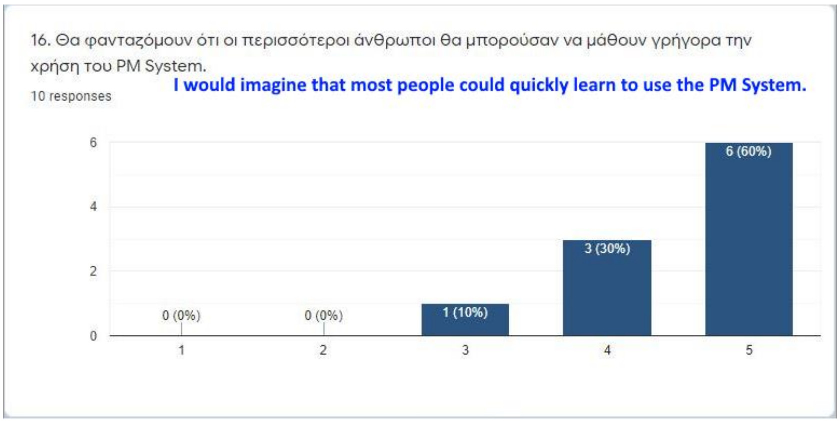


Figure 58 - Possibility of quick learn of PM SYSTEM's use by most of people

Next, users were asked to answer if they found PM SYSTEM too much difficult (see Figure 59 below). The vast majority (80%) didn't find the system at all difficult to use while 10% found it rather easy. Only 10% found it neither too much difficult nor too much easy to use.

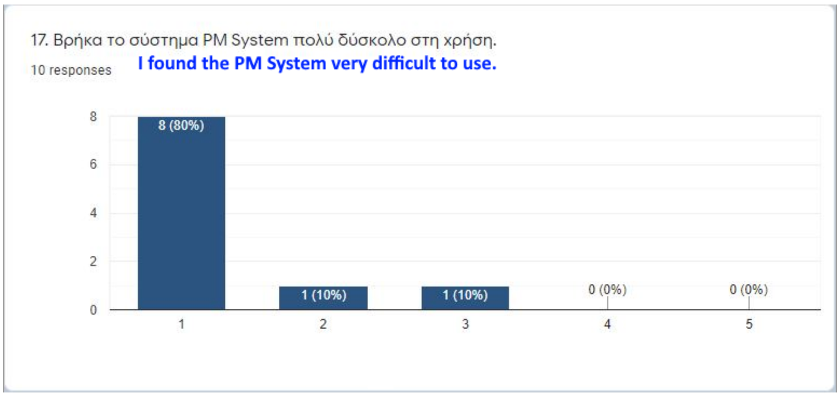
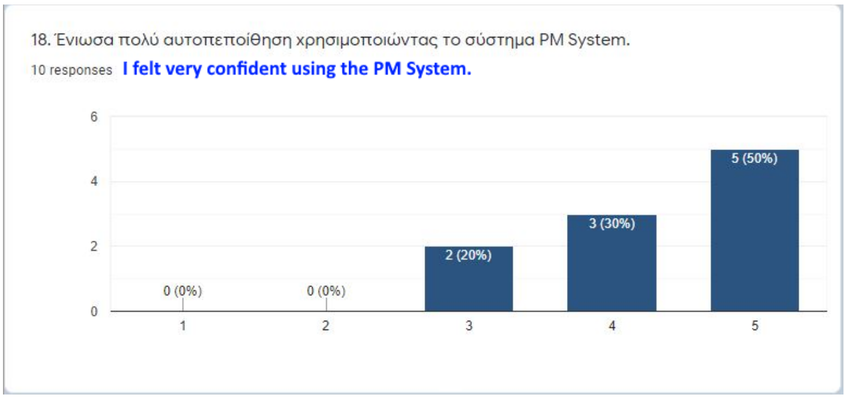


Figure 59 - Difficulty in the use of PM SYSTEM

The next question had to do with user's confidence by using PM SYSTEM (see Figure 60 below). Half of the whole (50%) answered that they felt very confident by using the system while 30% simply agreed with this aspect. The rest of users (20%) replied that they felt neutral by system's use.

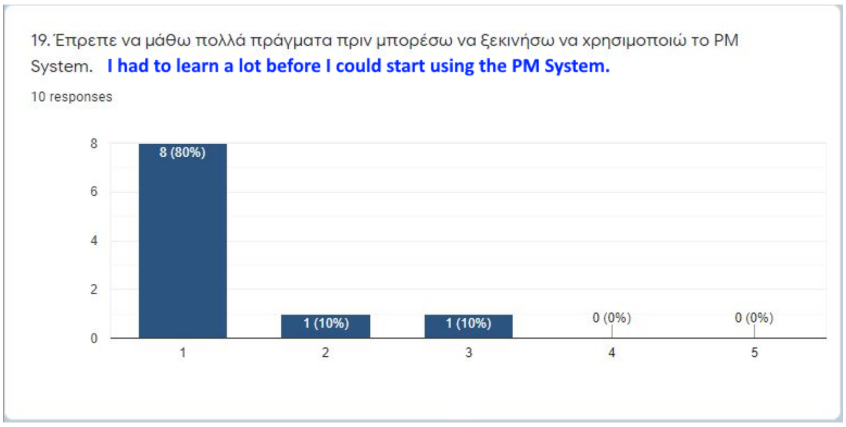


18. Ένιωσα πολύ αυτοπεποίθηση χρησιμοποιώντας το σύστημα PM System.

10 responses **I felt very confident using the PM System.**

Figure 60 - Users' confidence by using PM SYSTEM

To conclude with this part of questionnaire, participants had to state if they needed to learn a lot of things before they could get going with PM SYSTEM. From their answers (see Figure 61), we saw that in the vast majority (80%) there was no need for such a thing at all. From the rest, 10% simply disagreed with such a need and 10% were neutral on this aspect.



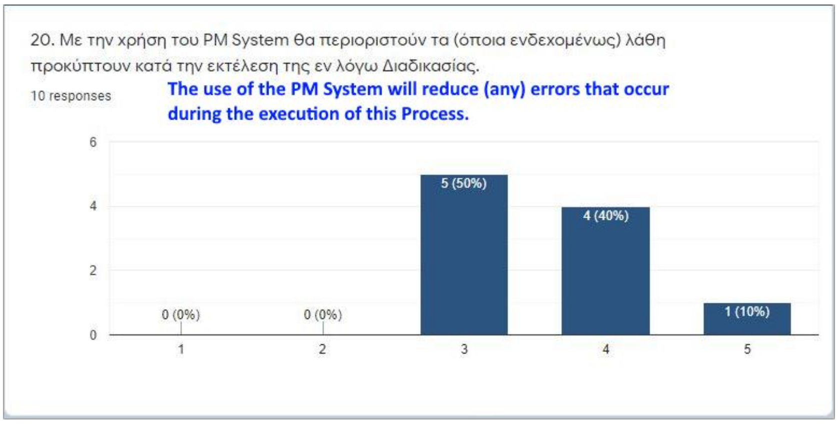
19. Έπρεπε να μάθω πολλά πράγματα πριν μπορέσω να ξεκινήσω να χρησιμοποιώ το PM System. **I had to learn a lot before I could start using the PM System.**

10 responses

Figure 61 - Users' need for previous knowledge before using PM SYSTEM

Moving on to the last section and closing with the questionnaire, it was of paramount importance to get participants' general opinion for PM SYSTEM as well as their comments on its aspects that may facilitated them on the one hand but also made it difficult for them on the other one.

Therefore, in the next question, they were asked for their opinion on whether they believe that the use of PM SYSTEM will reduce any errors that may arise during the process's execution. As we can see in Figure 62 below, half of the whole (50%) were neutral as they neither disagreed nor agreed with this statement. From the rest of participants, 40% agreed that the system will help reduce mistakes while 10% strongly agreed with this opinion.



20. Με την χρήση του PM System θα περιοριστούν τα (όποια ενδεχομένως) λάθη προκύπτουν κατά την εκτέλεση της εν λόγω Διαδικασίας.

10 responses

The use of the PM System will reduce (any) errors that occur during the execution of this Process.

Figure 62 - Users' opinion on errors reduction with PM SYSTEM's support

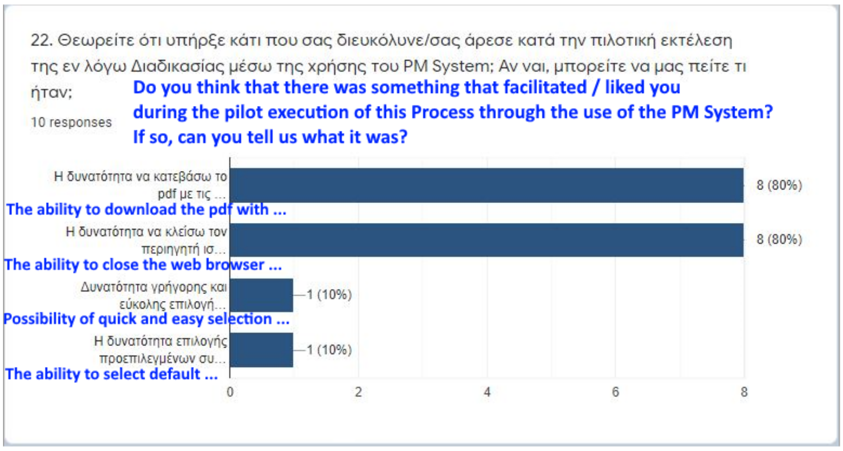
The questions that followed, targeted on getting participants' comments on PM SYSTEM's specific features.

First, they were asked to mention features of the system that they found difficult or they didn't like. 40% of the sample answered that they didn't find anything that made it difficult for them. From users' comments, it is worth mentioning the following ones:

- The plethora of system's choices which seemed pointless was mentioned by the 20% of the total.
- The platform did not look very user friendly in 10% of the total.
- The steps of the process were not completely clear in 10% of the total.
- The inability to import a product that wasn't included in the preconfigured list of the central administrator in 10% of the total.

- The inability to repeat the process in case of error or need for changes as well as the fact that there were no auxiliary messages to the user, e.g. budget override message was mentioned by the 10% of the total.
- Lack of user's actions history so as to be aware of his choices was mentioned by the 10% of the total.

Then, they were asked to mention features of the system that they liked (see Figure 63 below). The vast majority of participants (80%) assessed as positive the fact that they had the ability of exporting and downloading a pdf document with their choices included. In addition, the ability of saving the current state of a task form was also assessed as positive by the same percentage of users (80%). Apart from that, it is also worth mentioning the fact that 20% of the sample liked the way of making their orders (quickly and easily without too much interaction as they mentioned).



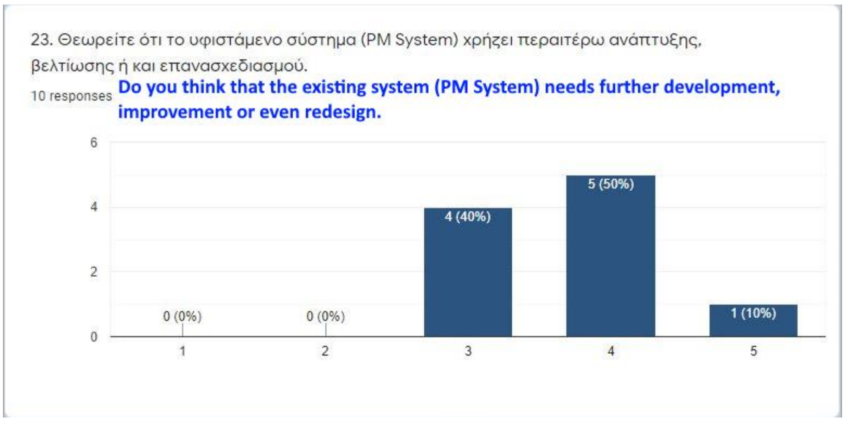
22. Θεωρείτε ότι υπήρξε κάτι που σας διευκόλυνε/σας άρεσε κατά την πιλοτική εκτέλεση της εν λόγω Διαδικασίας μέσω της χρήσης του PM System; Αν ναι, μπορείτε να μας πείτε τι ήταν;

Do you think that there was something that facilitated / liked you during the pilot execution of this Process through the use of the PM System? If so, can you tell us what it was?

10 responses

Figure 63 - PM SYSTEM's features that liked to users

To conclude, last question asked participants' opinion on PM SYSTEM's possible further development, improvement or even redesign in the future. As we can see in Figure 64 below, half of the whole (50%) agreed with this statement and 10% strongly agreed with. 40% were neutral as they neither agreed nor disagreed with this aspect.



23. Θεωρείτε ότι το υφιστάμενο σύστημα (PM System) χρήζει περαιτέρω ανάπτυξης, βελτίωσης ή και επανασχεδιασμού.

10 responses

Do you think that the existing system (PM System) needs further development, improvement or even redesign.

Figure 64 - Users' opinion on the need of future PM SYSTEM improvement

5.4 Discussion

This paragraph aims to give a further analysis and discuss some useful findings based on the questionnaire's answers, the statistical analysis that followed as well as a citation in another similar survey and the brief comparison made with ours on the BPMS market.

To begin with the participants of our sample, we targeted on middle-aged people from both sexes (with previous experience in similar systems), who interacted with PM SYSTEM on their daily working hours.

To continue with the quantitative comparison with the previous situation in the procurement process, we made use of a hypothesis testing so as to prove (with the help of statistics) that the above process was improved (regarding users' required time) with PM SYSTEM's pilot support. Hypothesis testing is a method offered by Statistics and is used in stochastic decision problems between two alternative cases. The one hypothesis has been denoted by "H_0" and is named null hypothesis and the other one by "H_1" is named as alternative hypothesis. We will check the H_0 (hypothesis that the procurement process hasn't been improved after PM SYSTEM's use) against H_1 (hypothesis that the procurement process has been improved after PM SYSTEM's use). For this purpose, we followed the method of "sign test" which is based on the sign of the difference of sample values $X_1,\ldots X_n$ from the value (to be checked) m_0. This value (m_0) equals to zero in our case since zero indicates that there is no difference before and after system's use. Therefore, we first created the differences $X_1 - m_0,\ldots,X_n - m_0$, and we set "+" when they were positive, that is, when $X_i - m_0 > 0$ while when they were negative that is, when $X_i - m_0 < 0$, we set "-". We assumed that "T" indicates the number of positive differences $X_i - m_0$ that is, the number of signs "+". In other words, $T = \Sigma_{(i=1\ldots n)} I (X_i > m_0)$ where "I" denotes the indicator function. Assuming that

$H_0 : m=m_0$, that is, assuming that median “m” equals to “m_0”, it turns out that: P ($X > m_0$) = P ($X < m_0$) = 0.5. Therefore, $H_0 : m=m_0$, the “T” statistic describes the number of positive signs (success = positive sign) in “n” number of signs (hence in “n” trials of a luck experiment with two possible results) with a probability of a positive sign equal to 0.5. So it is understood that the “T” statistic follows a binomial distribution in the null hypothesis (with parameters “n” and “p”=0.5). In other words:

$T^{H0} \sim B$ (n, p=0.5) and P (T=t / H_0 true) = $\binom{n}{t}0.5^n$.

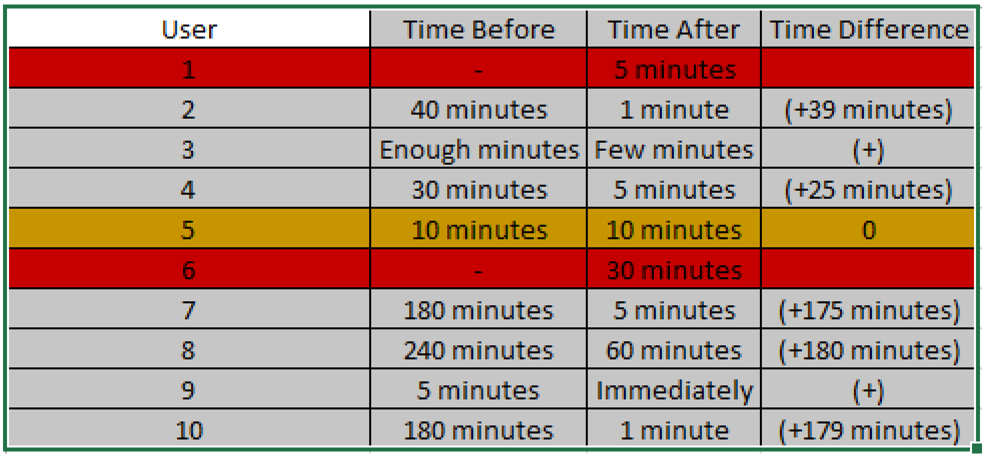
Therefore, the “T” statistic is a reversible quantity (as it has under null hypothesis a known distribution independent of the unknown parameter “m”) and can be used for the sign test. In addition, it is easy to understand that the test of the null hypothesis:

$H_0 : m=m_0$, against one of the following three alternatives:

i) $H_1 : m > m_0$,
ii) $H_1 : m < m_0$ and
iii) $H_1 : m \neq m_0$,

is reduced to the test of null hypothesis $H_0 : p = 0.5$, against the first alternative hypothesis $H_1 : p > 0.5$ in confidence interval a=0.05.

Therefore, we recorded the required times (before and after pilot test) and we calculated their differences in the following table (see Figure 65 below):



User	Time Before	Time After	Time Difference
1	-	5 minutes	
2	40 minutes	1 minute	(+39 minutes)
3	Enough minutes	Few minutes	(+)
4	30 minutes	5 minutes	(+25 minutes)
5	10 minutes	10 minutes	0
6	-	30 minutes	
7	180 minutes	5 minutes	(+175 minutes)
8	240 minutes	60 minutes	(+180 minutes)
9	5 minutes	Immediately	(+)
10	180 minutes	1 minute	(+179 minutes)

Figure 65 - Users’ required time before and after pilot test

We excluded the 2 users (1^{st} and 6^{th}) without prior participation in a corresponding contractual procurement process and the zero difference from 1 user (5^{th}) and so we have n* = 7, with 7 positive signs. We assume that the null hypothesis "H_0" is true.

The critical value "k" will be the one for which:

b(n*, n*, 0.5) + b(n*-1, n*, 0.5) + … + b(k, n*, 0.5) < 0.05, whereas

b(n*, n*, 0.5) + …+ b(k, n*, 0.5) + b (k-1, n*, 0.5) > 0.05

In our case, using the formula for binomial distribution in excel (instead of the respective tables), we found the following:

- b(n*, n*, 0.5) = b(7, 7, 0.5) = 0.007813 (< 0.05) and so we proceeded
- b(n*-1, n*, 0.5) = b(6, 7, 0.5) = 0.054688

So, by summing the 2 above results:

b(7, 7, 0.5) + b(6, 7, 0.5) = 0.0625 > 0.05.

Therefore, the critical value "k" of the test is between the values 6 and 7, which means we have to reject H0 in confidence interval a=0.05 if the number of positive signs (+) equals to 7. Since our sample had 7 positive signs (+), we rejected the null hypothesis H0. So we concluded that the alternative hypothesis H1 is correct and as a consequence the procurement process has been improved after PM SYSTEM's use.

When the discussion came to the qualitative results of the above satisfaction survey, we made use of the applied (on the questionnaire) S.U.S. evaluation method. At this point it would be useful to make clear how this method worked. As mentioned above, S.U.S. survey consisted of 10 statements and each one was presented in a form of a Likert five point scale, ranging from 1 to 5. The even numbered questions (10-12-14-16-18) expressed positive attitudes, while the odd ones (11-13-15-17-19) expressed negative. In order to calculate S.U.S. score, we subtracted 1 from the user responses to questions expressed positive attitudes (10-12-14-16-18), and subtract corresponding values in the questions expressed negative attitudes (11-13-15-17-19), from 5. At this point the converted response scale ranged from 0 to 4 with four being the most positive. By adding responses from all participants and multiplying the total by 2.5 the range was converted from 0-40 to 0-100.

The relevant statistics are presented in Figure 66 below.

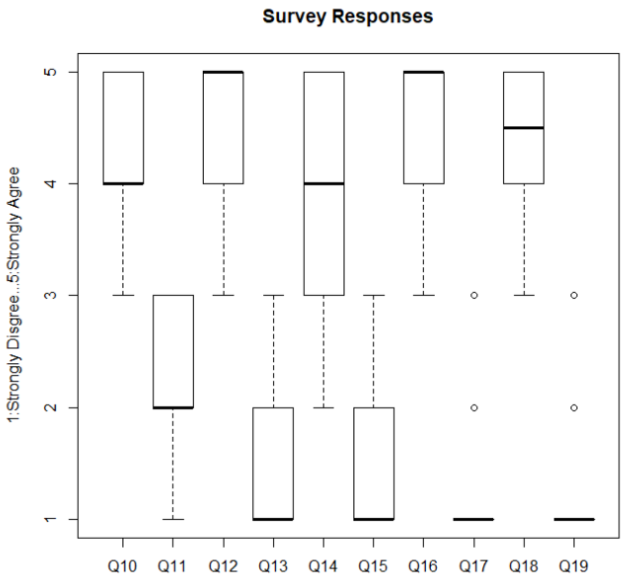


Figure 66 - Responses boxplots for the 10 questions of our survey

For odd questions the favorable results were towards “1” and in even questions towards “5”. It is worth noticing that the boxplot for question 17 regarding PM SYSTEM’s difficulty in use for respondents had almost no negative response as more than three quarters of users strongly disagreed with this statement. The same goes for the question 19 regarding the necessity of learning a lot of things before they could get going with PM SYSTEM. Other favorable responses indicated that users wouldn't need technical support for the use of system (Question 13). Finally, the results were summed up and the S.U.S. score was calculated as an average of their scores. The statistics for the S.U.S. score were given in the boxplot of Figure 67 below.

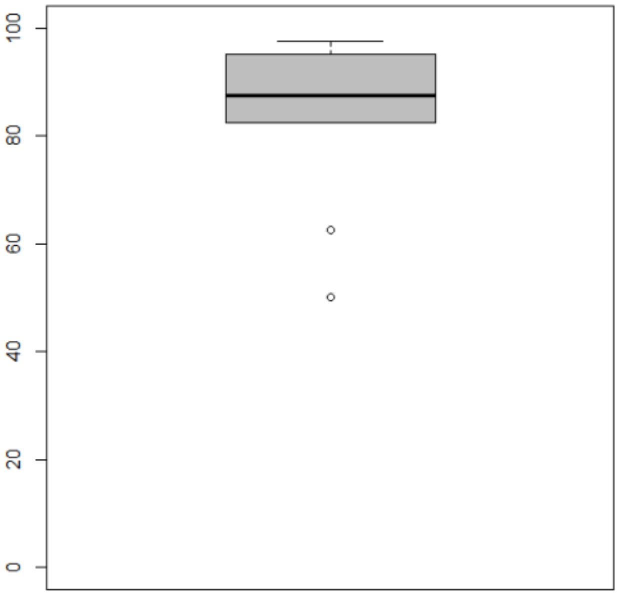


Figure 67 - The boxplot of the S.U.S. score of our survey

Based on the research, a S.U.S. score above 68 would be considered above average and anything below 68 is below average. As a consequence, we can support the hypothesis that PM SYSTEM's usability is above average as the mean value of our sample is 83.5 (median: 87.5, standard deviation: 15.64).

To continue with the general opinion of respondents regarding the pilot system, we could say that PM SYSTEM could improve the procurement process by offering them some new capabilities and possibly limiting any errors that arise but this does not mean it doesn't need any further improvement or development. This also stems from the fact that when users were asked to mention system features that were difficult for them during the pilot execution, almost half of them seemed completely satisfied and the rest reported something that made it difficult for them (as mentioned in the previous paragraph).

To conclude with another similar survey (Meidan et all, 2016), the authors have provided a comparative assessment of open source BPMS tools based on the phases of Hill's BP Lifecycle, as it is depicted at Figure 68 below:

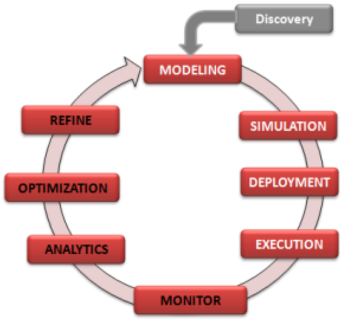


Figure 68 - Hill's BP Lifecycle [Meidan et all, 2016]

That survey has presented the total of features (for each phase) and has compared 7 open source BPMS tools that met authors' quality assessments criteria. After a brief description of those BPMS (similar with our presentation in Chapter 3.2), they applied a rating method so as to provide an analytical score for each BPMS. Armed with their calculated scores, the authors concluded their survey by stating their opinion on the most appropriate BPMS for each Lifecycle's phase.

Nevertheless, we would like to comment on some points of that research paper with which we don't fully agree:

As far as the evaluation of their characterization scheme for the BPMS tools (and more specifically for Camunda BPM) is concerned, we have to point out the following:

- **Modeling Criteria**: the authors mentioned that the generation of process documentation isn't supported. This isn't true since Camunda BPM supports the manual generation of documents (e.x. PDF) with the invoke of custom libraries (e.x. in Java) as it was proved in our case study with T.U.C.
- **Design criteria**: the authors mentioned that Service Level Agreements (SLAs) and Key Performance Indicators (KPIs) aren't supported by Camunda BPM. This is partially true on the grounds that its enterprise edition provides this capability as we mentioned in our research.
  Armed with this comment and more generally speaking, they don't mention the cases in which some features aren't supported in the community edition but are supported in the enterprise edition of the relative BPMS.
- **Deployment criteria**: the authors mentioned that distributed execution is not supported by Camunda BPM. But as we mentioned in our research, clustering is offered as the supported method for distributed execution.
  Armed with this comment and more generally speaking, they don't mention the feature of BPMS tools' compatibility with the available operating systems (e.g. Windows, Linux).
- **Other criteria**: the authors mentioned that Camunda BPM is available since 2012. This isn't true, since Camunda BPM founded on 2008 as we mentioned in our research.
  Armed with this comment and more generally speaking, they don't mention some important features such as the ease of installation as well as the installation prerequisites for each BPMS.

6 CONCLUSION

The objective of this dissertation thesis was to highlight the aspects of Business Process Management with the benefits and solutions it can offer in the competitive and complex environment of businesses and organizations nowadays. In fact, when BPM combined with Informatics, the benefits regarding the quality of services offered can be significantly increased. For this reason, a brief analysis (based on the recent BPM market) was presented regarding systems which support processes taken place in businesses or organizations. Taking into consideration the process scenario for the procurements taken place in Technical University of Crete, Camunda BPM was selected as the platform in which our PM SYSTEM was developed and implemented so as to run and support the procurement process in a pilot context. In order to draw useful conclusions from the use and experience of our PM SYSTEM platform, users' feedback was gotten and some useful findings and results were presented. The initial goal of developing a web interface, which contributed to the reduction of the required implementation time as this captured by users' responses and the statistical analysis that followed, seems to have been achieved. The usability of our system was evaluated and the results were quite encouraging as derived from users' responses and the applied S.U.S. method. Some new capabilities, like the pdf document export of users' orders and the temporary save of a task form were offered to users during the pilot test and they were assessed as positive by them. Nevertheless, it should be mentioned that an issue concerning the functionality of our system arose during the pilot test. We hadn't predicted the possibility that some users (as mentioned in 5.1 paragraph) may not submit their task forms during the pilot process execution. Thus, this was the major drawback of our implementation as emerged from the pilot test and could be improved along with some other features as reported by users in the questionnaire, on a future basis.

In conclusion, if we had to state a personal opinion on the experience gained and lessons learned from this thesis project, it would be the notion that an advanced background in Programming skills and some innovative technologies is necessary. Personally speaking, this background was not rich enough from the beginning so as to develop and implement in a short period of time a system which could run and support the above process scenario. For this reason, knowledge of specific skills such as Web Design and Development languages (HTML, CSS, Javascript, AngularJS) and Java programming were necessary so as to proceed with this project. Many personal hours in internet tutorials, forums and classes were devoted so as to enrich this knowledge. Configuring and managing a software system is not the same with developing and implement a respective one. In addition, the initial process model had to be modified (as mentioned in 3.1 paragraph) many times due to BPMN 2.0 specifications standards, Camunda BPM specific features and scenario's requirements. In particular, the last factor plays an important role to the degree of difficulty on the grounds that the more complex the scenario, the more advanced this background knowledge must be. In our case, the multiplicity in the role of Local Administrator was the main factor which made a bit more difficult the final implementation of PM SYSTEM for the pilot test. The personal feeling that remains after the end of this dissertation thesis is that the basis for an even more complete implementation in Camunda BPM platform was set for the future with the purpose of supporting the procurement process in Technical University of Crete.

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8 APPENDIX

8.1 Project Resources

- **HTML Files**

HTML Form code for the start event "Time for supplies"

```
<!DOCTYPE html>
<html lang="en">
        <head>
                        <meta charset="UTF-8">
                        <meta name="viewport" content="width=device-width, initial-scale=1.0">
                        <meta http-equiv="X-UA-Compatible" content="ie=edge">
                        <title>Time for procurements</title>
        </head>
        <body>
                        <form role="form" name="startForm" accept-charset="utf-8">
                                        <h2>Ώρα για προμήθειες</h2>
                        </form>
        </body>
</html>
```

HTML Form code for the user task "Configure products and specifications"

```
<!DOCTYPE html>
<html lang="en">
        <head>
                <meta charset="UTF-8">
                <meta name="viewport" content="width=device-width, initial-scale=1.0">
                <meta http-equiv="X-UA-Compatible" content="ie=edge">
                <title>Insert products and specifications</title>
                <link rel="stylesheet"
                href="https://maxcdn.bootstrapcdn.com/bootstrap/3.3.7/css/bootstrap.min.css"
                integrity="sha384-
                BVYiiSIFeK1dGmJRAkycuHAHRg32OmUcww7on3RYdg4Va+PmSTsz/K68vbdEjh4u"
                crossorigin="anonymous" />
                <style>
                        body                            {counter-reset: Serial;}
                        table                           {border-collapse: separate;}
                        tr td:first-child:before
                                                        {
                                                        counter-increment: Serial;
                                                        content: "" counter(Serial);
                                                        }
                </style>
        </head>
        <body>
                <form role="form" name="insertForm" accept-charset="utf-8">
                        <script cam-script type="text/form-script">
                                function loadJSON(callback) {
                                        var xobj = new XMLHttpRequest();
                                            xobj.overrideMimeType("application/json");
                                        xobj.open('GET', '../scripts/categories.json?t='+Date.now(),
true);

                                        xobj.onreadystatechange = function () {
                                                 if (xobj.readyState == 4 && xobj.status == "200") {
                                                        callback(xobj.responseText);
                                                 }
                                        };
                                        xobj.send(null);
                                }
                                loadJSON(function(response) {
                                        var productCategoriesJSON = JSON.parse(response);
                                        $scope.productCategories = productCategoriesJSON
                                });
                                $scope.products = [];
                                $scope.addProduct = function () {
                                        var product = {
                                                Category : $scope.Category,
                                                Description : $scope.Description,
                                                Details : $scope.Details,
                Price : $scope.Price
        };
        $scope.products.push(product);
                $scope.Category = "";
                        $scope.Description = "";
        $scope.Details = "";
        $scope.Price = "";
};
$scope.removeProduct = function (index) {
        var category = $scope.products[index].Category;
                $scope.products.splice(index, 1);
                }
$scope.isAddFormValid = function () {
        return ($scope.Category &&
                $scope.Description &&
                $scope.Details &&
                $scope.Price) ? true : false;
}
camForm.on('form-loaded', function() {
        camForm.variableManager.createVariable ({
                name:'product',
                type:'json',
                value:[]
        });
});
camForm.on('variables-fetched', function(evt) {
        var products =
camForm.variableManager.variableValue('product');
        if (products) {
                $scope.products = products;
        }
});
camForm.on('variables-restored', function(evt) {
        var products = evt.variableManager.variableValue('product');
        console.log(products)
        $scope.products = products ? products : [];
});
camForm.on('variables-stored', function(evt) {

});
camForm.on('store', function(evt) {
        evt.variableManager.variableValue('product', $scope.products);
        evt.retrieveVariables()
});
camForm.on('submit', function(evt) {
        if ($scope.products.length<1) {
                evt.submitPrevented = true;
        } else {
                    }
                });
            </script>
            <h2><b>Λίστα Προϊόντων</b></h2>
                <div>
                <table style="width:100%;">
                    <thead>
                        <tr>
                            <th><b>α/α<br>Είδους</b></th>
                            <th><b>Είδος</b></th>
                            <th><b>Περιγραφή</b></th>
                            <th><b>Κόστος (€)<br>(με ΦΠΑ)</b></th>
                            <th><b>URL<br>Ενδεικτικού
                            Αρχείου<br>Προδιαγραφών</b></th>
                            <th></th>
                        </tr>
                    </thead>
                    <tbody ng-repeat="x in products track by $index">
                        <tr>
                            <td></td>
                            <td><input style="width:250px;" type="text"
                            value="{{x.Category}}" /></td>
                            <td style="width:100% ; padding: 0px 0px 0px
                            0px"><textarea rows="3" type="text"
                            style="width:100%;">{{x.Description}}</textarea
                            ></td>
                            <td><input style="width:75px;"  type="number"
                            value="{{x.Price}}" /></td>
                            <td style="width:100% ; padding: 0px 0px 0px
                            0px"><textarea rows="1" type="url"
                            style="width:100%;">{{x.Details}}</textarea></
                            td>
                                <td><input type="button" ng-
                            click="removeProduct($index)"
                            value="Remove" /></td>
                        </tr>
                    </tbody>
                </table>
            </div>
            <hr>
            <div>
                <h2><b>Καταχώρησε νέο προϊόν</b></h2>
                <div class="row">
                    <div class="col-md-6">
                        <div class="form-group">
                            <label class="control-label"
            for="category">Επίλεξε Είδος:</label>
                            <select hidden cam-variable-
name="PRODUCT_CATEGORIES"
```

```
                                cam-variable-type="json">
                            </select>
                            <div class="controls">
                                <input list="category"
name="categories" style="width:250px;" ng-model="Category" />
                                <datalist  id="category" >
                                    <option ng-
repeat="productCategory in productCategories" value="{{productCategory.name}}">Name
{{productCategory.name}}</option>
                                </datalist>
                            </div>
                        </div>
                    </div>
                    <div class="col-md-6">
                        <div class="form-group">
                            <label class="control-label"
                            for="description">Περιγραφή</label>
                            <div class="controls">
                                <textarea id="description" rows="3"
onkeypress="this.style.width = Math.min((this.value.length + 1) * 8,400) + 'px';" ng-
model="Description" type="text"></textarea>
                            </div>
                        </div>
                        <div class="form-group">
                            <label class="control-label" for="price">Κόστος
                            (€)<br>(με ΦΠΑ)</label>
                            <div class="controls">
                                <input style="width:75px;" id="price"
                            type="number" min="0" ng-model="Price" />
                            </div>
                        </div>
                        <div class="form-group">
                            <label class="control-label"
                            for="details">URL<br>Ενδεικτικού
                            Αρχείου<br>Προδιαγραφών</label>
                            <div class="controls">
                                <textarea id="details" rows="3"
onkeypress="this.style.width = Math.min((this.value.length + 1) * 8,400) + 'px';" ng-model="Details"
type="url"></textarea>
                            </div>
                        </div>
                        <div class="controls">
                            <input type="button" ng-click="addProduct()"
ng-show="isAddFormValid()" value="Add" />
                            </div>
                    </div>
                </div>
            </div>
        </form>
```

```
    </body>
</html>
```

HTML Form code for the user task “Select Products”

```
<!DOCTYPE html>
<html lang="en">
    <head>
            <meta charset="UTF-8">
            <meta name="viewport" content="width=device-width, initial-scale=1.0">
            <meta http-equiv="X-UA-Compatible" content="ie=edge">
            <title>Select products</title>
    </head>
    <body>
        <form role="form" name="selectForm" accept-charset="utf-8">
            <script cam-script type="text/form-script">
                $scope.product = [];
                function loadJSON(callback) {
                    var xobj = new XMLHttpRequest();
                        xobj.overrideMimeType("application/json");
                    xobj.open('GET', '../scripts/budgets.json?t='+Date.now(), true);
                    xobj.onreadystatechange = function () {
                         if (xobj.readyState == 4 && xobj.status == "200") {
                            callback(xobj.responseText);
                         }
                    };
                    xobj.send(null);
                }
                loadJSON(function(response) {
                    var facultyBudgetsJSON = JSON.parse(response);
                    $scope.facultyBudgets = facultyBudgetsJSON;
                    $scope.faculty = '';
                    $scope.budget = '';
                    inject(['$rootScope', function($rootScope) {
                        var username = $rootScope.authentication.name;
                        angular.forEach($scope.facultyBudgets,
function(facultyBudget) {
                            if (facultyBudget.username == username) {
                                $scope.faculty = facultyBudget.faculty;
                                $scope.budget = facultyBudget.budget;
                            }
                        });
                    }]);
                });
```

```
camForm.on('form-loaded', function(evt) {
    camForm.variableManager.fetchVariable('product');
});
camForm.on('variables-fetched', function() {
    var products =
camForm.variableManager.variableValue('product');
    console.log('variables-fetched',products)
    if (products) {
        $scope.product = products;
    }
});
camForm.on('variables-restored', function(evt) {
    var product = evt.variableManager.variableValue('product');
    console.log('variables-restored',product)
    $scope.product = product ? product : [];
    $scope.total = total();
    $scope.countProducts = countProducts();
});
camForm.on('variables-stored', function(evt) {

});
camForm.on('store', function(evt) {
    evt.variableManager.variableValue('product', $scope.product);
    evt.retrieveVariables()
});
$scope.changeQuantity = function(x, index, chkselct) {
        console.log('x: ' +x.Quantity+ ', chkselct: ' +chkselct+ ',
index: '+ index);
            if (!chkselct) {
                x.Quantity=undefined;
            }
    var product = $scope.product;
    product[index] = x;
    product[index]['chkselct'] = chkselct;
    $scope.product = product;
    $scope.total = total();
    $scope.countProducts = countProducts();
    $scope.selectForm.$dirty = true;
}
function countProducts() {
    var countProducts = 0;
    angular.forEach($scope.product, function(x) {
        if (x.Quantity) {
                countProducts += x.Quantity;
            }
    })
    console.log('countProducts: ' + countProducts);
        return countProducts;
    }
    function total() {
            var total = 0;
            angular.forEach($scope.product, function(x) {
                if (x.Quantity) {
                        total += x.Price * x.Quantity;
                    }
        })
        console.log('Total: ' + total);
        return total;
    }
    camForm.on('submit', function(evt) {
        var selectedProduct = [];
            angular.forEach($scope.product, function(x) {
                if (x.Quantity) {
                        selectedProduct.push(x);
                        }
        })
        if (selectedProduct.length<1 || $scope.total>$scope.budget) {
                evt.submitPrevented = true;
        } else {
            camForm.variableManager.createVariable ({
                name: 'selectedProduct',
                    type: 'json',
                    value: selectedProduct
            });
        }
    });
</script>
<div>
    <label for="faculty">ΤΜΗΜΑ :</label>
    <span>{{faculty}}</span><br>
    <label for="budget">ΠΡΟΥΠΟΛΟΓΙΣΜΟΣ :</label>
    <span>{{budget}} (€)</span><br>
    <label for="budget">ΥΠΟΛΟΙΠΟ :</label>
    <span>{{budget - total}} (€)</span>
</div>
<hr>
<h2><b>Λίστα Προϊόντων</b></h2>
    <style>
        table.robotCLS td, table.robotCLS th {
        padding: 2px 5px 2px 5px !important;
        font-size: 13px;
    }
    table.robotCLS textarea {
        width:100%;
    }
</style>
<div>
```

```
                                        <table class="robotCLS" style="width:100%;">
                                                        <thead>
                                                        <tr>
                                                                <th><b>α/α<br>Είδους</b></th>
                                                                <th><b>Είδος</b></th>
                                                                <th><b>Περιγραφή</b></th>
                                                                <th><b>Κόστος (€)<br>(με ΦΠΑ)</b></th>
                                                                <th><b>URL<br>Ενδεικτικού
Αρχείου<br>Προδιαγραφών</b></th>
                                                                <th><b>Επιλογή</b></th>
                                                                <th><b>Ποσότητα</b></th>
                                                                <th><b>Κόστος Παραγγελίας (€)<br>(με
ΦΠΑ)</b></th>
                                                        </tr>
                                                </thead>
                                                <tbody>
                                                        <tr ng-repeat="x in product track by $index">
                                                                <td>{{$index+1}}</td>
                                                                <td><input style="width:250px;" type="text"
value="{{x.Category}}" readonly /></td>
                                                                <td style="width:100% ; padding: 0px 0px 0px
0px"><textarea rows="3" type="text" readonly>{{x.Description}}</textarea></td>
                                                                <td><input style="width:75px;" type="text"
value="{{x.Price}}" readonly /></td>
                                                                <td><input style="width:100px;" type="url"
value="{{x.Details}}" readonly hidden /><a href="{{x.Details}}" target="_blank">URL
Αρχείου</a></td>                                                <td><input style="width:25px;
height:25px;" type="checkbox" ng-model="x.chkselct"        cam-variable-name="isProductSelected"
cam-variable-type="Boolean" ng-change="changeQuantity(x, $index, x.chkselct)" /></td>
                                                                                        <td ng-
show="x.chkselct"><input type="number" ng-model="x.Quantity" cam-variable-name="quantity"
min="1" cam-variable-type="Integer" ng-change="changeQuantity(x, $index, x.chkselct)" /></td>

        <td><input value="{{x.Quantity>0 ? x.Price * x.Quantity : 0}}" readonly /></td>
                                                        </tr>
                                                        <tr>
                                                                <td></td>
                                                                <td></td>
                                                                <td></td>
                                                                <td></td>
                                                                <td></td>
                                                                <td><b>Σύνολο</b></td>
                                                                <td><b><input value="{{countProducts}}"
readonly /></b></td>
                                                                <td><b><input value="{{total}}" readonly
/></b></td>
                                                        </tr>
                                                </tbody>
                                        </table>
```

```
                </div>
            </form>
        </body>
</html>
```

<u>HTML Form code for the user task “Export the document with orders”</u>

```
<!DOCTYPE html>
<html lang="en">
        <head>
            <meta charset="UTF-8">
            <meta name="viewport" content="width=device-width, initial-scale=1.0">
            <meta http-equiv="X-UA-Compatible" content="ie=edge">
            <title>Download the orders document</title>
        </head>
        <body>
            <form role="form" name="downloadTheOrdersDocument" accept-charset="utf-8">
                <b><p>Μπορείτε να κατεβάσετε το αρχείο της παραγγελίας σας κλικάροντας στον
σύνδεσμο που ακολουθεί: <a cam-file-download="orderList"></a> </p></b>
                <b><p>Για την επιτυχή ολοκλήρωση της Διαδικασίας Διαλογής Προϊόντων σας,
παρακαλώ πατήστε το πλήκτρο "Complete" στα δεξιά της φόρμας</p></b>
            </form>
        </body>
</html>
```

<u>HTML Form code for the user task “Receive the orders”</u>

```
<!DOCTYPE html>
<html lang="en">
        <head>
            <meta charset="UTF-8">
            <meta name="viewport" content="width=device-width, initial-scale=1.0">
            <meta http-equiv="X-UA-Compatible" content="ie=edge">
        <title>Receive the orders</title>
    </head>
    <body>
        <form role="form" name="receiveTheOrders" accept-charset="utf-8">
            <script cam-script type="text/form-script">
                var variableManager = camForm.variableManager;
                var selectedProducts = [];
                camForm.on('form-loaded', function() {
                    console.log('asdasd')
                    variableManager.fetchVariable('aggregatedList');
                    console.log('rrrr')
                });
                camForm.on('variables-fetched', function(t) {
                    console.log('rrrr1',t,t.variableManager.variables.aggregatedList)
                    var aggregatedList = t.variableManager.variables.aggregatedList;
                    console.log($scope)
                    var selectedProducts = [];
                    var total = 0;
                    var countProducts = 0;
                    for (var key in aggregatedList.value){
                        var selectedProductsPerUser = aggregatedList.value[key];

    selectedProductsPerUser.forEach(function(selectedProduct) {
                            selectedProduct.user = key;
                            selectedProducts.push(selectedProduct)
                            total += selectedProduct.Price *
selectedProduct.Quantity;
                            countProducts += selectedProduct.Quantity;
                        });
                    }
                    $scope.total = total;
                    $scope.countProducts = countProducts;
                    $scope.selectedProducts = selectedProducts;
                    console.log('rrrr2',$scope.selectedProducts)
                });
            </script>
            <h2><b>Λίστα Επιλεγμένων Προϊόντων</b></h2>
             <style>
                    table.robotCLS td, table.robotCLS th {
                    padding: 2px 5px 2px 5px !important;
                    font-size: 13px;
                }
                table.robotCLS textarea {
                    width:100%;
                }
            </style>
            <div>
                <table class="robotCLS" style="width:100%;">
                    <thead>
```

```
                        <tr>
                            <th>α/α<br>Είδους</th>
                            <th>Τοπικός Διαχειριστής</th>
                            <th>Είδος</th>
                            <th>Περιγραφή</th>
                            <th>Κόστος (€)<br>(με ΦΠΑ)</th>
                            <th>URL<br>Ενδεικτικού
Αρχείου<br>Προδιαγραφών</th>
                            <th>Ποσότητα</th>
                            <th>Σύνολο (€)<br>(με ΦΠΑ)</th>
                        </tr>
                    </thead>
                    <tbody>
                        <tr ng-repeat="y in selectedProducts track by $index">
                            <td>{{$index+1}}</td>
                            <td><input style="width:125px;" type="text"
value="{{y.user}}" readonly /></td>
                            <td><input style="width:250px;" type="text"
value="{{y.Category}}" readonly /></td>
                            <td style="width:100% ; padding: 0px 0px 0px
0px"><textarea rows="3" type="text" readonly>{{y.Description}}</textarea></td>
                            <td><input style="width:75px;" type="number"
value="{{y.Price}}" readonly /></td>
                            <td><input style="width:100px;" type="url"
value="{{y.Details}}" readonly hidden /><a href="{{y.Details}}" target="_blank">URL
Αρχείου</a></td>
                            <td><input type="number"
value="{{y.Quantity}}" min="1" readonly /></td>
                                        <td><input
value="{{y.Price * y.Quantity}}" readonly /></td>
                        </tr>
                        <tr>
                            <td></td>
                            <td></td>
                            <td></td>
                            <td></td>
                            <td></td>
                            <td><b>Σύνολο</b></td>
                            <td><b><input value="{{countProducts}}"
readonly /></b></td>
                            <td><b><input value="{{total}}" readonly
/></b></td>
                        </tr>
                    </tbody>
                </table>
            </div>
        </form>
    </body>
</html>
```

HTML Form code for the user task “Export the final document with orders”

```
<!DOCTYPE html>
<html lang="en">
        <head>
                        <meta charset="UTF-8">
                        <meta name="viewport" content="width=device-width, initial-scale=1.0">
                        <meta http-equiv="X-UA-Compatible" content="ie=edge">
                        <title>Download the final document</title>
        </head>
        <body>
                <form role="form" name="downloadTheFinalDocument" accept-charset="utf-8">
                        <b><p>Μπορείτε να κατεβάσετε το αρχείο των προς παραγγελία προϊόντων κλικάροντας στον σύνδεσμο που ακολουθεί: <a cam-file-download="finalList"></a> </p></b>
                        <b><p>Για την επιτυχή ολοκλήρωση της Διαδικασίας Διαγωνισμού Προμηθειών Αναλώσιμων Ειδών, παρακαλώ πατήστε το πλήκτρο "Complete" στα δεξιά της φόρμας</p></b>
                </form>
        </body>
</html>
```

- **Java Class Files**

Java class code for the assignment of user task “Select Products”

```
package org.camunda.bpm.myproject.electronic_equipment_competitions;

import java.util.logging.Level;
import java.util.logging.Logger;

import org.apache.commons.mail.Email;
import org.apache.commons.mail.SimpleEmail;
import org.camunda.bpm.engine.IdentityService;
import org.camunda.bpm.engine.delegate.DelegateTask;
import org.camunda.bpm.engine.delegate.TaskListener;
import org.camunda.bpm.engine.identity.User;
import org.camunda.bpm.engine.impl.context.Context;

public class TaskAssignmentListener implements TaskListener {

    private static final String HOST = "smtp.isc.tuc.gr";
    private static final int PORT = 587;
    private static final String USER = "promsystem@isc.tuc.gr";
    private static final String PWD = "pilotAksio!0801";
    private final static Logger LOGGER =
   Logger.getLogger(TaskAssignmentListener.class.getName());

    public void notify(DelegateTask delegateTask) {

      String assignee = delegateTask.getAssignee();
      String taskId = delegateTask.getId();

      if (assignee != null) {

        IdentityService identityService =
Context.getProcessEngineConfiguration().getIdentityService();
        User user = identityService.createUserQuery().userId(assignee).singleResult();

        if (user != null) {

          String recipient = user.getEmail();

          if (recipient != null && !recipient.isEmpty()) {

            Email email = new SimpleEmail();
            email.setCharset("utf-8");
            email.setHostName(HOST);
            email.setSSLOnConnect(false);
            email.setStartTLSRequired(true);
```

```
                    email.setStartTLSEnabled(true);
                    email.setSmtpPort(PORT);
                    email.setSslSmtpPort("587");
                    email.setAuthentication(USER, PWD);

                    try {
                              email.setFrom("promsystem@isc.tuc.gr");
                              email.setSubject("Ανάθεση Εργασίας: " + delegateTask.getName());
                              email.setMsg("Για τη συμμετοχή σας στην πιλοτική λειτουργία και αξιολόγηση του
συστήματος αυτοματοποίησης της διαδικασίας διαγωνισμών προμηθειών στο Πολυτεχνείο Κρήτης
παρακαλούμε ακολουθήστε τον παρακάτω σύνδεσμο. " + "Θα χρειαστείτε και το username και password που
λάβατε σε προηγούμενο email για να συνδεθείτε. " + "Αφού συνδεθείτε θα χρειαστεί να επιλέξετε Είδη
Υπολογιστικής Υποδομής (Η/Υ και Περιφερειακά), σύμφωνα με το διαθέσιμο προϋπολογισμό σας. " +
"Παρακαλούμε διαθέστε 5 λεπτά για να συμπληρώσετε την φόρμα. " + "Η προθεσμία που έχουμε βάλει για
την πιλοτική αυτή εφαρμογή είναι ως την Τρίτη 14/7/2020 στις 14:00. " + "Συνδεθείτε: " +
"http://147.27.70.60:8080/camunda/app/tasklist/default/#/task/" + taskId);

                              email.addTo(recipient);
                              email.send();
                              LOGGER.info("Task Assignment Email successfully sent to user '" + assignee
+ "' with address '" + recipient + "'.");
                         } catch (Exception e) {
                                                  LOGGER.log(Level.WARNING, "Could not send email to
assignee", e);
                                                  }

                  } else {
                              LOGGER.warning("Not sending email to user " + assignee + "', user has no
email address.");
                        }

                 } else {
                                        LOGGER.warning("Not sending email to user " + assignee + "', user is
not enrolled with identity service.");
                        }

             }

           }

}
```

Java class code for the generation of orders document in user task "Export the document with orders"

```
package org.camunda.bpm.myproject.electronic_equipment_competitions;

import java.io.File;
import java.io.IOException;
import java.io.InputStream;

import org.camunda.bpm.engine.delegate.DelegateTask;
import org.camunda.bpm.engine.delegate.TaskListener;
import org.camunda.bpm.engine.variable.Variables;
import org.camunda.bpm.engine.variable.value.FileValue;
import org.camunda.spin.plugin.variable.value.JsonValue;
import org.camunda.spin.plugin.variable.value.impl.JsonValueImpl;
import org.camunda.spin.impl.json.jackson.JacksonJsonNode;
import org.camunda.spin.json.*;
import static org.camunda.spin.Spin.*;
import static org.camunda.spin.Spin.*;
import org.camunda.spin.SpinList;
import static org.camunda.spin.DataFormats.*;
import java.util.List;

import com.openhtmltopdf.pdfboxout.PdfRendererBuilder;
import java.io.File;
import java.io.IOException;
import java.nio.file.Files;

import java.io.FileOutputStream;
import java.io.OutputStream;
import java.io.IOException;

public class GenerationOrdersDocumentDelegate implements TaskListener {

  @Override
  public void notify(DelegateTask delegateTask)  {
    JsonValue json  = (delegateTask.getVariableTyped("selectedProduct"));
    SpinJsonNode jsont = S(delegateTask.getVariable("selectedProduct"), json());
    System.out.println("test "+jsont.toString());
    SpinList products = jsont.elements();
    String pdfHTMLtrs = "";
    double totalPrice = 0.0;
    int totalQuantity = 0;
    for (int i = 0; i < products.size(); i++) {
      SpinJsonNode product = S(products.get(i), json());
      System.out.println("product "+product.toString());
      double price = Double.parseDouble(product.prop("Price").toString());
      int quantity = Integer.parseInt(product.prop("Quantity").toString());
      totalQuantity += quantity;
      double priceInnerTotal = price*quantity;
      totalPrice += priceInnerTotal;
      pdfHTMLtrs = pdfHTMLtrs + "<tr>"+
          "<td>"+product.prop("Category")+"</td>"+
          "<td>"+product.prop("Description")+"</td>"+
          "<td>"+product.prop("Price")+"</td>"+
          "<td>"+product.prop("Details")+"</td>"+
          "<td>"+product.prop("Quantity")+"</td>"+
          "<td>"+Double.toString(priceInnerTotal)+"</td>"+
          "</tr>";
    }
    System.out.println("test2 ");
    pdfHTMLtrs = pdfHTMLtrs + "<tr>"+
        "<td>-</td>"+
        "<td>-</td>"+
        "<td>-</td>"+
        "<td>-</td>"+
        "<td>"+Integer.toString(totalQuantity)+"</td>"+
        "<td>"+Double.toString(totalPrice)+"</td>"+
        "</tr>";
    try (OutputStream os = new FileOutputStream("/tmp/myOrdersDocument.pdf")) {
      PdfRendererBuilder builder = new PdfRendererBuilder();
      builder.useFastMode();
      builder.useFont(new File("/tmp/SourceSansPro-Regular.ttf"), "source-sans");
      builder.withHtmlContent("<?xml version='1.0' encoding='UTF-8'?><!DOCTYPE
html><html><head><meta http-equiv=\"Content-Type\" content=\"text/html; charset=UTF-
8\"/><meta charset=\"UTF-8\" />"+
          "<style>"+
            "@page {" +
              "size: A4 portrait;" +
            "}"+
            ".table {" +
              "width: 100%;" +
              "max-width: 100%;" +
              "border-collapse: collapse;" +
              "margin-bottom: 8px;" +
              "text-align: center;" +
            "}"+
            "@font-face {"+
              "font-family: 'source-sans';"+
              "font-style: normal;"+
              "font-weight: 400;"+
              "src: url('file:///tmp/SourceSansPro-Regular.ttf');"+
              "-fs-font-subset: complete-font;"+
            "} *{font-family: 'source-sans';} "+
          "</style></head><body><div></div><table style=\"width:100%;\" border=\"1\">"+
          "<tr>"+
            "<td>Είδος</td>"+
            "<td>Περιγραφή</td>"+
            "<td>Κόστος (€) (με ΦΠΑ)</td>"+
                        "<td>URL Ενδεικτικού Αρχείου Προδιαγραφών</td>"+
                        "<td>Ποσότητα</td>"+
                        "<td>Σύνολο</td>"+
                    "</tr>"+pdfHTMLtrs+
                    "</table></body></html>","");
            builder.toStream(os);
            builder.run();
            FileValue typedFileValue = Variables
                    .fileValue("myOrdersDocument.pdf")
                    .file(new File("/tmp/myOrdersDocument.pdf"))
                    .mimeType("application/pdf")
                    .encoding("UTF-8")
                    .create();
            delegateTask.setVariable("orderList", typedFileValue);
            FileValue retrievedTypedFileValue = delegateTask.getVariableTyped("orderList");
            InputStream fileContent = retrievedTypedFileValue.getValue();
            String fileName = retrievedTypedFileValue.getFilename();
            String mimeType = retrievedTypedFileValue.getMimeType();
            String encoding = retrievedTypedFileValue.getEncoding();
            System.out.println(fileName.toString());
            System.out.println(mimeType.toString());
            System.out.println(encoding.toString());
        } catch(Exception e) {

    }

    }
}
```

Java class code for the assignment of user task “Receive the orders”

```
package org.camunda.bpm.myproject.electronic_equipment_competitions;

import java.util.logging.Level;
import java.util.logging.Logger;

import org.apache.commons.mail.Email;
import org.apache.commons.mail.SimpleEmail;
import org.camunda.bpm.engine.IdentityService;
import org.camunda.bpm.engine.delegate.DelegateTask;
import org.camunda.bpm.engine.delegate.TaskListener;
import org.camunda.bpm.engine.identity.User;
import org.camunda.bpm.engine.impl.context.Context;

public class FinalTaskAssignmentListener implements TaskListener {

  private static final String HOST = "smtp.isc.tuc.gr";
  private static final int PORT = 587;
  private static final String USER = "promsystem@isc.tuc.gr";
  private static final String PWD = "pilotAksio!0801";

  private final static Logger LOGGER =
Logger.getLogger(FinalTaskAssignmentListener.class.getName());

  public void notify(DelegateTask delegateTask) {

    String assignee = delegateTask.getAssignee();
    String taskId = delegateTask.getId();

    if (assignee != null) {

      IdentityService identityService = Context.getProcessEngineConfiguration().getIdentityService();
      User user = identityService.createUserQuery().userId(assignee).singleResult();

      if (user != null) {

        String recipient = user.getEmail();

        if (recipient != null && !recipient.isEmpty()) {

          Email email = new SimpleEmail();
          email.setCharset("utf-8");
          email.setHostName(HOST);
          email.setSSLOnConnect(false);
          email.setStartTLSRequired(true);
          email.setStartTLSEnabled(true);
          email.setSmtpPort(PORT);
          email.setSslSmtpPort("587");
          email.setAuthentication(USER, PWD);
          try {
            email.setFrom("promsystem@isc.tuc.gr");
            email.setSubject("Ανάθεση Εργασίας: " + delegateTask.getName());
            email.setMsg("Η Διαδικασία Διαλογής Ειδών Υπολογιστικής Υποδομής (Η/Υ και
Περιφερειακά) ολοκληρώθηκε. " +
                  "Παρακαλούμε ακολουθήστε την παρακάτω διεύθυνση προκειμένου να λάβετε και
ακολούθως να υποβάλλετε την Λίστα Παραγγελιών. " +
                  "Για την προμήθεια των εν λόγων Ειδών θα ακολουθήσει Διαγωνιστική Διαδικασία,
συνολική για όλο το Ίδρυμα. " +
                  "http://147.27.70.60:8080/camunda/app/tasklist/default/#/task/" + taskId);

            email.addTo(recipient);

            email.send();
            LOGGER.info("Final Task Assignment Email successfully sent to user '" + assignee + "'
with address '" + recipient + "'.");

          } catch (Exception e) {
            LOGGER.log(Level.WARNING, "Could not send email to assignee", e);
          }

        } else {
          LOGGER.warning("Not sending email to user " + assignee + "', user has no email
address.");
        }

      } else {
        LOGGER.warning("Not sending email to user " + assignee + "', user is not enrolled with
identity service.");
      }

    }

  }

}
```

Java class code for the generation of orders document in user task “Export the document with orders”

```
package org.camunda.bpm.myproject.electronic_equipment_competitions;

import java.io.File;
import java.io.IOException;
import java.io.InputStream;

import org.camunda.bpm.engine.delegate.DelegateTask;
import org.camunda.bpm.engine.delegate.TaskListener;
import org.camunda.bpm.engine.variable.Variables;
import org.camunda.bpm.engine.variable.value.FileValue;
import org.camunda.spin.plugin.variable.value.JsonValue;
import org.camunda.spin.plugin.variable.value.impl.JsonValueImpl;
import org.camunda.spin.impl.json.jackson.JacksonJsonNode;
import org.camunda.spin.json.*;
import static org.camunda.spin.Spin.*;
import static org.camunda.spin.Spin.*;
import org.camunda.spin.SpinList;
import static org.camunda.spin.DataFormats.*;
import java.util.List;

import com.openhtmltopdf.pdfboxout.PdfRendererBuilder;
import java.io.File;
import java.io.IOException;
import java.nio.file.Files;

import java.io.FileOutputStream;
import java.io.OutputStream;
import java.io.IOException;

public class GenerationDocumentDelegate implements TaskListener  {

        @Override
        public void notify(DelegateTask delegateTask)  {
                JsonValue json  = (delegateTask.getVariableTyped("aggregatedList"));
                SpinJsonNode jsont = S(delegateTask.getVariable("aggregatedList"), json());
                List<String> fieldNames = jsont.fieldNames();
                String pdfHTMLtrs = "";
                double totalPrice = 0.0;
                int totalQuantity = 0;
                for (int i = 0; i < fieldNames.size(); i++) {
                        String key = fieldNames.get(i);
                        SpinJsonNode userJs = jsont.prop(key);
                        SpinList selections = userJs.elements();
                        for (int j = 0; j < selections.size(); j++) {
                                SpinJsonNode selection = S(selections.get(j), json());
                                System.out.println(selection.toString());
                                double price = Double.parseDouble(selection.prop("Price").toString());
                                int quantity = Integer.parseInt(selection.prop("Quantity").toString());
                                totalQuantity += quantity;
                                double priceInnerTotal = price*quantity;
                                totalPrice += priceInnerTotal;
                                pdfHTMLtrs = pdfHTMLtrs + "<tr>"+
                                    "<td>"+selection.prop("user")+"</td>"+
                                    "<td>"+selection.prop("Category")+"</td>"+
                                    "<td>"+selection.prop("Description")+"</td>"+
                                        "<td>"+selection.prop("Price")+"</td>"+
                                    "<td>"+selection.prop("Quantity")+"</td>"+
                                    "<td>"+Double.toString(priceInnerTotal)+"</td>"+
                                "</tr>";
                        }

                }
                pdfHTMLtrs = pdfHTMLtrs + "<tr>"+
                        "<td>-</td>"+
                        "<td>-</td>"+
                        "<td>-</td>"+
                        "<td>-</td>"+
                        "<td>"+Integer.toString(totalQuantity)+"</td>"+
                        "<td>"+Double.toString(totalPrice)+"</td>"+
                "</tr>";
        System.out.println(fieldNames.toString());
        try (OutputStream os = new FileOutputStream("/tmp/finalDocument.pdf")) {
        PdfRendererBuilder builder = new PdfRendererBuilder();
        builder.useFastMode();
        builder.useFont(new File("/tmp/SourceSansPro-Regular.ttf"), "source-sans");
        builder.withHtmlContent("<?xml version='1.0' encoding='UTF-8'?><!DOCTYPE
html><html><head><meta http-equiv=\"Content-Type\" content=\"text/html; charset=UTF-
8\"/><meta charset=\"UTF-8\" />"+
        "<style>"+
                                "@page {" +
                                    "size: A4 portrait;" +
                                "}"+
                                ".table {" +
                                    "width: 100%;" +
                                    "max-width: 100%;" +
                                    "border-collapse: collapse;" +
                                    "margin-bottom: 8px;" +
                                    "text-align: center;" +
                                "}"+
                "@font-face {"+
                                    "font-family: 'source-sans';"+
                "font-style: normal;"+
                "font-weight: 400;"+
                "src: url('file:///tmp/SourceSansPro-Regular.ttf');"+
                "-fs-font-subset: complete-font;"+
        "} *{font-family: 'source-sans';} "+
                        "</style></head><body><div></div><table          style=\"width:100%;\"
border=\"1\">"+
                                "<tr>"+
                                        "<td>Τοπικός Διαχειριστής</td>"+
                                        "<td>Είδος</td>"+
                                        "<td>Περιγραφή</td>"+
                                        "<td>Κόστος (€) (με ΦΠΑ)</td>"+
                                        "<td>Ποσότητα</td>"+
                                        "<td>Σύνολο</td>"+
                                "</tr>"+pdfHTMLtrs+
                                "</table></body></html>","");
        builder.toStream(os);
        builder.run();
        FileValue typedFileValue = Variables
                  .fileValue("finalDocument.pdf")
                  .file(new File("/tmp/finalDocument.pdf"))
                  .mimeType("application/pdf")
                  .encoding("UTF-8")
                  .create();
        delegateTask.setVariable("finalList", typedFileValue);

                 FileValue retrievedTypedFileValue = delegateTask.getVariableTyped("finalList");
                 InputStream fileContent = retrievedTypedFileValue.getValue();
                 String fileName = retrievedTypedFileValue.getFilename();
                 String mimeType = retrievedTypedFileValue.getMimeType();
                 String encoding = retrievedTypedFileValue.getEncoding();
                 System.out.println(fileName.toString());
                 System.out.println(mimeType.toString());
                 System.out.println(encoding.toString());
      } catch(Exception e) {

                 }

         }


}
```

- **JSON Files**

JSON file for the load of product categories in user task form “Configure products and specifications”

```
[{
        "name":"Οθόνη ΗΥ"
},{
        "name":"Υπολογιστής ταμπλέτα"
},{
        "name":"Σαρωτής"
},{
        "name":"Εκτυπωτής τύπου Α’"
},{
        "name":"Εκτυπωτής τύπου Β’"
},{
        "name":"Πολυμηχάνημα τύπου Α’"
},{
        "name":"Πολυμηχάνημα τύπου Β’"
},{
        "name":"Βιντεοπροβολέας"
},{
        "name":"Φορητό πανί προβολής"
},{
        "name":"Σταθεροποιητής τάσης (UPS)"
}]
```

JSON file for the load of faculties budget in user task form "Select Products"

[{
	"email":"dina@ict.tuc.gr", "faculty":"Τμήμα Διοικητικής Υπολογιστικής Υποδομής", "budget":5000, "username":"kglymidaki"
},{
	"email":"johnny@ict.tuc.gr", "faculty":"Διεύθυνση Τηλεπικοινωνιών, Δικτύων και Υπολογιστικής Υποδομής", "budget":3000, "username":"johnny"
},{
	"email":"mpathiaki1@isc.tuc.gr", "faculty":"Τμήμα Διοικητικής Υπολογιστικής Υποδομής", "budget":3000, "username":"mpathiaki1"
},{
	"email":"tlyrantonaki@isc.tuc.gr", "faculty":"Τμήμα Τηλεπικοινωνιών και Δικτύων", "budget":3000, "username":"tlyrantonaki"
},{
	"email":"spanaki@ict.tuc.gr", "faculty":"Τμήμα Τηλεπικοινωνιών και Δικτύων", "budget":3000, "username":"spanaki"
},{
	"email":"pkonto@ict.tuc.gr", "faculty":"Τμήμα Εκπαιδευτικής Υπολογιστικής Υποδομής", "budget":3000, "username":"pkonto"
},{
	"email":"vpapadakis@isc.tuc.gr", "faculty":"Τμήμα Διοικητικής Υπολογιστικής Υποδομής", "budget":3000, "username":"vpapadakis"
},{
	"email":"nispanoudakis@isc.tuc.gr", "faculty":"Σχολή Μηχανικών Παραγωγής και Διοίκησης", "budget":3000, "username":"nispanoudakis"
},{
	"email":"sotiris@telecom.tuc.gr", "faculty":"Εργαστήριο Πληροφορίας και Δικτύων", "budget":3000, "username":"sotiris"
},{
	"email":"lia@ergasya.tuc.gr", "faculty":"Εργαστήριο Σχεδιασμού και Ανάπτυξης Συστημάτων Υποστήριξης Αποφάσεων", "budget":3000, "username":"lia"
},{
	"email":"aliadaki1@isc.tuc.gr", "faculty":"Εργαστήριο Συστημάτων Χρηματοοικονομικής Διοίκησης", "budget":3000, "username":"aliadaki1"
},{
	"email":"garampatzis@pem.tuc.gr", "faculty":"Τομέας Συστημάτων Παραγωγής ΜΠΔ", "budget":3000, "username":"garampatzis"
},{
	"email":"gkritik@mred.tuc.gr", "faculty":"Εργαστήριο Εφαρμοσμένης Γεωφυσικής", "budget":3000, "username":"gkritik"
},{
	"email":"manolis@science.tuc.gr", "faculty":"Εργαστήριο Εφαρμοσμένων Μαθηματικών και Ηλεκτρονικών Υπολογιστών", "budget":3000, "username":"manolis"
},{
	"email":"sargyropoulos@isc.tuc.gr", "faculty":"Εργαστήριο Προγραμματισμού και Τεχνολογίας Ευφυών Υπολογιστικών Συστημάτων", "budget":3000, "username":"sargyropoulos"
},{

"email":"kanellos@ece.tuc.gr", "faculty":"Εργαστήριο Συστημάτων Ηλεκτρικής Ενέργειας", "budget":3000, "username":"kanellos"
},{
"email":"konstantina.tyrovola@enveng.tuc.gr", "faculty":"Εργαστήριο Βιοχημικής Μηχανικής και Περιβαλλοντικής Βιοτεχνολογίας", "budget":3000, "username":"ktyrovola"
}]

8.2 User Manual & Instructions

- **Central Admin Manual**

PM SYSTEM

Οδηγίες Λήψης και Εγκατάστασης στον Εικονικό Υπολογιστή του Ιδρύματος

Πριν την λήψη και εγκατάσταση του Camunda BPM Open Source Community Platform 7.12.0 (υπό την άδεια της Apache), απαιτείται η λήψη και εγκατάσταση του JDK 8 (Java Standard Edition Development Kit 8 Update 231 for 64-bit).

180 MB χώρου στον σκληρό δίσκο δεσμεύονται από την Java version 1.8.0_231.

Ακολούθως, ελέγχουμε αν προστέθηκαν οι εξής 2 μεταβλητές συστήματος (JAVA_HOME, JRE_HOME) στον εικονικό υπολογιστή του Ιδρύματος.

This PC → Right Click → Properties → Advanced system settings → Advanced → Environment Variables… → System variables

<u>Προστέθηκαν οι εξής 2 Μεταβλητές Συστήματος</u> :

- JAVA_HOME με Value "C:\Program Files\Java\jdk1.8.0_231"
- JRE_HOME με Value "C:\Program Files\Java\jre1.8.0_231"

Εν συνεχεία, επιλέγουμε την λήψη και εγκατάσταση της "Full Distribution" (προς αποφυγή επιπλέον βημάτων εγκατάστασης και παραμετροποίησης).

Στην "Full Distribution" περιλαμβάνονται τα εξής :

- Process Engine (Container Service) το οποίο ξεκινάει εντός ενός Runtime Container (Application Server)
- Runtime Web Applications (Tasklist, Cockpit, Admin)
- Rest Api
- Container / Application Server (Apache Tomcat 9.0.24 Application Server)

Σαν Container επιλέγουμε τον Apache Tomcat έχοντας τα παραπάνω 4 στοιχεία της "Full Distribution", προ-εγκατεστημένα (pre-deployed) και προ-ρυθμισμένα (pre-configured) εξ'ου και ο σχετικός όρος "Pre-Packaged Full Distribution".

Αποσυμπιέζουμε και εξαγάγουμε την Full Distribution (με τον Apache Tomcat server) σε φάκελο της επιλογής μας.

Πολύ μεγάλη προσοχή πρέπει να δοθεί στους χαρακτήρες (μόνο λατινικοί) του folder που περιέχει τον Apache Tomcat server καθώς σε διαφορετική περίπτωση (ελληνικοί χαρακτήρες) δεν πρόκειται να εκκινήσει !!!

Για την μοντελοποίηση και εκτέλεση BPMN 2.0 διαγραμμάτων εγκαθιστούμε το Camunda Modeler 3.4.1. το οποίο και αποσυμπιέζουμε-εξαγάγουμε σε φάκελο της επιλογής μας.

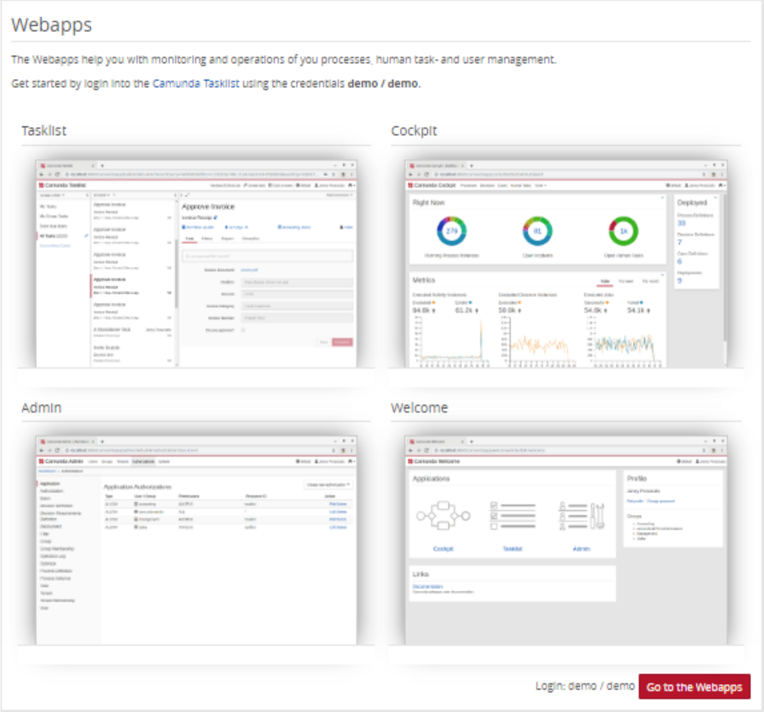
Αρχική σύνδεση στην εφαρμογή

Εντός του folder “triantis**”**, βρίσκεται ο folder “camunda-bpm-tomcat-7.12.0**”** τον οποίο και επιλέγουμε. Εκτελούμε το Windows Batch αρχείο (start-camunda.bat**)** με αποτέλεσμα την εκκίνηση του Apache Tomcat server υπό την διεύθυνση (“C:\Users\vmuser\Desktop\triantis\camunda-bpm-tomcat-7.12.0\server\apache-tomcat-9.0.24\bin”) και το επακόλουθο άνοιγμα της κεντρικής οθόνης καλωσορίσματος υπό την διεύθυνση (**localhost**:8080/camunda-welcome/index.html) στον web browser.

Από την URL διεύθυνση σύνδεσης στην εφαρμογή γίνεται αντιληπτό ότι ο Apache Tomcat server τρέχει τοπικά στον υπολογιστή (θύρα 8080).

Από τον δικό μας υπολογιστή, αν στην παραπάνω URL διεύθυνση σύνδεσης στην εφαρμογή αντικαταστήσουμε το **localhost** με την **διεύθυνση IP** (**147.27.70.60**) **του εικονικού υπολογιστή** στον οποίο είναι εγκατεστημένος ο apache-tomcat-9.0.24 server, θα μπορέσουμε να συνδεθούμε στην κεντρική οθόνη καλωσορίσματος της εφαρμογής.

Εμφανίζεται η σελίδα που μας καλωσορίζει στην κεντρική οθόνη του Camunda BPM Platform (Welcome to the Camunda BPM Platform on **localhost**:8080).



Webapps

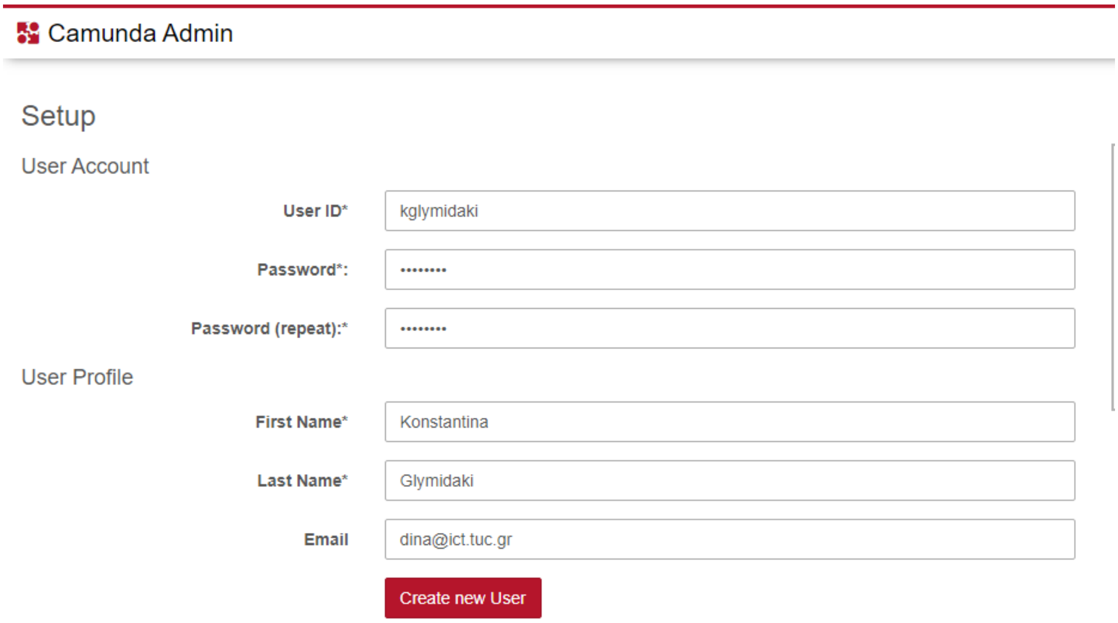
The Webapps help you with monitoring and operations of you processes, human task- and user management.

Get started by login into the Camunda Tasklist using the credentials **demo / demo**.

Δημιουργία Χρηστών και Ομάδων στην εφαρμογή

Δημιουργία Κεντρικού Διαχειριστή

Την 1η φορά της πρόσβασής μας στο process engine "default", προχωράμε στην δημιουργία χρήστη με διαχειριστικό δικαίωμα πρόσβασης στην εφαρμογή.



Camunda Admin

Setup

User Account

User ID*: kglymidaki

Password*: ••••••••

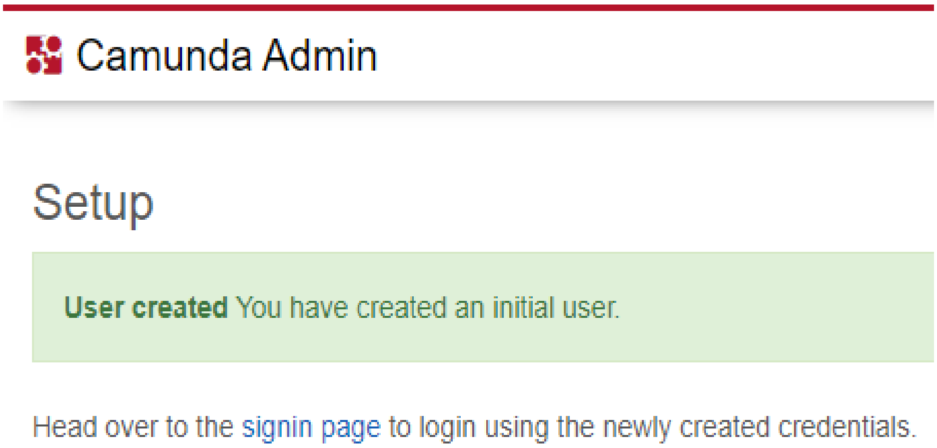
Password (repeat):*: ••••••••

User Profile

First Name*: Konstantina

Last Name*: Glymidaki

Email: dina@ict.tuc.gr



Camunda Admin

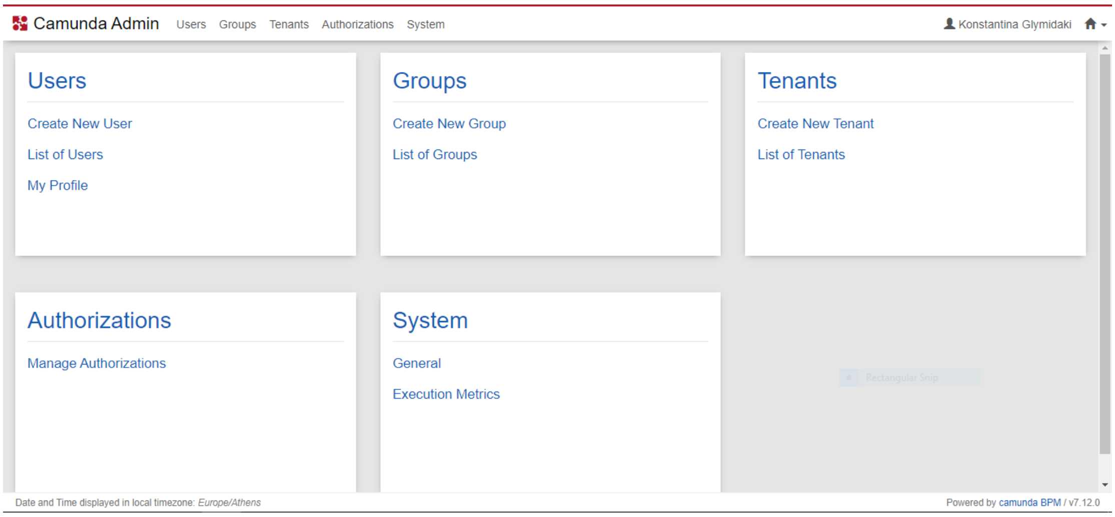
Setup

User created You have created an initial user.

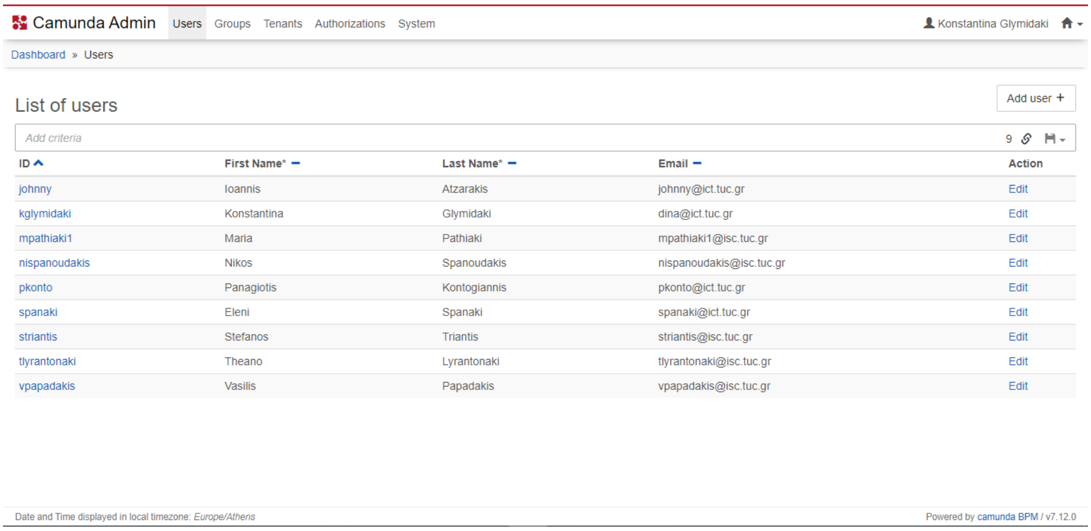
Head over to the signin page to login using the newly created credentials.

Δημιουργία Επιμέρους Χρηστών

Εν συνεχεία, συνδεόμαστε εκ νέου στην εφαρμογή Camunda Admin (User Management) με τα credentials του νέου Διαχειριστή της πλατφόρμας.

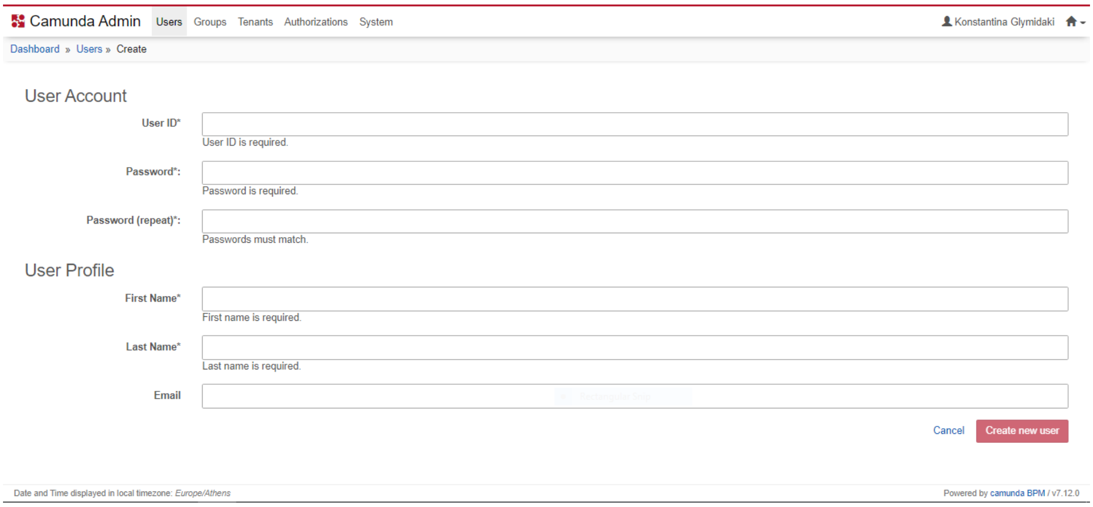


Δημιουργούμε τα Accounts των πιλοτικών χρηστών που πρόκειται να λάβουν μέρος στην αξιολόγηση της εν λόγω Διαδικασίας.



List of users

ID	First Name*	Last Name*	Email	Action
johnny	Ioannis	Atzarakis	johnny@ict.tuc.gr	Edit
kglymidaki	Konstantina	Glymidaki	dina@ict.tuc.gr	Edit
mpathiaki1	Maria	Pathiaki	mpathiaki1@isc.tuc.gr	Edit
nispanoudakis	Nikos	Spanoudakis	nispanoudakis@isc.tuc.gr	Edit
pkonto	Panagiotis	Kontogiannis	pkonto@ict.tuc.gr	Edit
spanaki	Eleni	Spanaki	spanaki@ict.tuc.gr	Edit
striantis	Stefanos	Triantis	striantis@isc.tuc.gr	Edit
tlyrantonaki	Theano	Lyrantonaki	tlyrantonaki@isc.tuc.gr	Edit
vpapadakis	Vasilis	Papadakis	vpapadakis@isc.tuc.gr	Edit



User Account

User ID*: User ID is required.

Password*: Password is required.

Password (repeat)*: Passwords must match.

User Profile

First Name*: First name is required.

Last Name*: Last name is required.

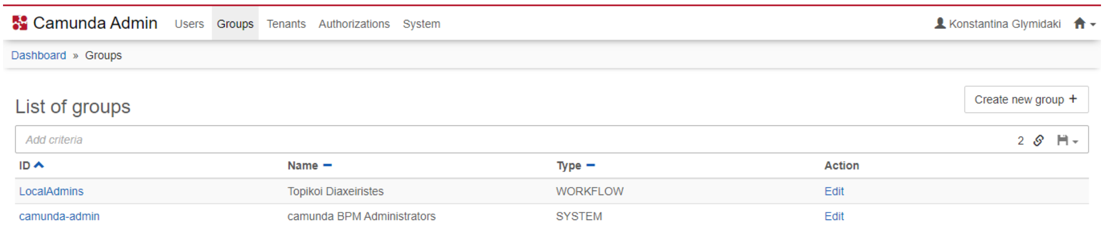
Email

Date and Time displayed in local timezone: *Europe/Athens*

Powered by camunda BPM / v7.12.0

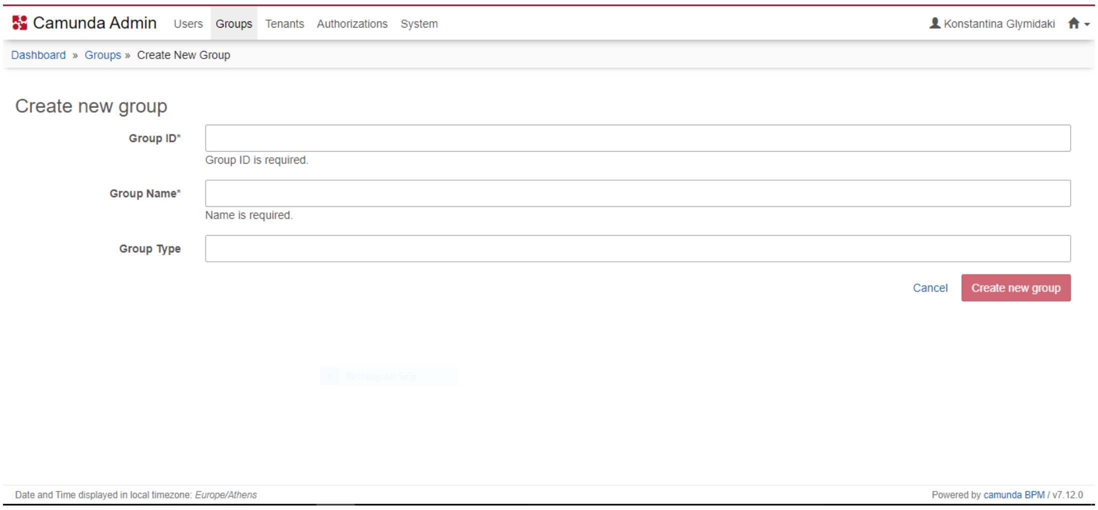
Δημιουργία Επιμέρους Ομάδων Χρηστών

Δημιουργούμε το Group στο οποίο και θα προστεθούν όλοι οι νέοι χρήστες με δικαίωμα Τοπικής Διαχείρισης.



List of groups

ID	Name	Type	Action
LocalAdmins	Topikoi Diaxeiristes	WORKFLOW	Edit
camunda-admin	camunda BPM Administrators	SYSTEM	Edit



Create new group

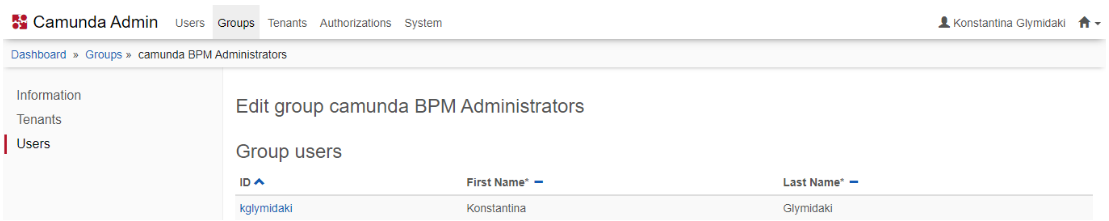
Group ID*: Group ID is required.

Group Name*: Name is required.

Group Type

Date and Time displayed in local timezone: *Europe/Athens*

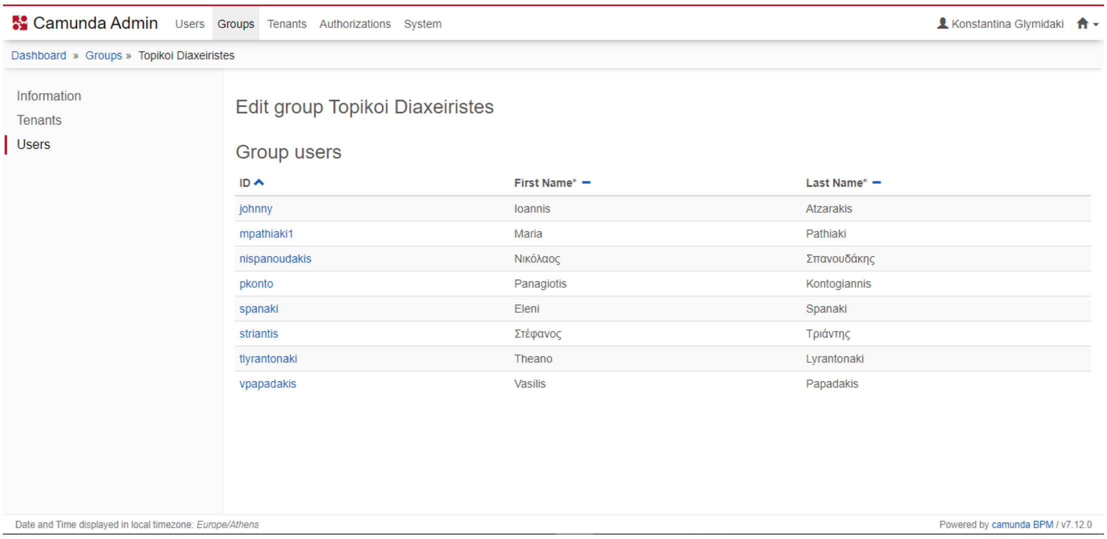
Powered by camunda BPM / v7.12.0



Edit group camunda BPM Administrators

Group users

ID	First Name*	Last Name*
kglymidaki	Konstantina	Glymidaki



Edit group Topikoi Diaxeiristes

Group users

ID	First Name*	Last Name*
johnny	Ioannis	Atzarakis
mpathiaki1	Maria	Pathiaki
nispanoudakis	Νικόλαος	Σπανουδάκης
pkonto	Panagiotis	Kontogiannis
spanaki	Eleni	Spanaki
striantis	Στέφανος	Τριάντης
tlyrantonaki	Theano	Lyrantonaki
vpapadakis	Vasilis	Papadakis

Date and Time displayed in local timezone: *Europe/Athens*

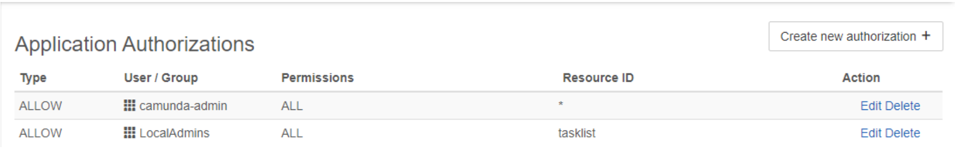
Powered by camunda BPM / v7.12.0

Διαχείριση Δικαιωμάτων Πρόσβασης Χρηστών και Ομάδων

Το επόμενο βήμα είναι η διαχείριση των δικαιωμάτων πρόσβασης (με βάση τον ρόλο των διαθέσιμων ομάδων χρηστών) στις διάφορες εφαρμογές (υπομενού) της πλατφόρμας:

Application Access

Αρχικώς ορίζουμε τα δικαιώματα πρόσβασης των ομάδων χρηστών στις επιμέρους εφαρμογές (υπομενού πλατφόρμας).



Application Authorizations

Type	User / Group	Permissions	Resource ID	Action
ALLOW	camunda-admin	ALL	*	Edit Delete
ALLOW	LocalAdmins	ALL	tasklist	Edit Delete

Με τον συγκεκριμένο κανόνα εξουσιοδότησης (authorization rule), κάθε μέλος της ομάδας των Τοπικών Διαχειριστών (LocalAdmins), έχει δικαίωμα πρόσβασης ΜΟΝΟ στην εφαρμογή (resource) Tasklist της πλατφόρμας.

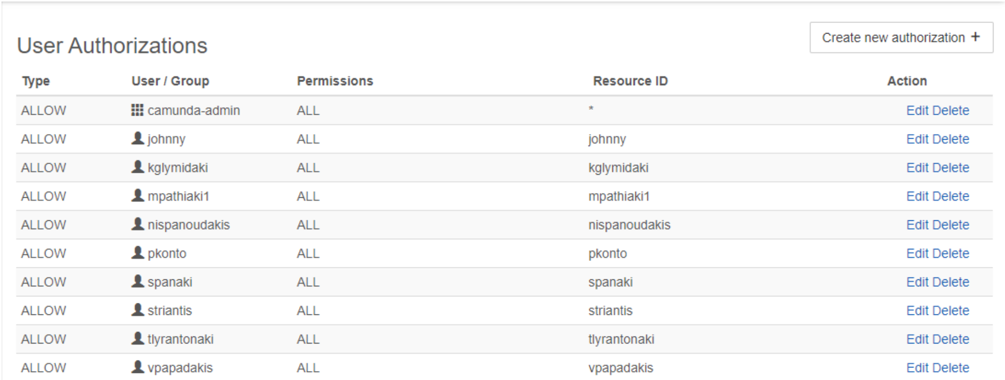
Σε αυτό το σημείο πρέπει να αναφερθεί ότι τα ατομικά (ανά χρήστη) δικαιώματα πρόσβασης στις εφαρμογές της πλατφόρμας υπερισχύουν έναντι των ομαδικών (ανά ομάδα).

Από προεπιλογή του συστήματος, κάθε χρήστης που ανήκει στο Systemic Group (camunda-admin), έχει δικαίωμα πρόσβασης σε όλες τις εφαρμογές (resources) της πλατφόρμας, εξ ου και ο σχετικός αστερίσκος (*).

Users Visibility

Από προεπιλογή του συστήματος, κάθε χρήστης που ανήκει στο Systemic Group (camunda-admin), έχει δικαίωμα πρόσβασης σε όλες τις εφαρμογές (resources) της πλατφόρμας, εξ ου και ο σχετικός αστερίσκος (*).

Επίσης (από προεπιλογή του συστήματος), κάθε χρήστης έχει δικαίωμα πρόσβασης μόνο στα προσωπικά του δεδομένα (π.χ. βλέποντας στην εφαρμογή Tasklist τις εκκρεμείς εργασίες του κλπ).

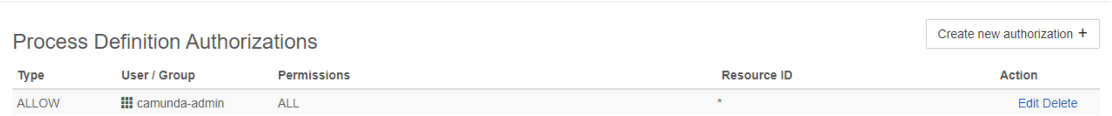


User Authorizations

Type	User / Group	Permissions	Resource ID	Action
ALLOW	camunda-admin	ALL	*	Edit Delete
ALLOW	johnny	ALL	johnny	Edit Delete
ALLOW	kglymidaki	ALL	kglymidaki	Edit Delete
ALLOW	mpathiaki1	ALL	mpathiaki1	Edit Delete
ALLOW	nispanoudakis	ALL	nispanoudakis	Edit Delete
ALLOW	pkonto	ALL	pkonto	Edit Delete
ALLOW	spanaki	ALL	spanaki	Edit Delete
ALLOW	striantis	ALL	striantis	Edit Delete
ALLOW	tlyrantonaki	ALL	tlyrantonaki	Edit Delete
ALLOW	vpapadakis	ALL	vpapadakis	Edit Delete

Start Processes from Tasklist

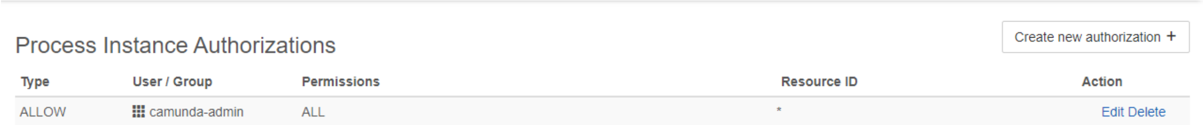
Κάθε νέα Διαδικασία (Process Definition) ξεκινάει από την εφαρμογή Tasklist (Human Task Management). Από προεπιλογή του Συστήματος κάθε χρήστης που ανήκει στο Systemic Group (camunda-admin) έχει το δικαίωμα έναρξης οποιασδήποτε (εξ ου και ο σχετικός αστερίσκος *) δηλωθείσας (βάσει του Resource ID που αντιστοιχεί στο Process Definition Key) Διαδικασίας.



Process Definition Authorizations

Type	User / Group	Permissions	Resource ID	Action
ALLOW	camunda-admin	ALL	*	Edit Delete

Παράλληλα, έχει το δικαίωμα έναρξης οποιουδήποτε (εξ ου και ο σχετικός αστερίσκος *) instance (στιγμιοτύπου) για την εκάστοτε Διαδικασία.



Process Instance Authorizations

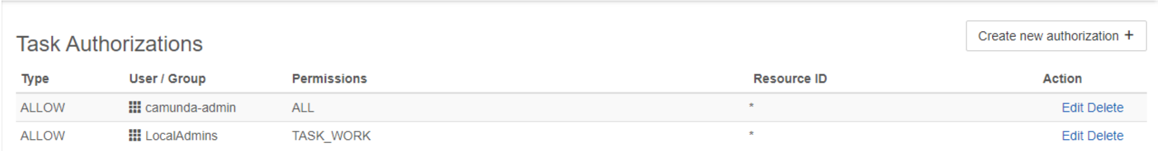
Type	User / Group	Permissions	Resource ID	Action
ALLOW	camunda-admin	ALL	*	Edit Delete

Το Resource ID κάθε στιγμιοτύπου της Διαδικασίας (Process Instance) είναι (by default και εξαρχής) δηλωμένο ως αστερίσκος (*) μιας και δεν είμαστε εκ των προτέρων (πριν την δημιουργία του) γνώστες του ID με το οποίο αποθηκεύεται στη Βάση Δεδομένων.

Τα IDs όλων των ενεργών στιγμιοτύπων της Διαδικασίας (running Process Instances) μπορούν να αναζητηθούν εντός της εφαρμογής Cockpit (Monitoring and Operations).

Τέλος, αναφορικά με τις εργασίες (tasks), κάθε χρήστης που ανήκει στο Systemic Group (camunda-admin) διαθέτει καθολικά (ALL) δικαιώματα διαχείρισης ενώ τα δικαιώματα κάθε χρήστη που ανήκει στο Group των Τοπικών Διαχειριστών (LocalAdmins) περιορίζονται στην υλοποίησή του (TASK_WORK).

Στην προκειμένη περίπτωση, το Resource ID αντιστοιχεί στο Task ID.



Task Authorizations

Type	User / Group	Permissions	Resource ID	Action
ALLOW	camunda-admin	ALL	*	Edit Delete
ALLOW	LocalAdmins	TASK_WORK	*	Edit Delete

Πρόσβαση στην διασυνδεδεμένη Βάση Δεδομένων H2

Η πρόσβαση στην Βάση Δεδομένων H2 (με την οποία είναι "by default" διασυνδεδεμένο το Camunda BPM) είναι εφικτή μόνο εφόσον έχει εκκινήσει (πάντα τοπικά στην θύρα 8080) ο Apache Tomcat server και άρα είναι "up and running" το Process engine του Συστήματός μας.

Η συγκεκριμένη Βάση Δεδομένων υποστηρίζει πολλαπλές Επιλογές Σύνδεσης (Connection Modes) και Ρυθμίσεις Σύνδεσης (Connection Settings).

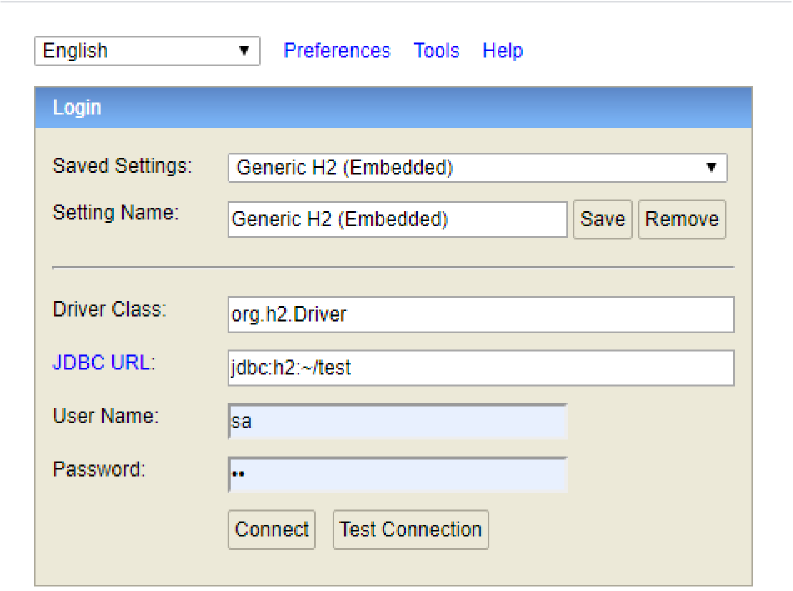
Από προεπιλογή, στην 1η μας σύνδεση στην H2 Βάση Δεδομένων, η Επιλογή Σύνδεσης είναι η "Embedded (local) connection" με "JDBC URL" το εξής: jdbc:h2:~/test.

Στην "Embedded" Επιλογή Σύνδεσης, η Βάση Δεδομένων "τρέχει" εντός του ιδίου process με την εφαρμογή. Στο σημείο αυτό πρέπει να αναφερθεί ότι η πρόσβαση στην Βάση ανά πάσα στιγμή επιτρέπεται μόνο σε 1 ενεργό Process.

Το URL της πρόσβασης στην Βάση είναι το εξής : http://localhost:8080/h2/h2

Τα αρχικά credentials σύνδεσης στη Βάση είναι τα εξής :

- User Name: sa
- Password: sa



Saved Settings: Generic H2 (Embedded)

Setting Name: Generic H2 (Embedded)

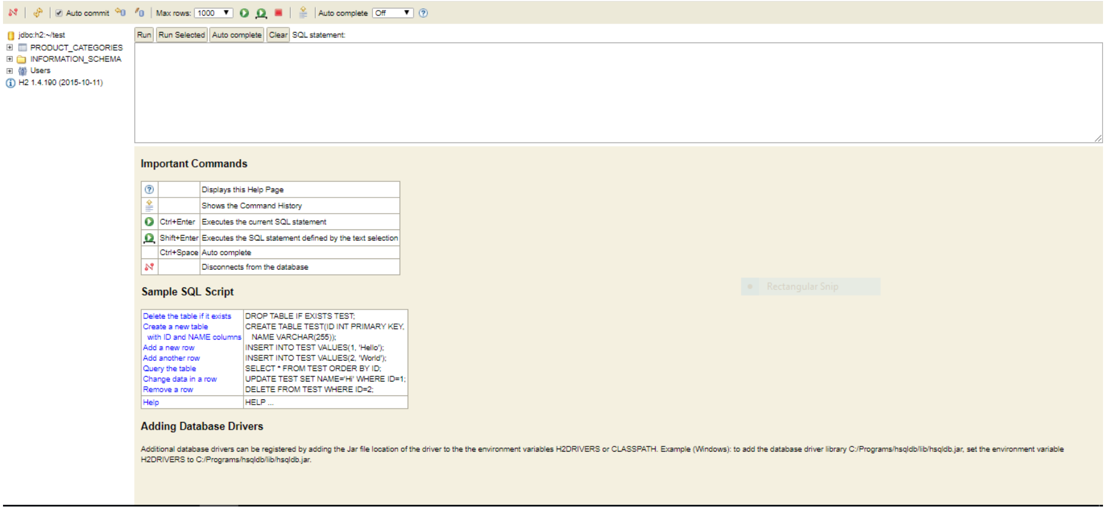
Driver Class: org.h2.Driver

JDBC URL: jdbc:h2:~/test

User Name: sa

Password: ••

Συνδεόμαστε στην Βάση επιλέγοντας το Connect.



Important Commands

?		Displays this Help Page
		Shows the Command History
	Ctrl+Enter	Executes the current SQL statement
	Shift+Enter	Executes the SQL statement defined by the text selection
	Ctrl+Space	Auto complete
		Disconnects from the database

Sample SQL Script

Delete the table if it exists
Create a new table
with ID and NAME columns
Add a new row
Add another row
Query the table
Change data in a row
Remove a row
	DROP TABLE IF EXISTS TEST;
	CREATE TABLE TEST(ID INT PRIMARY KEY,
	NAME VARCHAR(255));
	INSERT INTO TEST VALUES(1, 'Hello');
	INSERT INTO TEST VALUES(2, 'World');
	SELECT * FROM TEST ORDER BY ID;
	UPDATE TEST SET NAME='Hi' WHERE ID=1;
	DELETE FROM TEST WHERE ID=2;

Help	HELP ...

Adding Database Drivers

Additional database drivers can be registered by adding the Jar file location of the driver to the the environment variables H2DRIVERS or CLASSPATH. Example (Windows): to add the database driver library C:/Programs/hsqldb/lib/hsqldb.jar, set the environment variable H2DRIVERS to C:/Programs/hsqldb/lib/hsqldb.jar.

Αποσυνδεόμαστε από την Βάση επιλέγοντας το (πάνω και αριστερά στην κεντρική οθόνη).

Deployment της Μοντελοποϊημένης Διαδικασίας στην εφαρμογή

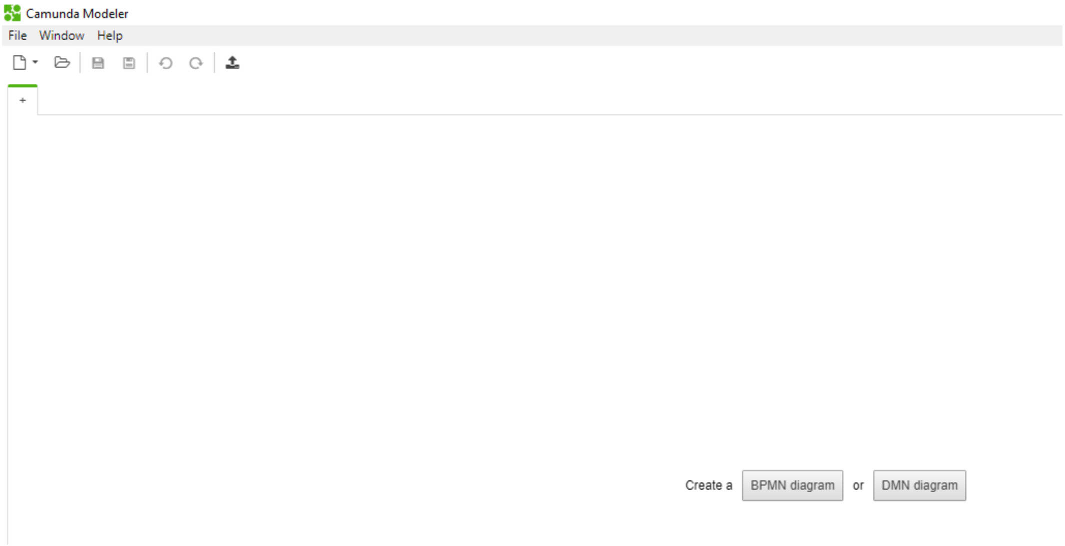
Η Διαδικασία Διαγωνισμού προμηθειών κοινού ηλεκτρονικού εξοπλισμού για τις ανάγκες του Ιδρύματος (Πολυτεχνείο Κρήτης) φαίνεται γραφικά (μοντελοποιημένη σε μορφή BPMN 2.0) στην (επίσης εγκατεστημένη) εφαρμογή Camunda Modeler 3.4.1.

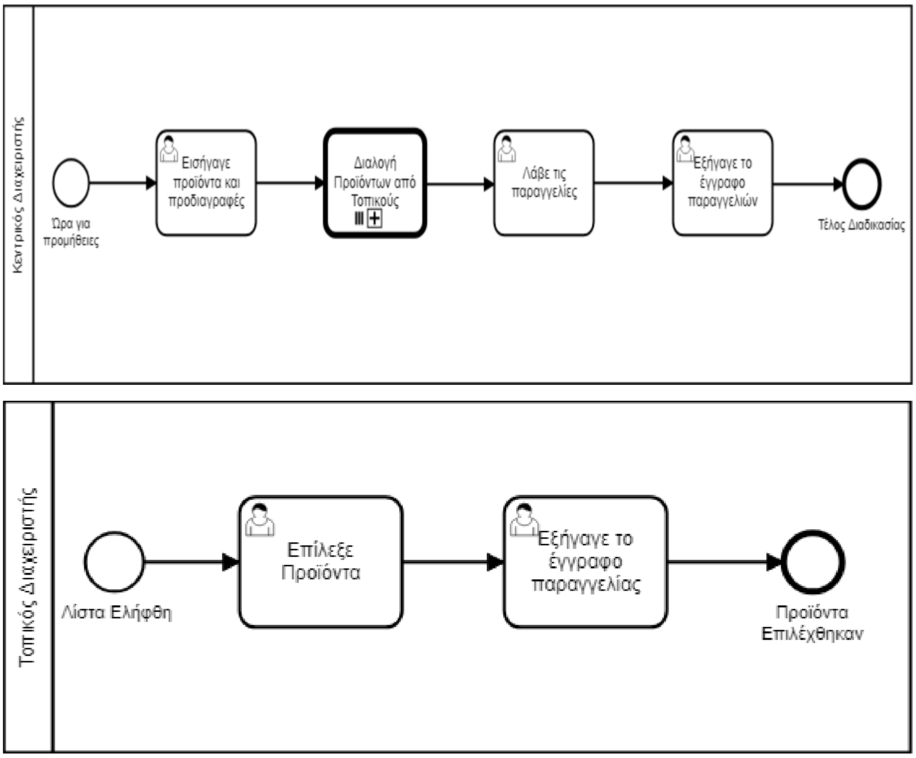
Αρχικώς, από τον αποσυμπιεσμένο φάκελο (camunda-modeler-3.4.1-win-x64) επιλέγουμε το εκτελέσιμο αρχείο της εφαρμογής **Camunda Modeler.exe**. Από τη στιγμή που επιθυμούμε το άνοιγμα (και όχι την δημιουργία) ενός υφιστάμενου BPMN 2.0 διαγράμματος επιλέγουμε τα εξής 2 διαγράμματα : File -> Open File… -> Main Process.bpmn και SubProcess.bpmn

Σε αυτό το σημείο πρέπει να επισημανθεί ότι τα συγκεκριμένα 2 bpmn αρχεία της Διαδικασίας μας είναι αποθηκευμένα στο Path : This PC -> Local Disk (C:) -> Users -> vmuser -> workspace -> electronic_equipment_competitions -> src -> main -> resources.

Τα αρχεία Main Process.bpmn και SubProcess.bpmn αφορούν τις παρακάτω 2 Εκτελέσιμες (“Executable” checkbox in Properties Panel is checked) Διαδικασίες αντίστοιχα :

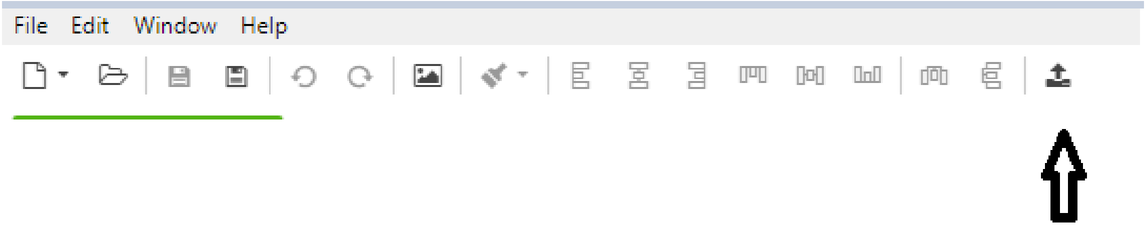
- Την Κύρια (Main Process - «Κεντρικός Διαχειριστής») με δοθέντα (Id = Participant_0iw5n56, Name = Κεντρικός Διαχειριστής, Process (Resource) Id = MainAdmin, που αντιστοιχεί στο process definition key, Process Name = Κεντρικός Διαχειριστής)
- Την Δευτερεύουσα (Subprocess - «Τοπικός Διαχειριστής») με δοθέντα (Id = Participant_1tmquh2, Name = Τοπικός Διαχειριστής, Process (Resource) Id = LocalAdmin, που αντιστοιχεί στο process definition key, Process Name = Τοπικός Διαχειριστής)



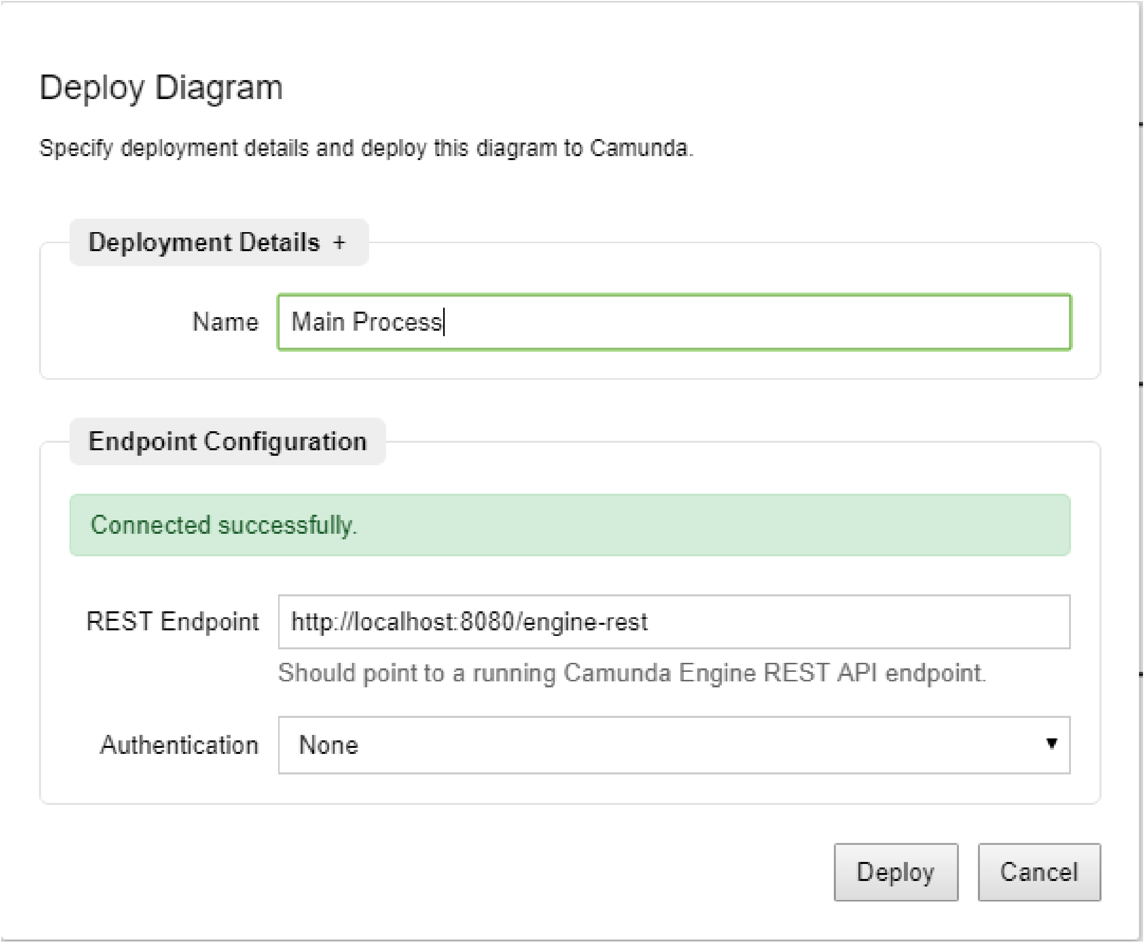


Μετά την Μοντελοποίηση, ακολουθεί το deployment των 2 BPMN 2.0 Διαγραμμάτων (Μοντέλων) της Διαδικασίας στο Camunda process engine.

Εκτελούμε το Windows Batch αρχείο (start-camunda.bat) με αποτέλεσμα την εκκίνηση του Apache Tomcat server υπό την διεύθυνση ("C:\Users\vmuser\Desktop\triantis\camunda-bpm-tomcat-7.12.0\server\apache-tomcat-9.0.24\bin") και το άνοιγμα της κεντρικής οθόνης καλωσορίσματος υπό την διεύθυνση (localhost:8080/camunda-welcome/index.html) στον web browser. Κλικάρουμε στο (Deploy Current Diagram) button που βρίσκεται πάνω από τον καμβά μοντελοποίησης.



Εμφανίζεται το ακόλουθο παράθυρο διαλόγου :



Deploy Diagram

Specify deployment details and deploy this diagram to Camunda.

Deployment Details +

Name: Main Process

Endpoint Configuration

Connected successfully.

REST Endpoint: http://localhost:8080/engine-rest

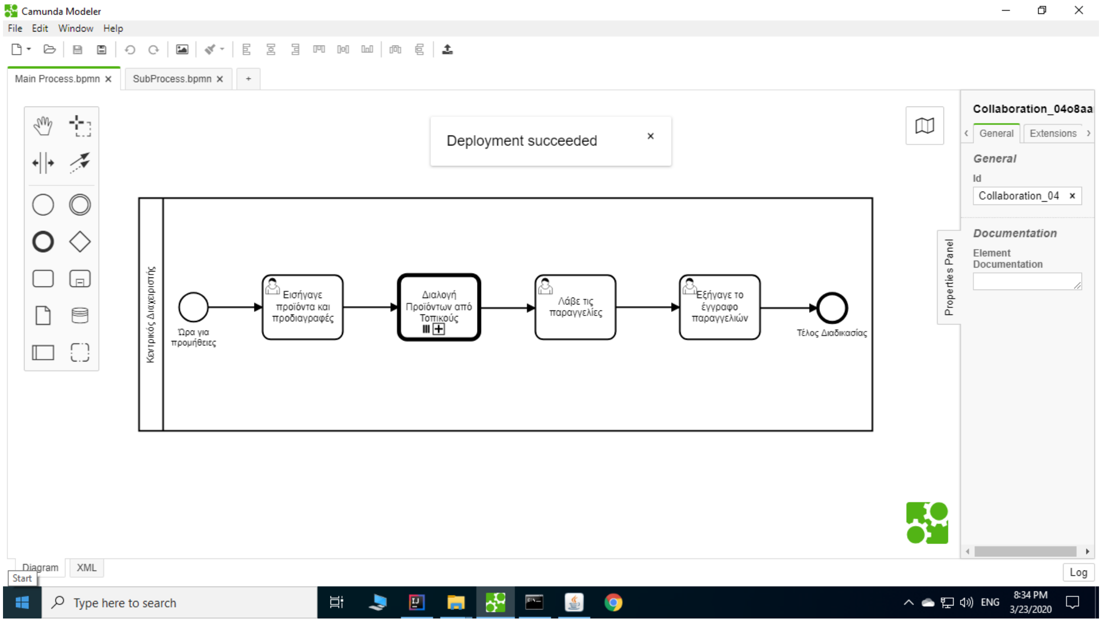
Should point to a running Camunda Engine REST API endpoint.

Authentication: None

- Name = Main Process
- Camunda Engine REST API endpoint = http://localhost:8080/engine-rest.
- Authentication Method = “None”.

Κλικάρουμε το “Deploy” button για την ολοκλήρωση του deployment.

Εμφανίζεται το μήνυμα “Deployment succeeded**”**.



Deployment succeeded

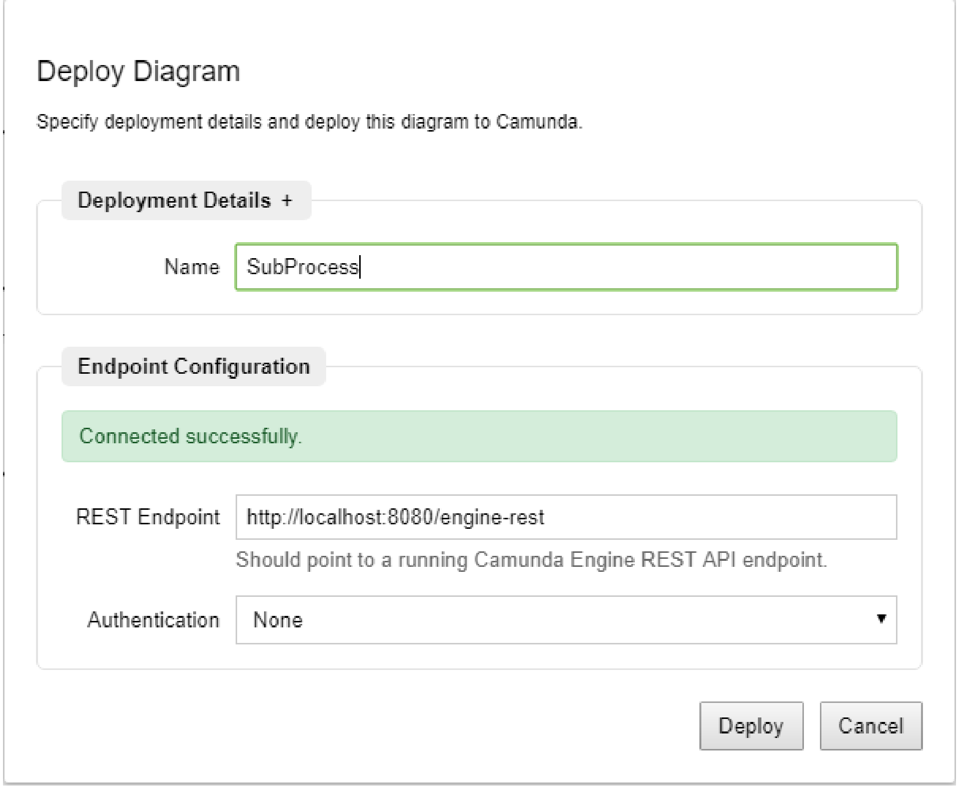
General

Id: Collaboration_04

Documentation

Element Documentation

Ομοίως για την Δευτερεύουσα Διαδικασία :



Deploy Diagram

Specify deployment details and deploy this diagram to Camunda.

Deployment Details +

Name: SubProcess

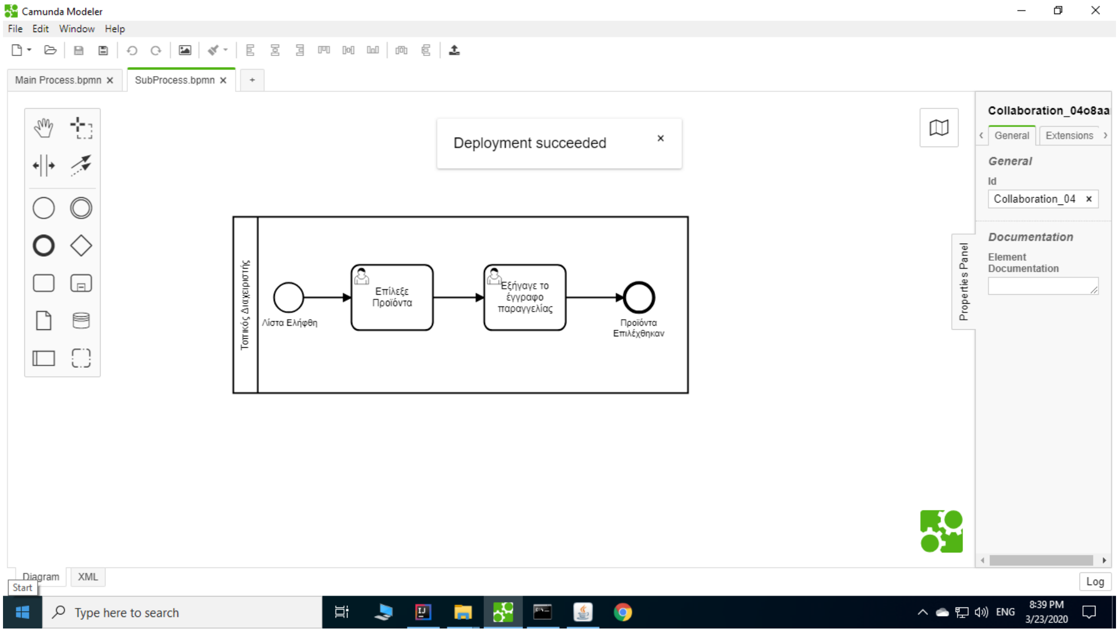
Endpoint Configuration

Connected successfully.

REST Endpoint: http://localhost:8080/engine-rest

Should point to a running Camunda Engine REST API endpoint.

Authentication: None



Deployment succeeded ×

Collaboration_04o8aa

General

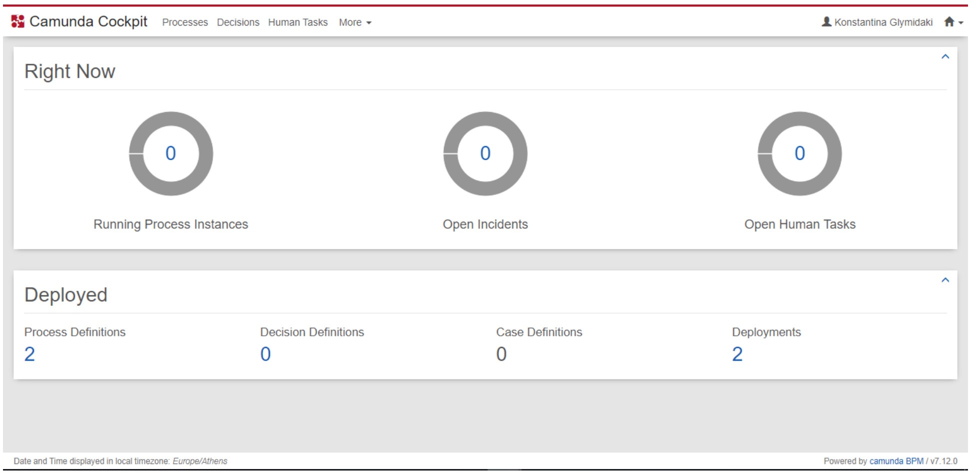
Id

Collaboration_04

Documentation

Στη συνέχεια, συνδεόμαστε στην εφαρμογή Cockpit όπου και επιβεβαιώνουμε το επιτυχές αποτέλεσμα του deployment των 2 BPMN 2.0 Διαγραμμάτων της Διαδικασίας μας στο Camunda process engine.

Στην ακόλουθη εικόνα απεικονίζεται το Κεντρικό Dashboard της εφαρμογής Cockpit όπου βλέπουμε ότι έχουν γίνει “deploy” στο Camunda process engine τα 2 νέα Process Definitions που απαρτίζουν τα 2 παραπάνω διαγράμματα της Διαδικασίας μας.



Right Now

Running Process Instances	Open Incidents	Open Human Tasks
0	0	0

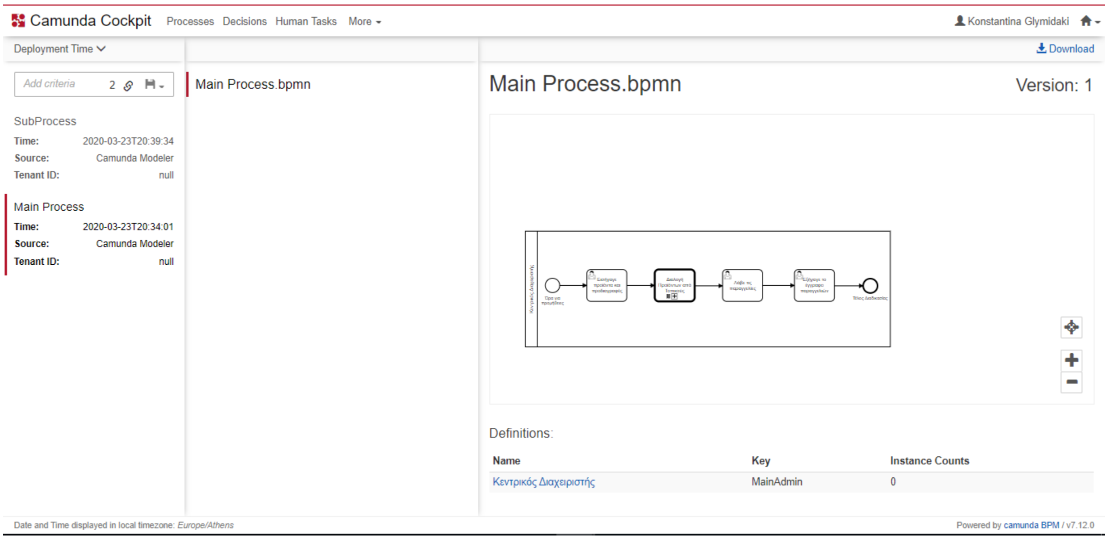
Deployed

Process Definitions	Decision Definitions	Case Definitions	Deployments
2	0	0	2

Date and Time displayed in local timezone: *Europe/Athens*

Powered by camunda BPM / v7.12.0

Στην ακόλουθη εικόνα απεικονίζεται το αποτέλεσμα του deployment του BPMN 2.0 Διαγράμματος της Κύριας Διαδικασίας στο Camunda process engine.



Deployment Time

Add criteria 2

SubProcess
Time: 2020-03-23T20:39:34
Source: Camunda Modeler
Tenant ID: null

Main Process
Time: 2020-03-23T20:34:01
Source: Camunda Modeler
Tenant ID: null

Main Process.bpmn

Main Process.bpmn Version: 1

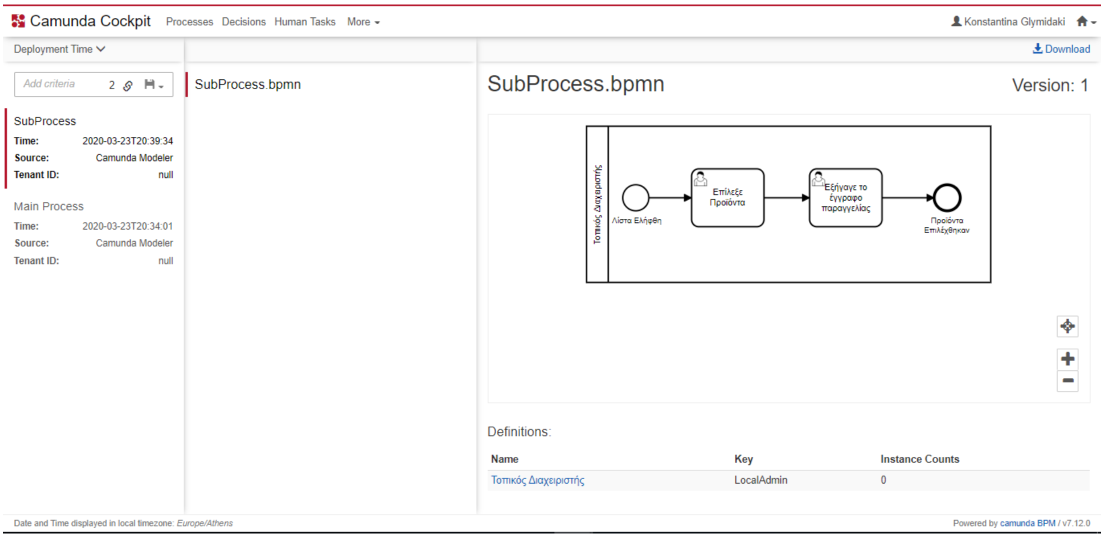
Definitions:

Name	Key	Instance Counts
Κεντρικός Διαχειριστής	MainAdmin	0

Date and Time displayed in local timezone: *Europe/Athens*

Powered by camunda BPM / v7.12.0

Στην ακόλουθη εικόνα απεικονίζεται το αποτέλεσμα του deployment του BPMN 2.0 Διαγράμματος της Δευτερεύουσας Διαδικασίας στο Camunda process engine.



Deployment Time

Add criteria 2

SubProcess
Time: 2020-03-23T20:39:34
Source: Camunda Modeler
Tenant ID: null

Main Process
Time: 2020-03-23T20:34:01
Source: Camunda Modeler
Tenant ID: null

SubProcess.bpmn

SubProcess.bpmn Version: 1

Definitions:

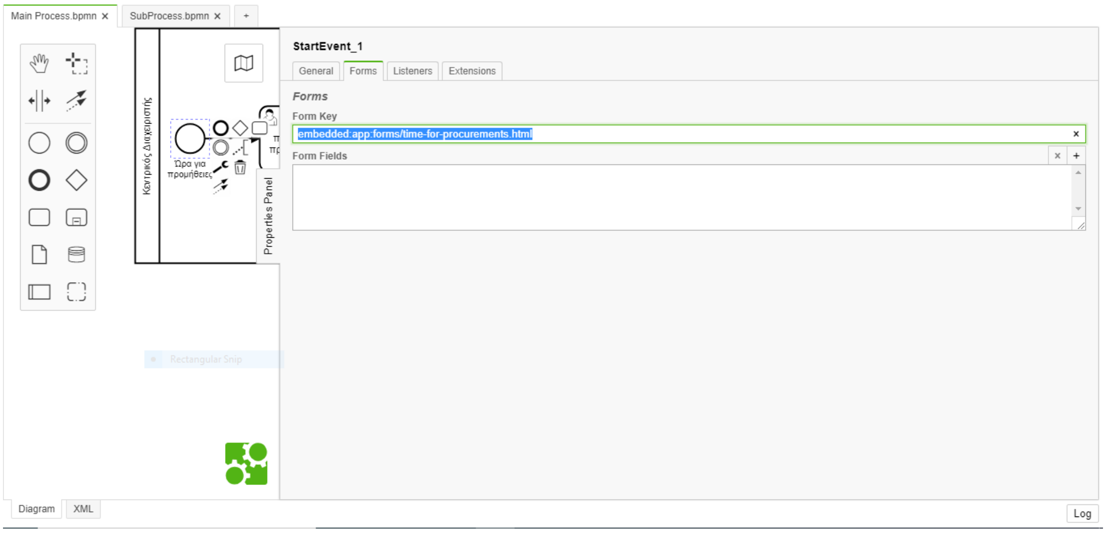
Name	Key	Instance Counts
Τοπικός Διαχειριστής	LocalAdmin	0

Date and Time displayed in local timezone: *Europe/Athens*

Powered by camunda BPM / v7.12.0

Διασύνδεση της Μοντελοποϊημένης Διαδικασίας με User Task Form Code

Ο Web κώδικας (HTML+CSS+JavaScript) που έχει αναπτυχθεί για όλα τα User Task Forms (User Interface) "καλείται" μέσα από τα εξής BPMN 2.0 elements: Start Events και User Tasks.
Οι φόρμες εργασίας των χρηστών που "φορτώνονται" στην εφαρμογή Tasklist, θεωρούνται "Embedded".
Η διασύνδεση User Task Form Κώδικα και BPMN 2.0 element γίνεται μέσω της "αναφοράς" του αντίστοιχου html αρχείου (με το περιεχόμενο της φόρμας) από ένα User Task ή Start Event στα διαγράμματα της Διαδικασίας.
Η αναφορά (και κατ' επέκταση διασύνδεση) του σχετικού html αρχείου γίνεται από το "Form Key" property field, έχοντας προηγουμένως επιλέξει το ανάλογο BPMN 2.0 Element από τον καμβά μοντελοποίησης (Start Event ή User Task) και κλικάροντας στο "Forms" Tab του Properties Panel View.



StartEvent_1

Form Key: embedded:app:forms/time-for-procurements.html

- **embedded:** δηλώνει το είδος της φόρμας εργασίας που φορτώνεται στην εφαρμογή Tasklist,
- **app:** δηλώνει τον τρόπο φόρτωσης του html αρχείου στην εφαρμογή Tasklist.

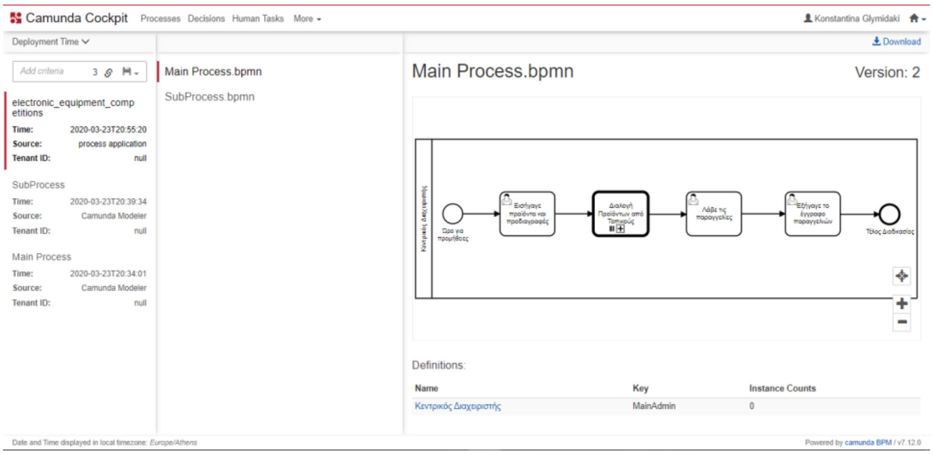
Το html αρχείο βρίσκεται αποθηκευμένο εντός του folder του Maven project (electronic_equipment_competitions) και πιο συγκεκριμένα στο path: This PC -> Local Disk (C:) -> Users -> vmuser -> workspace -> electronic_equipment_competitions -> src -> main -> webapp -> forms.
Σε αυτό το σημείο πρέπει να σημειωθεί ότι ο server "διαβάζει" το εκάστοτε html αρχείο από τον 0.1.0 SNAPSHOT folder ο οποίος δημιουργείται (μαζί με ένα WAR αρχείο) εντός του "target" folder του Maven project. Αυτή η διαδικασία αφορά το λεγόμενο Maven Project Install (Build).

Αφού γίνει αυτό, πρέπει να αντιγραφεί (και επικολληθεί) ο 0.1.0 SNAPSHOT folder (με το αντίστοιχο WAR αρχείο του) εντός του "webapps" folder του server προκειμένου να "διαβαστούν" (Maven Project Deploy) όλα τα forms resources από εκεί και να φορτωθούν στην εφαρμογή Tasklist.

Για την επιβεβαίωση της επιτυχούς ολοκλήρωσης του συγκεκριμένου deployment, ελέγχουμε στον "logs" folder που περιέχει τα αρχεία καταγραφής κάθε λογής δραστηριότητας στον server και πιο συγκεκριμένα στο τελευταίο (χρονικά ανανεωμένο) αρχείο "catalina.yy-mm-dd".

Επιβεβαιώνουμε το επιτυχές deployment των forms resources στον server βλέποντας το σχετικό log message στο κάτω μέρος του συγκεκριμένου αρχείου (ENGINE-08050 Process application Electronic Equipment Competitions App successfully deployed).

Στις εικόνες που ακολουθούν απεικονίζεται το αποτέλεσμα του deployment των form resources (που καλούνται από τα BPMN 2.0 Elements) στον server.



Main Process.bpmn
SubProcess.bpmn

electronic_equipment_competitions
Time: 2020-03-23T20:55:20
Source: process application
Tenant ID: null

SubProcess
Time: 2020-03-23T20:39:34
Source: Camunda Modeler
Tenant ID: null

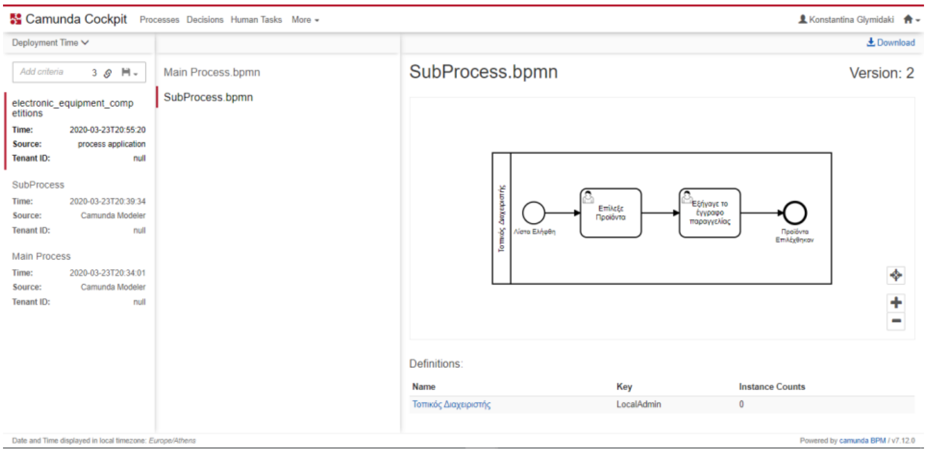
Main Process
Time: 2020-03-23T20:34:01
Source: Camunda Modeler
Tenant ID: null

Main Process.bpmn Version: 2

Definitions:

Name	Key	Instance Counts
Κεντρικός Διαχειριστής	MainAdmin	0

Date and Time displayed in local timezone: *Europe/Athens*
Powered by camunda BPM / v7.12.0



Main Process.bpmn
SubProcess.bpmn

electronic_equipment_competitions
Time: 2020-03-23T20:55:20
Source: process application
Tenant ID: null

SubProcess
Time: 2020-03-23T20:39:34
Source: Camunda Modeler
Tenant ID: null

Main Process
Time: 2020-03-23T20:34:01
Source: Camunda Modeler
Tenant ID: null

SubProcess.bpmn Version: 2

Definitions:

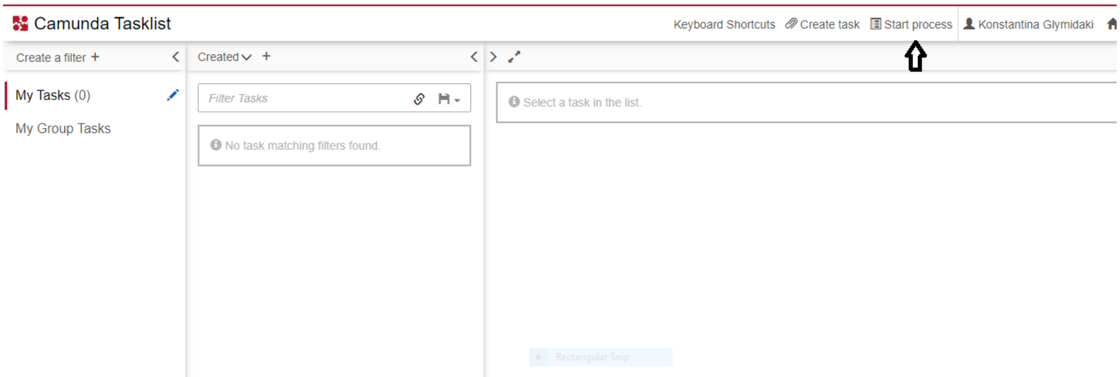
Name	Key	Instance Counts
Τοπικός Διαχειριστής	LocalAdmin	0

Date and Time displayed in local timezone: *Europe/Athens*
Powered by camunda BPM / v7.12.0

- forms/FORM_NAME.html : δηλώνει το όνομα του html αρχείου (με τον Web κώδικα που καλείται) για την ανάλογη φόρμα εργασίας.

Δημιουργία και εκκίνηση ενός νέου instance της Μοντελοποϊημένης Διαδικασίας

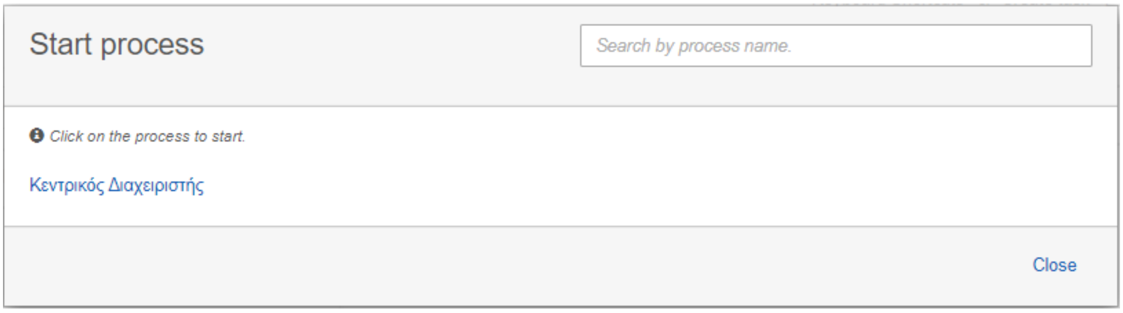
Το επόμενο βήμα είναι η δημιουργία και εκκίνηση ενός νέου instance (στιγμιοτύπου) της Διαδικασίας εντός του deployed Process Definition ("Κεντρικός Διαχειριστής").
Αφού συνδεθούμε στην εφαρμογή Tasklist, επιλέγουμε το Tab "Start process".



No task matching filters found.

Select a task in the list.

Στο νέο παράθυρο που εμφανίζεται, βλέπουμε το όνομα της Κύριας Διαδικασίας της οποίας το Process Definition έχει γίνει deployed στον server, που "καλείται" πλέον να την εκτελέσει.

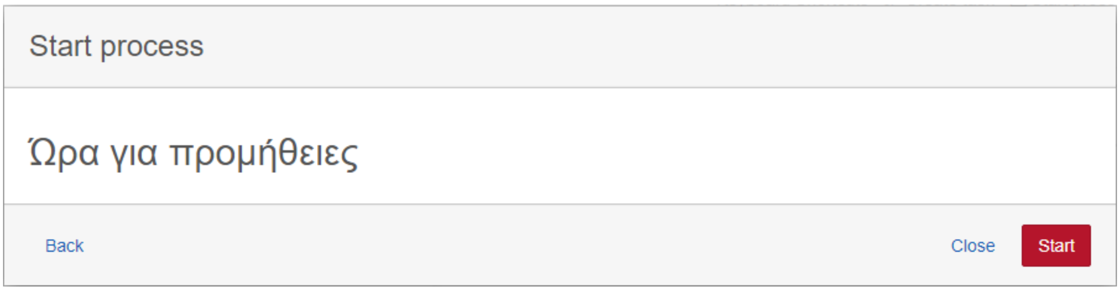


Click on the process to start.

Κεντρικός Διαχειριστής

Για την εκκίνηση της Διαδικασίας μας, καλούμαστε να επιλέξουμε την Κύρια Διαδικασία ("Κεντρικός Διαχειριστής ").
Αυτομάτως εμφανίζεται το μήνυμα ("Ώρα για προμήθειες") του Γεγονότος Έναρξης (Start Event) της Διαδικασίας Διαγωνισμού Προμηθειών.

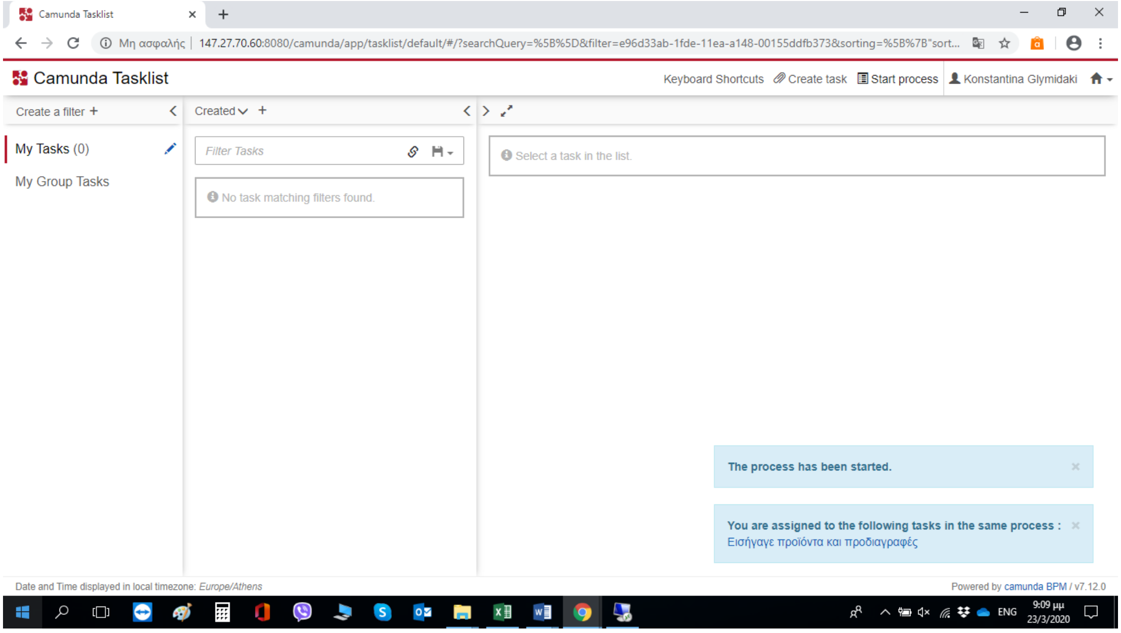
Για την δημιουργία και εκκίνηση ενός στιγμιοτύπου της Διαδικασίας μας (Process Instance), επιλέγουμε το Start button.



Start process

Ώρα για προμήθειες

Ακολούθως (κάτω και δεξιά στην οθόνη της εφαρμογής), εμφανίζεται το μήνυμα έναρξης της Διαδικασίας μας, “**The process has been started.”** καθώς και το μήνυμα (“**You are assigned to the following tasks in the same process :**”) με το link παραπομπής στο 1ο κατά σειρά task (“Εισήγαγε προϊόντα και προδιαγραφές”).



147.27.70.60:8080/camunda/app/tasklist/default/#/?searchQuery=%5B%5D&filter=e96d33ab-1fde-11ea-a148-00155ddfb373&sorting=%5B%7B"sort...

No task matching filters found.

Select a task in the list.

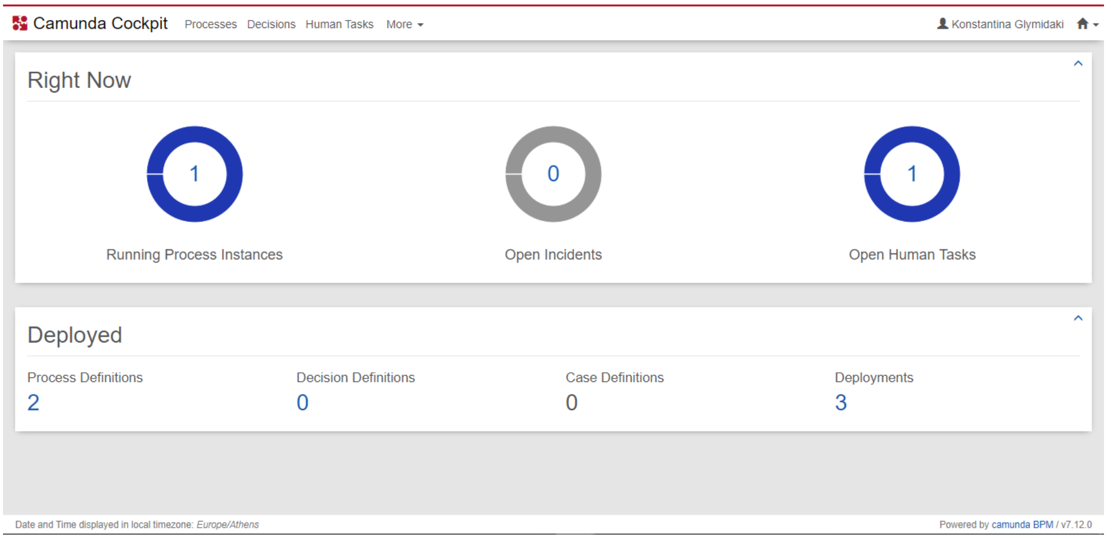
The process has been started.

You are assigned to the following tasks in the same process : Εισήγαγε προϊόντα και προδιαγραφές

Date and Time displayed in local timezone: *Europe/Athens*

Powered by camunda BPM / v7.12.0

Με την σύνδεση του Κεντρικού Διαχειριστή της Διαδικασίας και χρήστη της πλατφόρμας (Admin User) στην εφαρμογή Cockpit, βλέπουμε στο Κεντρικό Dashboard την δημιουργία ενός στιγμιοτύπου της Διαδικασίας (1 running Process Instance) το οποίο και σηματοδοτεί την έναρξη ενός “token” που “περιμένει” την εκτέλεση της 1ης κατά σειράς εργασίας (“Εισήγαγε προϊόντα και προδιαγραφές”) από τον αρμόδιο χρήστη (Κεντρικός Διαχειριστής).



Right Now

1 Running Process Instances

0 Open Incidents

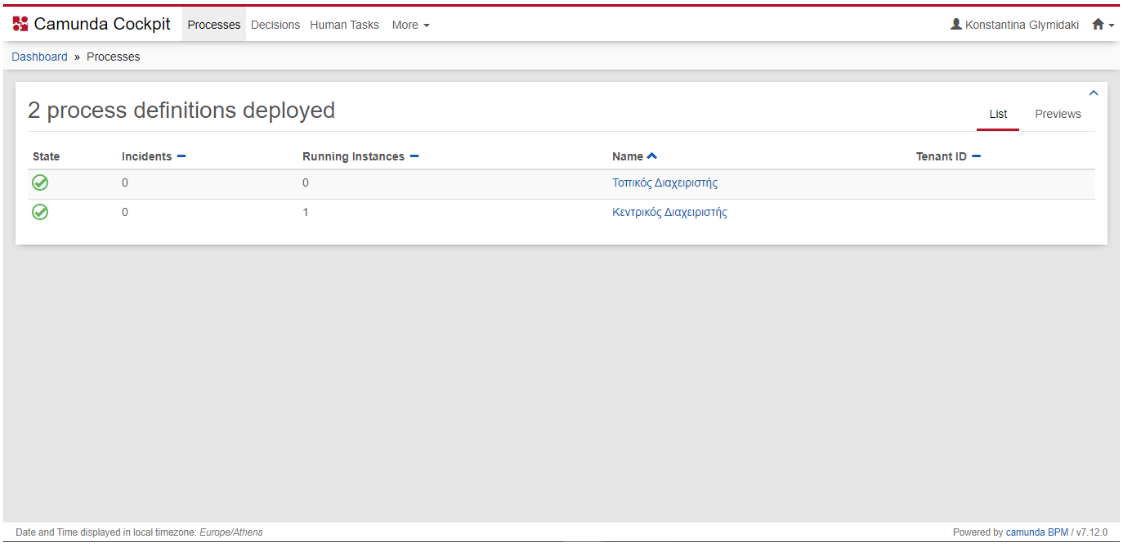
1 Open Human Tasks

Deployed

Process Definitions	Decision Definitions	Case Definitions	Deployments
2	0	0	3

Date and Time displayed in local timezone: *Europe/Athens*

Powered by camunda BPM / v7.12.0

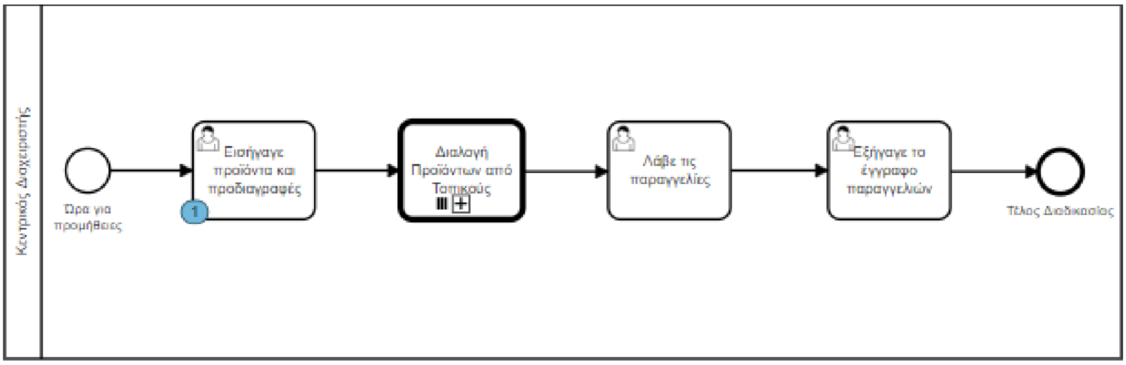


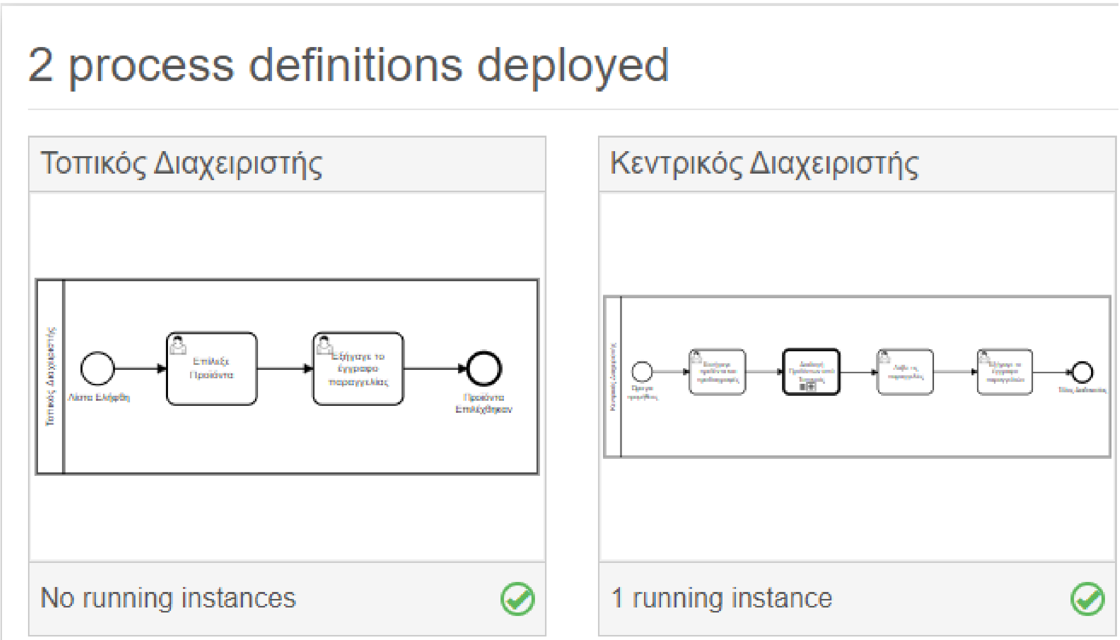
2 process definitions deployed

State	Incidents	Running Instances	Name	Tenant ID
✓	0	0	Τοπικός Διαχειριστής	
✓	0	1	Κεντρικός Διαχειριστής	

Date and Time displayed in local timezone: *Europe/Athens*

Powered by camunda BPM / v7.12.0


Κεντρικός Διαχειριστής
Ώρα για προμήθειες
Εισήγαγε προϊόντα και προδιαγραφές
1
Διαλογή Προϊόντων από Τοπικούς
Λάβε τις παραγγελίες
Εξήγαγε το έγγραφο παραγγελιών
Τέλος Διαδικασίας



2 process definitions deployed

Τοπικός Διαχειριστής

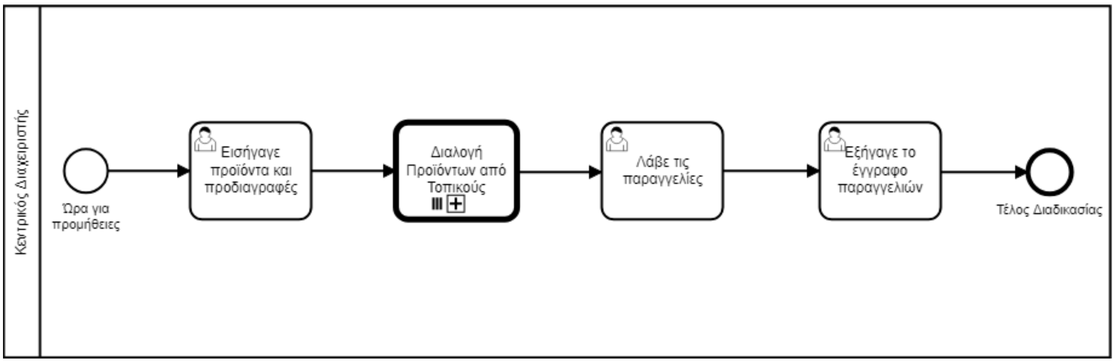
No running instances ✓

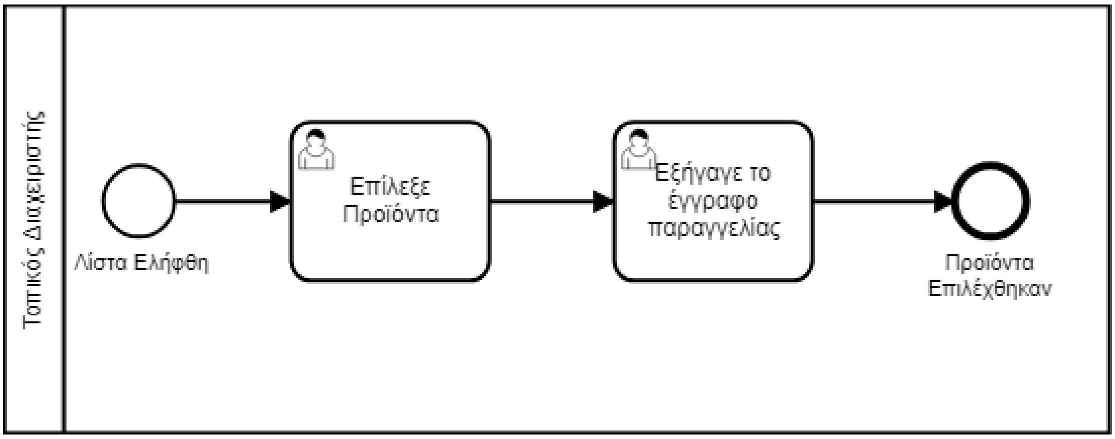
Κεντρικός Διαχειριστής

1 running instance ✓

Περιγραφή Διαδικασίας Διαγωνισμού Προμηθειών Αναλώσιμων Ηλεκτρονικών Ειδών στο Πολυτεχνείο Κρήτης

Απεικόνιση Μοντέλου Διαδικασίας Διαγωνισμού Προμηθειών


Κεντρικός Διαχειριστής
Ώρα για προμήθειες
Εισήγαγε προϊόντα και προδιαγραφές
Διαλογή Προϊόντων από Τοπικούς
Λάβε τις παραγγελίες
Εξήγαγε το έγγραφο παραγγελιών
Τέλος Διαδικασίας



Όπως φαίνεται στα 2 παραπάνω BPMN 2.0 διαγράμματα, η συνολική διαδικασία είναι χωρισμένη σε 2 επιμέρους διαδικασίες:

- Την Κύρια (Main Process), ονόματι «Κεντρικός Διαχειριστής», που ξεκινάει αυθαίρετα (κατόπιν επιθυμίας του Κεντρικού Διαχειριστή της Διαδικασίας).

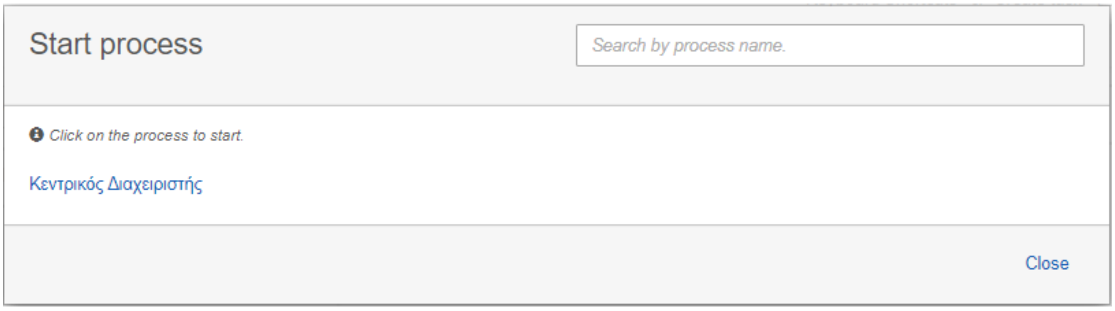
- Την Δευτερεύουσα (Subprocess), ονόματι «Τοπικός Διαχειριστής», που καλείται (αυτόματα) μόλις ο Κεντρικός Διαχειριστής υποβάλλει την φόρμα με την Αρχική Λίστα (των προς παραγγελία) προϊόντων.

Βήματα Διαδικασίας

Στη συνέχεια, επεξηγούνται με λόγια αλλά και γραφικά (μέσω screenshots από την εφαρμογή "Tasklist" του Camunda BPM) τα βήματα της Διαδικασίας.

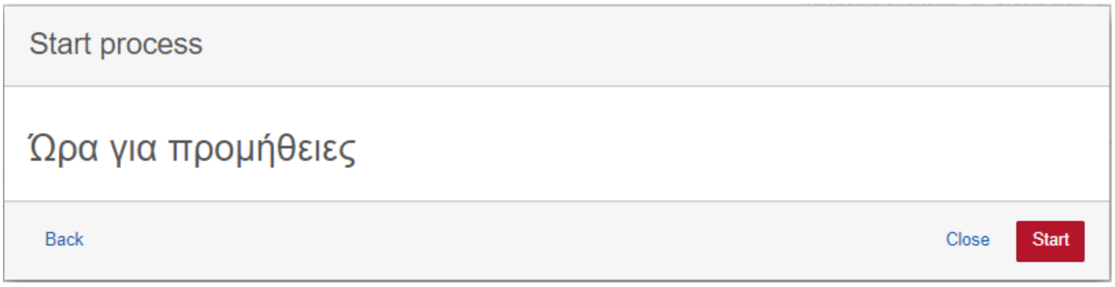
Έναρξη Διαδικασίας

Δυνατότητα έναρξης της Διαδικασίας παρέχεται μόνο στον Κεντρικό Διαχειριστή της εφαρμογής, ο οποίος ξεκινάει την Διαδικασία όταν κριθεί απαραίτητο για τις ανάγκες του Διαγωνισμού Προμηθειών.


Start process

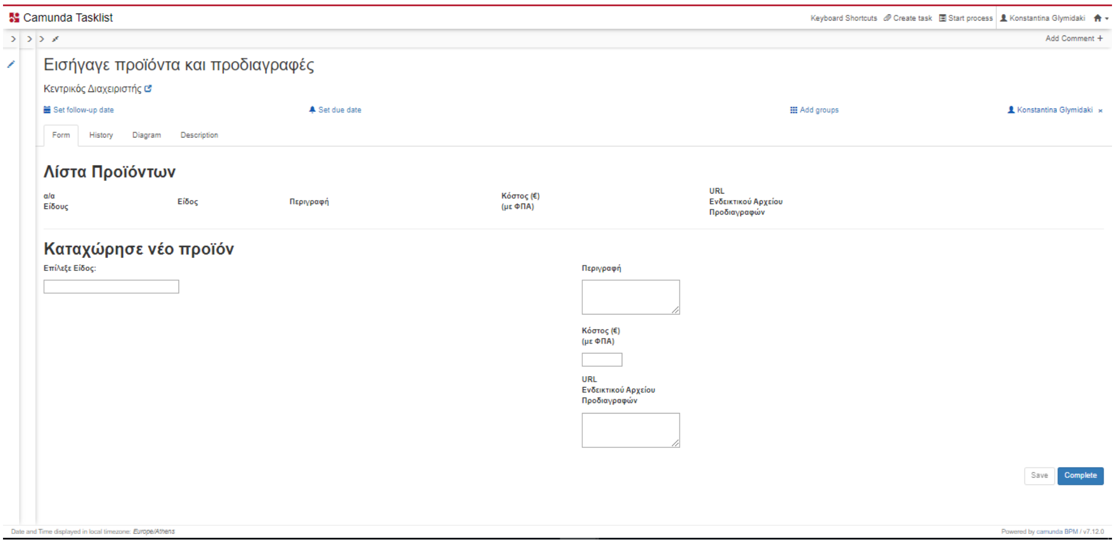
Click on the process to start.
Κεντρικός Διαχειριστής

Καλείται να επιλέξει την Κύρια Διαδικασία, που εμφανίζεται με το όνομα «Κεντρικός Διαχειριστής». Ακολούθως, εμφανίζεται στην οθόνη της εφαρμογής το σχετικό μήνυμα έναρξης της Διαδικασίας («Ώρα για προμήθειες») που αφορά στο start event (γεγονός έναρξης).


Start process
Ώρα για προμήθειες

Εισαγωγή Προϊόντων & Προδιαγραφών

Με το που επιλεγεί η έναρξη της Διαδικασίας, ο Κεντρικός Διαχειριστής παραπέμπεται στην 1η φόρμα εργασίας («Εισήγαγε προϊόντα και προδιαγραφές») για την οποία και είναι ο αρμόδιος υπεύθυνος (assignee).



Εισήγαγε προϊόντα και προδιαγραφές

Κεντρικός Διαχειριστής

Λίστα Προϊόντων

α/α Είδους	Είδος	Περιγραφή	Κόστος (€) (με ΦΠΑ)	URL Ενδεικτικού Αρχείου Προδιαγραφών

Καταχώρησε νέο προϊόν

Επίλεξε Είδος:

Περιγραφή

Κόστος (€) (με ΦΠΑ)

URL Ενδεικτικού Αρχείου Προδιαγραφών

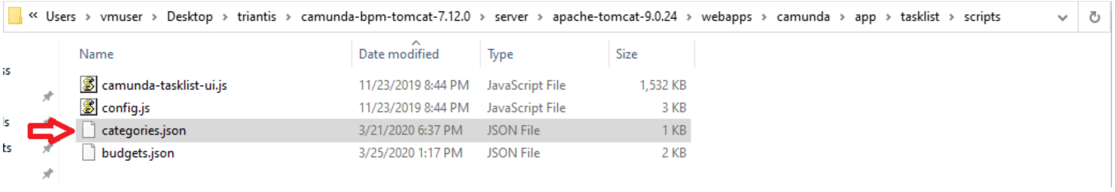
Στη συγκεκριμένη φόρμα ο Κεντρικός Διαχειριστής καλείται να συμπληρώσει όλα τα απαραίτητα πεδία (Είδος, Περιγραφή, Κόστος (€) (με ΦΠΑ), URL Ενδεικτικού Αρχείου Προδιαγραφών) για την καταχώρηση κάθε νέου προϊόντος και των προδιαγραφών του («Καταχώρησε νέο προϊόν»).

Για κάθε Είδος Προϊόντος που επιλέγεται (από το Drop-Down Menu αριστερά στην φόρμα) και με την συμπλήρωση όλων των υπολοίπων υποχρεωτικών πεδίων (δεξιά στην φόρμα), αυτομάτως εμφανίζεται το κουμπί («Add») προκειμένου να συμπληρωθεί δυναμικά («on-the-fly») ο Πίνακας με τα καταχωρημένα προϊόντα («Λίστα Προϊόντων»).

Σε αυτό το σημείο πρέπει να αναφερθεί ότι τα «Είδη Προϊόντων» του Drop-Down Menu βρίσκονται αποθηκευμένα εντός ενός επεξεργάσιμου αρχείου τύπου JSON από το οποίο και φορτώνονται στην συγκεκριμένη φόρμα εργασίας κάθε φορά.

Με κάθε επεξεργασία (προσαφαιρέσεις Ειδών Προϊόντων) του συγκεκριμένου αρχείου (categories.json) και ανανέωση (f5) της σελίδας της συγκεκριμένης φόρμας από τον web browser, το Drop-Down Menu ανανεώνεται ανάλογα.

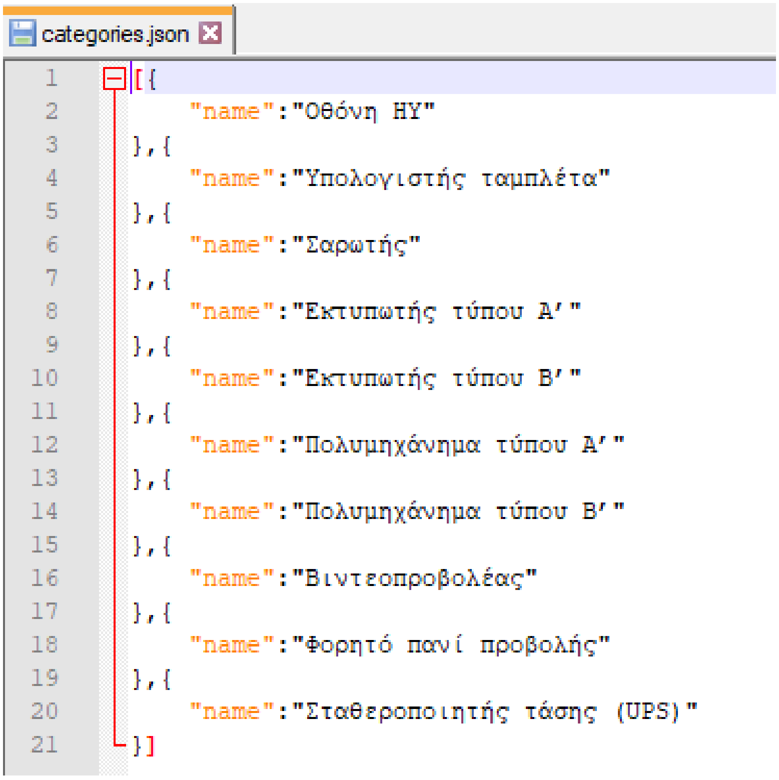
Το σχετικό αρχείο τύπου JSON (categories.json) βρίσκεται αποθηκευμένο στο ακόλουθο directory path εντός του Apache Tomcat server : C:\Users\vmuser\Desktop\triantis\camunda-bpm-tomcat-7.12.0\server\apache-tomcat-9.0.24\webapps\camunda\app\tasklist\scripts



« Users › vmuser › Desktop › triantis › camunda-bpm-tomcat-7.12.0 › server › apache-tomcat-9.0.24 › webapps › camunda › app › tasklist › scripts

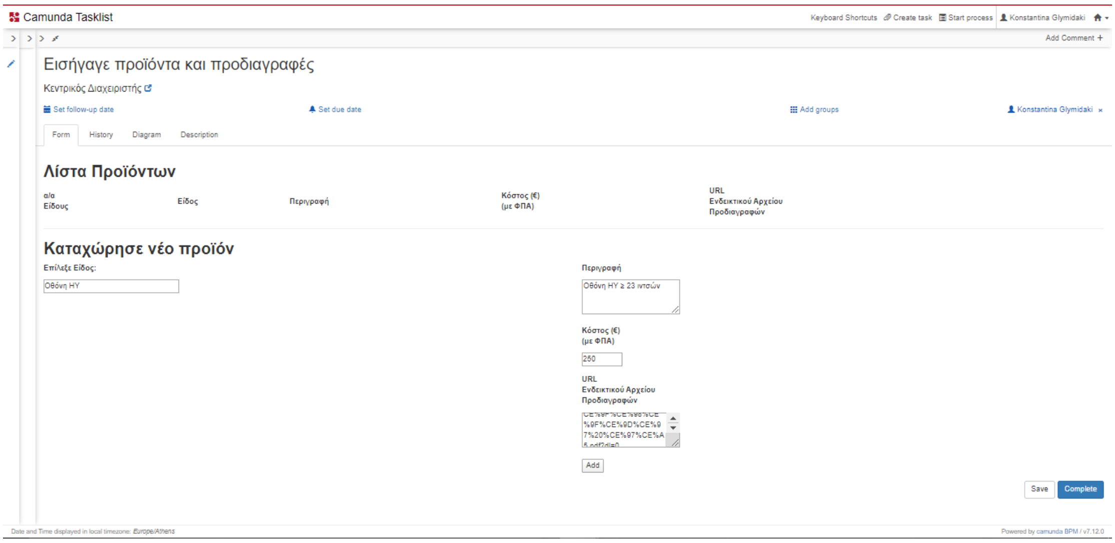
Name	Date modified	Type	Size
camunda-tasklist-ui.js	11/23/2019 8:44 PM	JavaScript File	1,532 KB
config.js	11/23/2019 8:44 PM	JavaScript File	3 KB
categories.json	3/21/2020 6:37 PM	JSON File	1 KB
budgets.json	3/25/2020 1:17 PM	JSON File	2 KB

Με χρήση ενός προγράμματος επεξεργασίας αρχείων (π.χ. Notepad++) επεξεργαζόμαστε το σχετικό αρχείο, προσαφαιρώντας Είδη Προϊόντων.



categories.json

```
[{
    "name":"Οθόνη ΗΥ"
},{
    "name":"Υπολογιστής ταμπλέτα"
},{
    "name":"Σαρωτής"
},{
    "name":"Εκτυπωτής τύπου Α'"
},{
    "name":"Εκτυπωτής τύπου Β'"
},{
    "name":"Πολυμηχάνημα τύπου Α'"
},{
    "name":"Πολυμηχάνημα τύπου Β'"
},{
    "name":"Βιντεοπροβολέας"
},{
    "name":"Φορητό πανί προβολής"
},{
    "name":"Σταθεροποιητής τάσης (UPS)"
}]
```



Εισήγαγε προϊόντα και προδιαγραφές

Κεντρικός Διαχειριστής

Λίστα Προϊόντων

α/α Είδους	Είδος	Περιγραφή	Κόστος (€) (με ΦΠΑ)	URL Ενδεικτικού Αρχείου Προδιαγραφών

Καταχώρησε νέο προϊόν

Επίλεξε Είδος: Οθόνη HY

Περιγραφή: Οθόνη HY ≥ 23 ιντσών

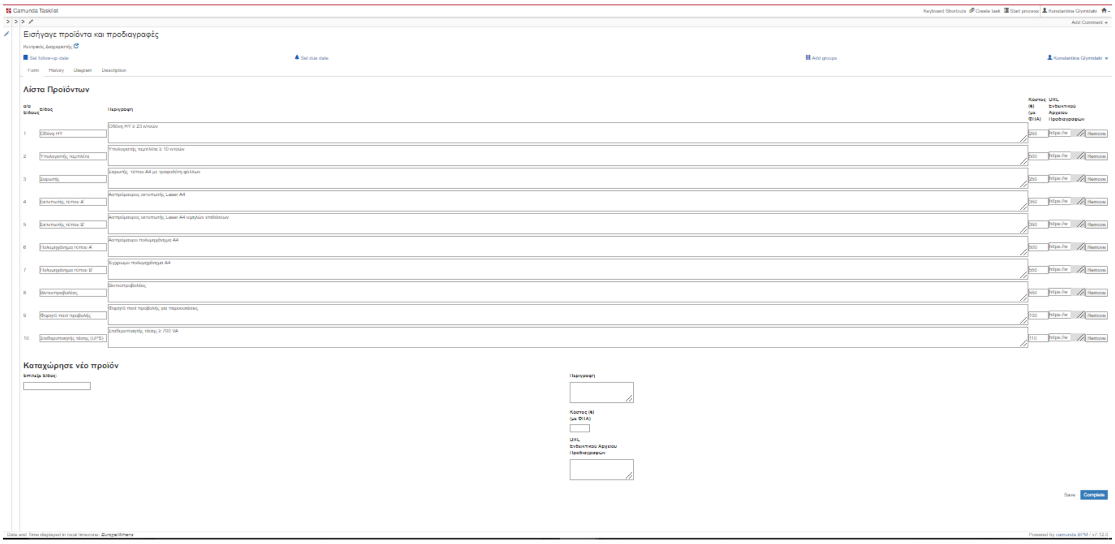
Κόστος (€) (με ΦΠΑ): 250

URL Ενδεικτικού Αρχείου Προδιαγραφών: CE%9F%CE%98%CE %9F%CE%9D%CE%9 7%20%CE%97%CE%A 5.pdf?dl=0

Date and Time displayed in local timezone: Europe/Athens

Powered by camunda BPM / v7.12.0

Η τελική μορφή ενός συμπληρωμένου Πίνακα με την Λίστα Προϊόντων (ενδεικτικά για 10 προϊόντα στο Demo) απεικονίζεται στο παρακάτω screenshot:



Εισήγαγε προϊόντα και προδιαγραφές

Κεντρικός Διαχειριστής

Λίστα Προϊόντων

α/α Είδους	Είδος	Περιγραφή	Κόστος (€) (με ΦΠΑ)	URL Ενδεικτικού Αρχείου Προδιαγραφών
1	Οθόνη HY	Οθόνη HY ≥ 23 ιντσών	250	https://w
2	Υπολογιστής ταμπλέτα	Υπολογιστής ταμπλέτα ≥ 10 ιντσών	500	https://w
3	Σαρωτής	Σαρωτής τύπου A4 με τροφοδότη φύλλων	250	https://w
4	Εκτυπωτής τύπου Α'	Ασπρόμαυρος εκτυπωτής Laser A4	350	https://w
5	Εκτυπωτής τύπου Β'	Ασπρόμαυρος εκτυπωτής Laser A4 υψηλών επιδόσεων	350	https://w
6	Πολυμηχάνημα τύπου Α'	Ασπρόμαυρο πολυμηχάνημα A4	500	https://w
7	Πολυμηχάνημα τύπου Β'	Έγχρωμο πολυμηχάνημα A4	550	https://w
8	Βιντεοπροβολέας	Βιντεοπροβολέας	550	https://w
9	Φορητό πανί προβολής	Φορητό πανί προβολής για παρουσιάσεις	100	https://w
10	Σταθεροποιητής τάσης (UPS)	Σταθεροποιητής τάσης ≥ 700 VA	110	https://w

Καταχώρησε νέο προϊόν

Επίλεξε Είδος:

Περιγραφή

Κόστος (€) (με ΦΠΑ)

URL Ενδεικτικού Αρχείου Προδιαγραφών

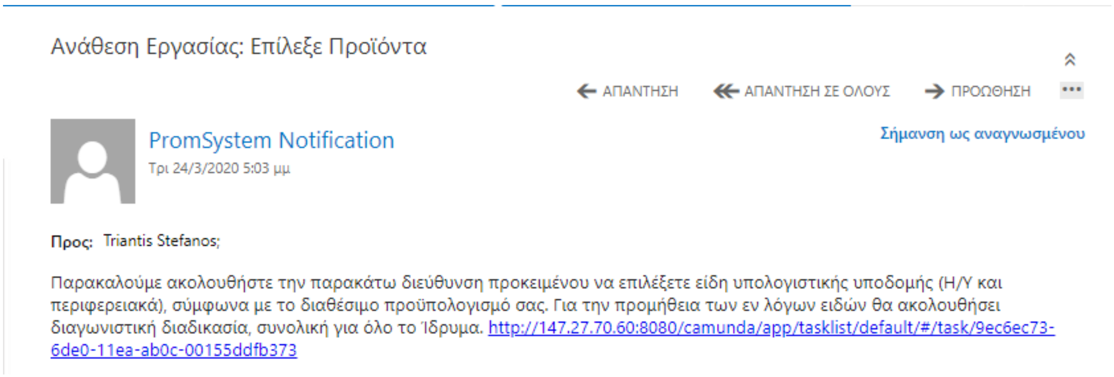
Date and Time displayed in local timezone: Europe/Athens

Powered by camunda BPM / v7.12.0

Διαλογή Προϊόντων

Με την υποβολή της 1ης φόρμας εργασίας («Εισήγαγε προϊόντα και προδιαγραφές») από τον Κεντρικό Διαχειριστή, καλείται αυτομάτως η Δευτερεύουσα Διαδικασία («Τοπικός Διαχειριστής»).

Η αυτόματη ανάθεση της $2^{ης}$ φόρμας εργασίας («Επίλεξε Προϊόντα») κοινοποιείται σε κάθε έναν από τους Τοπικούς Διαχειριστές με αυτοματοποιημένο (από το σύστημα) email στον προσωπικό τους λογαριασμό που έχει δηλωθεί στην εφαρμογή "Admin" του Camunda BPM.



Ανάθεση Εργασίας: Επίλεξε Προϊόντα

PromSystem Notification
Τρι 24/3/2020 5:03 μμ

Προς: Triantis Stefanos;

Παρακαλούμε ακολουθήστε την παρακάτω διεύθυνση προκειμένου να επιλέξετε είδη υπολογιστικής υποδομής (Η/Υ και περιφερειακά), σύμφωνα με το διαθέσιμο προϋπολογισμό σας. Για την προμήθεια των εν λόγων ειδών θα ακολουθήσει διαγωνιστική διαδικασία, συνολική για όλο το Ίδρυμα. http://147.27.70.60:8080/camunda/app/tasklist/default/#/task/9ec6ec73-6de0-11ea-ab0c-00155ddfb373

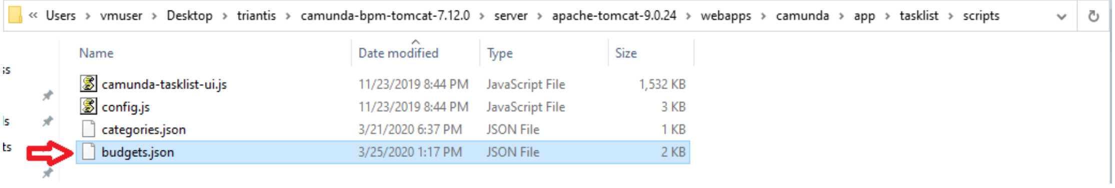
Κάθε ένας από τους Τοπικούς Διαχειριστές, καλείται να επιλέξει από την υποβληθείσα Αρχική Λίστα, προϊόντα με βάση τις ανάγκες του Τμήματος / Διεύθυνσης που εκπροσωπεί στο Ίδρυμα. Ανάλογα με τις επιλογές και τις προσαφαιρέσεις, υπολογίζονται δυναμικά («on-the-fly») το κόστος παραγγελίας (επιμέρους για το κάθε προϊόν και συνολικό) καθώς και το σύνολο των παραγγελθέντων προϊόντων.

Πάνω και αριστερά στην φόρμα απεικονίζονται (για τον κάθε χρήστη μεμονωμένα) το Τμήμα και ο διαθέσιμος Προϋπολογισμός. Το διαθέσιμο Υπόλοιπο υπολογίζεται δυναμικά («on-the-fly») με κάθε επιλογή και προσαφαίρεση αντίστοιχα από την Λίστα Προϊόντων. Σημειωτέον ότι ο χρήστης δεν δύναται να υποβάλλει την συγκεκριμένη φόρμα σε περίπτωση που το συνολικό κόστος παραγγελίας δεν καλύπτεται από τον διαθέσιμο Προϋπολογισμό (αρνητικό Υπόλοιπο).

Σε αυτό το σημείο πρέπει να αναφερθεί ότι το «Τμήμα» καθώς και ο διαθέσιμος (για κάθε Τοπικό Διαχειριστή) «Προϋπολογισμός» βρίσκονται αποθηκευμένα εντός ενός επεξεργάσιμου αρχείου τύπου JSON από το οποίο και φορτώνονται στην συγκεκριμένη φόρμα εργασίας κάθε φορά.

Με κάθε επεξεργασία (αλλαγή «Τμήματος» ή «διαθέσιμου Προϋπολογισμού») του συγκεκριμένου αρχείου (budgets.json) και ανανέωση (f5) της σελίδας της συγκεκριμένης φόρμας από τον web browser, η σχετική πληροφορία (για τον κάθε Τοπικό Διαχειριστή) ανανεώνεται ανάλογα.

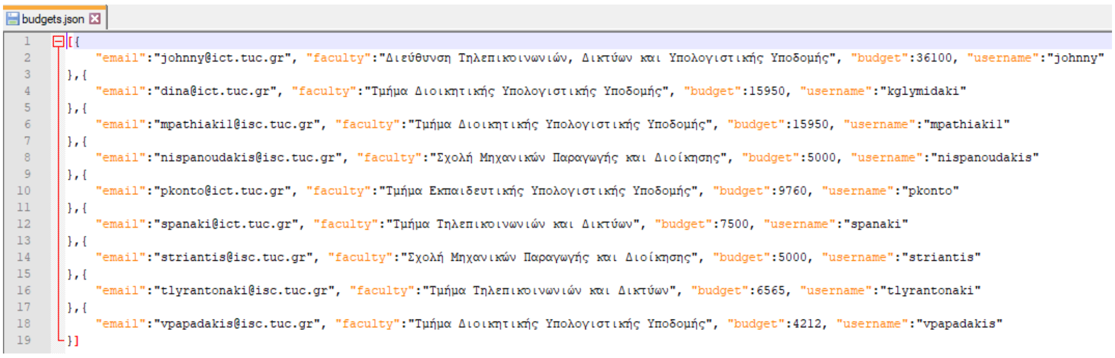
Το σχετικό αρχείο τύπου JSON (budgets.json) βρίσκεται αποθηκευμένο στο ακόλουθο directory path εντός του Apache Tomcat server : C:\Users\vmuser\Desktop\triantis\camunda-bpm-tomcat-7.12.0\server\apache-tomcat-9.0.24\webapps\camunda\app\tasklist\scripts



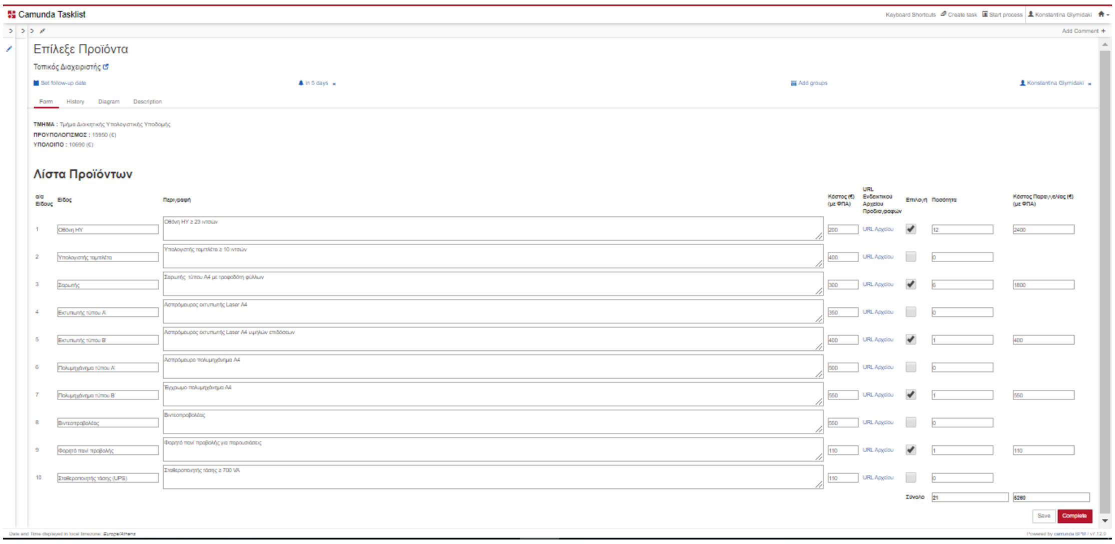
« Users › vmuser › Desktop › triantis › camunda-bpm-tomcat-7.12.0 › server › apache-tomcat-9.0.24 › webapps › camunda › app › tasklist › scripts

Name	Date modified	Type	Size
camunda-tasklist-ui.js	11/23/2019 8:44 PM	JavaScript File	1,532 KB
config.js	11/23/2019 8:44 PM	JavaScript File	3 KB
categories.json	3/21/2020 6:37 PM	JSON File	1 KB
budgets.json	3/25/2020 1:17 PM	JSON File	2 KB

Με χρήση ενός προγράμματος επεξεργασίας αρχείων (π.χ. Notepad++) επεξεργαζόμαστε το σχετικό αρχείο, αλλάζοντας (ενδεχομένως) το Τμήμα ή τον διαθέσιμο (για κάποιον Τοπικό Διαχειριστή) Προϋπολογισμό.



```
[{
    "email":"johnny@ict.tuc.gr", "faculty":"Διεύθυνση Τηλεπικοινωνιών, Δικτύων και Υπολογιστικής Υποδομής", "budget":36100, "username":"johnny"
},{
    "email":"dina@ict.tuc.gr", "faculty":"Τμήμα Διοικητικής Υπολογιστικής Υποδομής", "budget":15950, "username":"kglymidaki"
},{
    "email":"mpathiakil@isc.tuc.gr", "faculty":"Τμήμα Διοικητικής Υπολογιστικής Υποδομής", "budget":15950, "username":"mpathiakil"
},{
    "email":"nispanoudakis@isc.tuc.gr", "faculty":"Σχολή Μηχανικών Παραγωγής και Διοίκησης", "budget":5000, "username":"nispanoudakis"
},{
    "email":"pkonto@ict.tuc.gr", "faculty":"Τμήμα Εκπαιδευτικής Υπολογιστικής Υποδομής", "budget":9760, "username":"pkonto"
},{
    "email":"spanaki@ict.tuc.gr", "faculty":"Τμήμα Τηλεπικοινωνιών και Δικτύων", "budget":7500, "username":"spanaki"
},{
    "email":"striantis@isc.tuc.gr", "faculty":"Σχολή Μηχανικών Παραγωγής και Διοίκησης", "budget":5000, "username":"striantis"
},{
    "email":"tlyrantonaki@isc.tuc.gr", "faculty":"Τμήμα Τηλεπικοινωνιών και Δικτύων", "budget":6565, "username":"tlyrantonaki"
},{
    "email":"vpapadakis@isc.tuc.gr", "faculty":"Τμήμα Διοικητικής Υπολογιστικής Υποδομής", "budget":4212, "username":"vpapadakis"
}]
```



Επίλεξε Προϊόντα

Τοπικός Διαχειριστής

ΤΜΗΜΑ : Τμήμα Διοικητικής Υπολογιστικής Υποδομής
ΠΡΟΥΠΟΛΟΓΙΣΜΟΣ : 15950 (€)
ΥΠΟΛΟΙΠΟ : 10690 (€)

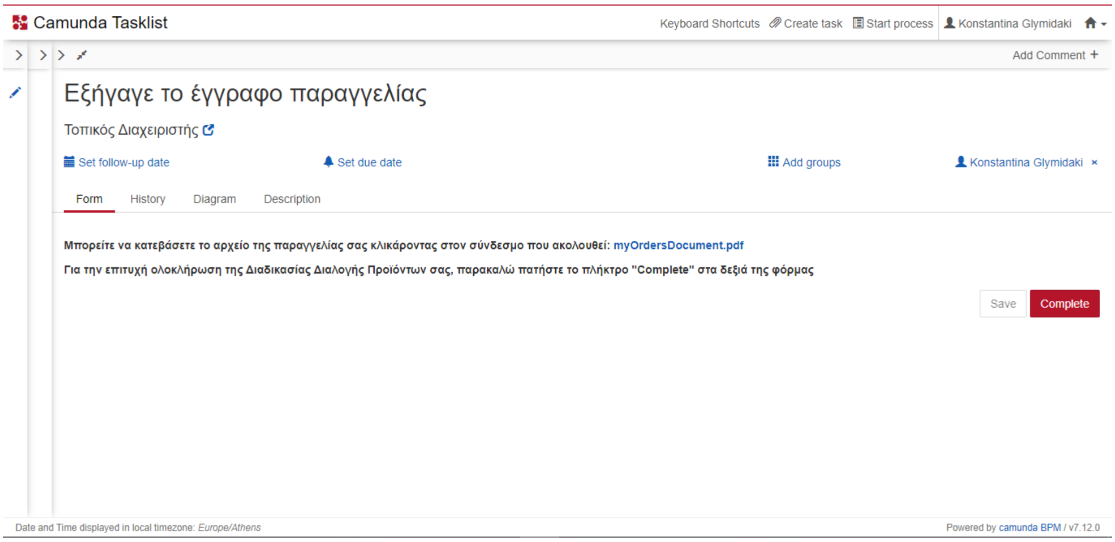
Λίστα Προϊόντων

α/α Είδους	Είδος	Περιγραφή	Κόστος (€) (με ΦΠΑ)	URL Ενδεικτικού Αρχείου Προδιαγραφών	Επιλογή	Ποσότητα	Κόστος Παραγγελίας (€) (με ΦΠΑ)
1	Οθόνη HY	Οθόνη HY ≥ 23 ιντσών	200	URL Αρχείου	☑	12	2400
2	Υπολογιστής ταμπλέτα	Υπολογιστής ταμπλέτα ≥ 10 ιντσών	400	URL Αρχείου	□	0	
3	Σαρωτής	Σαρωτής τύπου Α4 με τροφοδότη φύλλων	300	URL Αρχείου	☑	6	1800
4	Εκτυπωτής τύπου Α'	Ασπρόμαυρος εκτυπωτής Laser A4	350	URL Αρχείου	□	0	
5	Εκτυπωτής τύπου Β'	Ασπρόμαυρος εκτυπωτής Laser A4 υψηλών επιδόσεων	400	URL Αρχείου	☑	1	400
6	Πολυμηχάνημα τύπου Α'	Ασπρόμαυρο πολυμηχάνημα Α4	500	URL Αρχείου	□	0	
7	Πολυμηχάνημα τύπου Β'	Έγχρωμο πολυμηχάνημα Α4	550	URL Αρχείου	☑	1	550
8	Βιντεοπροβολέας	Βιντεοπροβολέας	550	URL Αρχείου	□	0	
9	Φορητό πανί προβολής	Φορητό πανί προβολής για παρουσιάσεις	110	URL Αρχείου	☑	1	110
10	Σταθεροποιητής τάσης (UPS)	Σταθεροποιητής τάσης ≥ 700 VA	110	URL Αρχείου	□	0	
					Σύνολο	21	5280

Save
Complete
Date and Time displayed in local timezone: Europe/Athens
Powered by camunda BPM / v7.12.0

Εξαγωγή εγγράφου προσωπικής παραγγελίας προϊόντων

Με την υποβολή της φόρμας εργασίας («Επίλεξε Προϊόντα») κάθε Τοπικός Διαχειριστής παραπέμπεται στην επόμενη φόρμα όπου και δύναται να κατεβάσει στον υπολογιστή του την Λίστα με την Παραγγελία προϊόντων, σε μορφή pdf, κλικάροντας στον σχετικό σύνδεσμο που αναγράφεται στο μήνυμα.



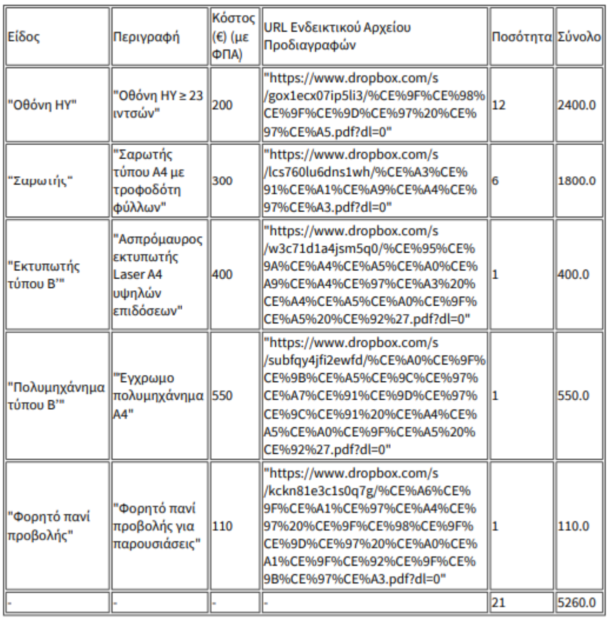
Εξήγαγε το έγγραφο παραγγελίας

Τοπικός Διαχειριστής

Μπορείτε να κατεβάσετε το αρχείο της παραγγελίας σας κλικάροντας στον σύνδεσμο που ακολουθεί: myOrdersDocument.pdf

Για την επιτυχή ολοκλήρωση της Διαδικασίας Διαλογής Προϊόντων σας, παρακαλώ πατήστε το πλήκτρο "Complete" στα δεξιά της φόρμας

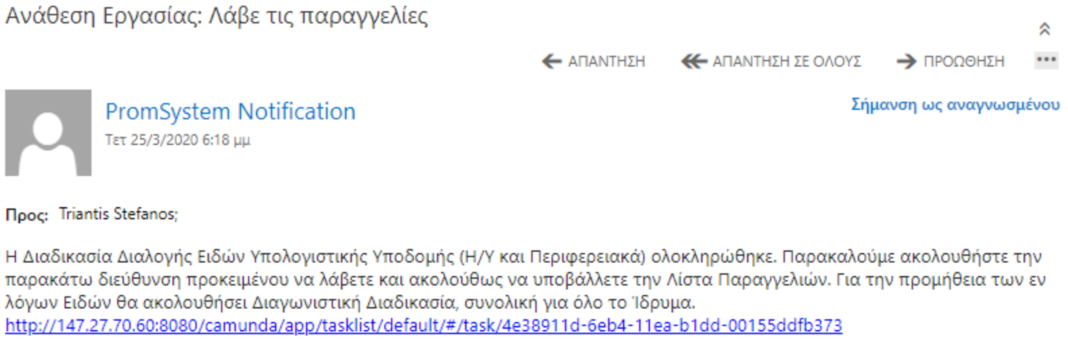
Το εξαγώγιμο pdf έγγραφο είναι της παρακάτω μορφής:



Είδος	Περιγραφή	Κόστος (€) (με ΦΠΑ)	URL Ενδεικτικού Αρχείου Προδιαγραφών	Ποσότητα	Σύνολο
"Οθόνη ΗΥ"	"Οθόνη ΗΥ ≥ 23 ιντσών"	200	"https://www.dropbox.com/s/gox1ecx07ip5li3/%CE%9F%CE%98%CE%9F%CE%9D%CE%97%20%CE%97%CE%A5.pdf?dl=0"	12	2400.0
"Σαρωτής"	"Σαρωτής τύπου Α4 με τροφοδότη φύλλων"	300	"https://www.dropbox.com/s/lcs760lu6dns1wh/%CE%A3%CE%91%CE%A1%CE%A9%CE%A4%CE%97%CE%A3.pdf?dl=0"	6	1800.0
"Εκτυπωτής τύπου Β'"	"Ασπρόμαυρος εκτυπωτής Laser A4 υψηλών επιδόσεων"	400	"https://www.dropbox.com/s/w3c71d1a4jsm5q0/%CE%95%CE%9A%CE%A4%CE%A5%CE%A0%CE%A9%CE%A4%CE%97%CE%A3%20%CE%A4%CE%A5%CE%A0%CE%9F%CE%A5%20%CE%92%27.pdf?dl=0"	1	400.0
"Πολυμηχάνημα τύπου Β'"	"Έγχρωμο πολυμηχάνημα Α4"	550	"https://www.dropbox.com/s/subfqy4jfi2ewfd/%CE%A0%CE%9F%CE%9B%CE%A5%CE%9C%CE%97%CE%A7%CE%91%CE%9D%CE%97%CE%9C%CE%91%20%CE%A4%CE%A5%CE%A0%CE%9F%CE%A5%20%CE%92%27.pdf?dl=0"	1	550.0
"Φορητό πανί προβολής"	"Φορητό πανί προβολής για παρουσιάσεις"	110	"https://www.dropbox.com/s/kckn81e3c1s0q7g/%CE%A6%CE%9F%CE%A1%CE%97%CE%A4%CE%9F%20%CE%9F%CE%98%CE%9F%CE%9D%CE%97%20%CE%A0%CE%A1%CE%9F%CE%92%CE%9F%CE%9B%CE%97%CE%A3.pdf?dl=0"	1	110.0
-	-	-	-	21	5260.0

Συγκέντρωση Προσωπικών Παραγγελιών Προϊόντων

Με την ολοκλήρωση της διαδικασίας Διαλογής Προϊόντων από όλους τους Τοπικούς Διαχειριστές, συνεχίζεται η Κύρια Διαδικασία από τον Κεντρικό Διαχειριστή (ο οποίος επίσης ενημερώνεται με αυτοματοποιημένο από το σύστημα email για την διεκπεραίωση του ανάλογου task) και λαμβάνει την ενοποιημένη Τελική Λίστα με τις επιλογές όλων των Τοπικών Διαχειριστών («Λάβε τις παραγγελίες»).

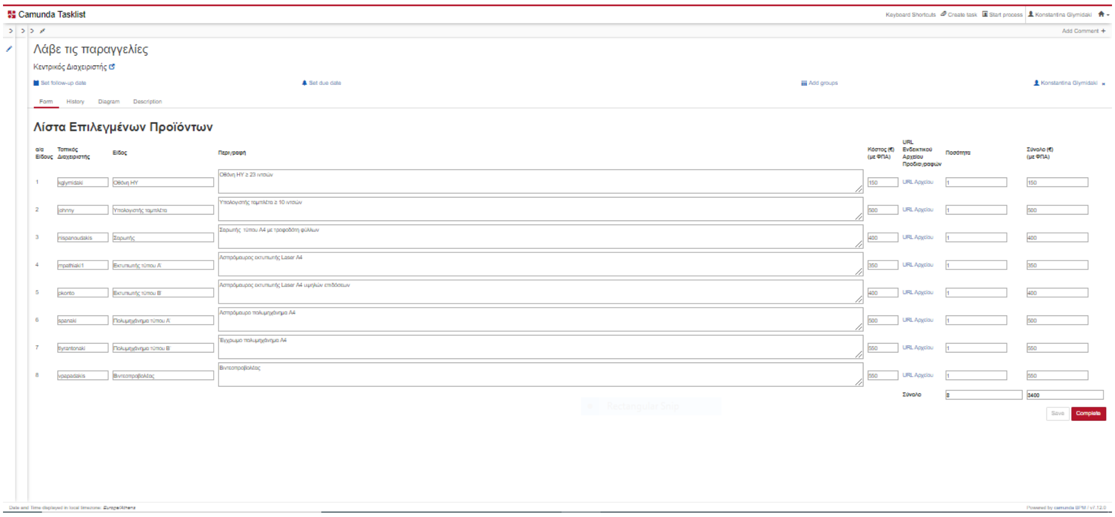


Ανάθεση Εργασίας: Λάβε τις παραγγελίες

PromSystem Notification
Τετ 25/3/2020 6:18 μμ

Προς: Triantis Stefanos;

Η Διαδικασία Διαλογής Ειδών Υπολογιστικής Υποδομής (Η/Υ και Περιφερειακά) ολοκληρώθηκε. Παρακαλούμε ακολουθήστε την παρακάτω διεύθυνση προκειμένου να λάβετε και ακολούθως να υποβάλλετε την Λίστα Παραγγελιών. Για την προμήθεια των εν λόγων Ειδών θα ακολουθήσει Διαγωνιστική Διαδικασία, συνολική για όλο το Ίδρυμα.
http://147.27.70.60:8080/camunda/app/tasklist/default/#/task/4e38911d-6eb4-11ea-b1dd-00155ddfb373



Λάβε τις παραγγελίες
Κεντρικός Διαχειριστής

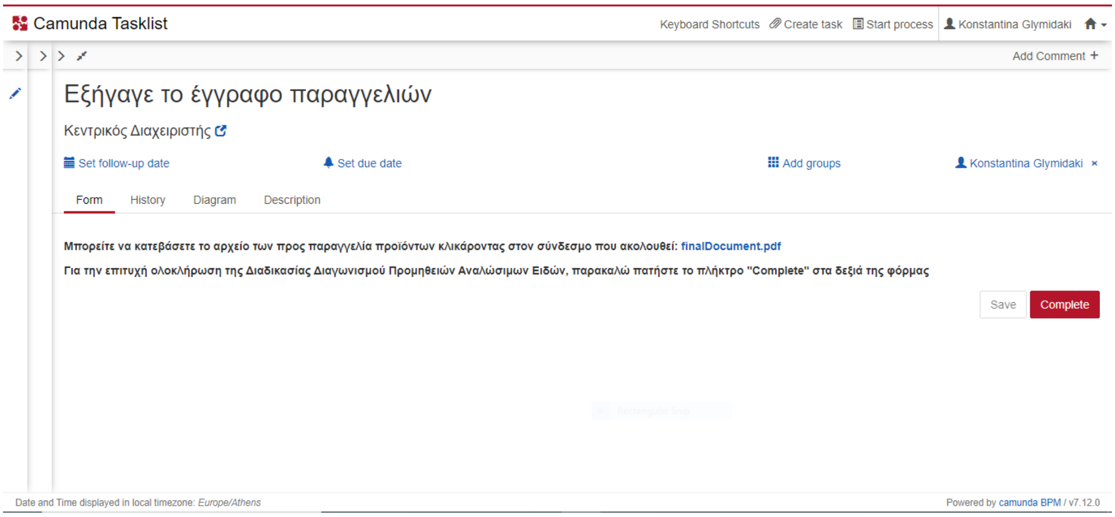
Λίστα Επιλεγμένων Προϊόντων

α/α Είδους	Τοπικός Διαχειριστής	Είδος	Περιγραφή	Κόστος (€) (με ΦΠΑ)	URL Ενδεικτικού Αρχείου Προδιαγραφών	Ποσότητα	Σύνολο (€) (με ΦΠΑ)
1	kglymidaki	Οθόνη ΗΥ	Οθόνη ΗΥ ≥ 23 ιντσών	150	URL Αρχείου	1	150
2	johnny	Υπολογιστής ταμπλέτα	Υπολογιστής ταμπλέτα ≥ 10 ιντσών	500	URL Αρχείου	1	500
3	nispanoudakis	Σαρωτής	Σαρωτής τύπου Α4 με τροφοδότη φύλλων	400	URL Αρχείου	1	400
4	mpathiaki1	Εκτυπωτής τύπου Α'	Ασπρόμαυρος εκτυπωτής Laser A4	350	URL Αρχείου	1	350
5	pkonto	Εκτυπωτής τύπου Β'	Ασπρόμαυρος εκτυπωτής Laser A4 υψηλών επιδόσεων	400	URL Αρχείου	1	400
6	spanaki	Πολυμηχάνημα τύπου Α'	Ασπρόμαυρο πολυμηχάνημα Α4	500	URL Αρχείου	1	500
7	tyrantonaki	Πολυμηχάνημα τύπου Β'	Έγχρωμο πολυμηχάνημα Α4	550	URL Αρχείου	1	550
8	vpapadakis	Βιντεοπροβολέας	Βιντεοπροβολέας	550	URL Αρχείου	1	550
					Σύνολο	8	3400

Save
Complete
Date and Time displayed in local timezone: Europe/Athens
Powered by camunda BPM / v7.12.0

Εξαγωγή εγγράφου συνολικής παραγγελίας προϊόντων

Αφού ληφθεί η τελική λίστα προϊόντων, ο Κεντρικός Διαχειριστής υποβάλλει την φόρμα και ακολούθως οδηγείται στο τελευταίο task («Εξήγαγε το έγγραφο παραγγελιών») όπου και δύναται να κατεβάσει το τελικό έγγραφο (σε μορφή pdf) μέσω του σχετικού συνδέσμου λήψης του αρχείου. Η Διαδικασία ολοκληρώνεται με την υποβολή της φόρμας (Complete).



Εξήγαγε το έγγραφο παραγγελιών

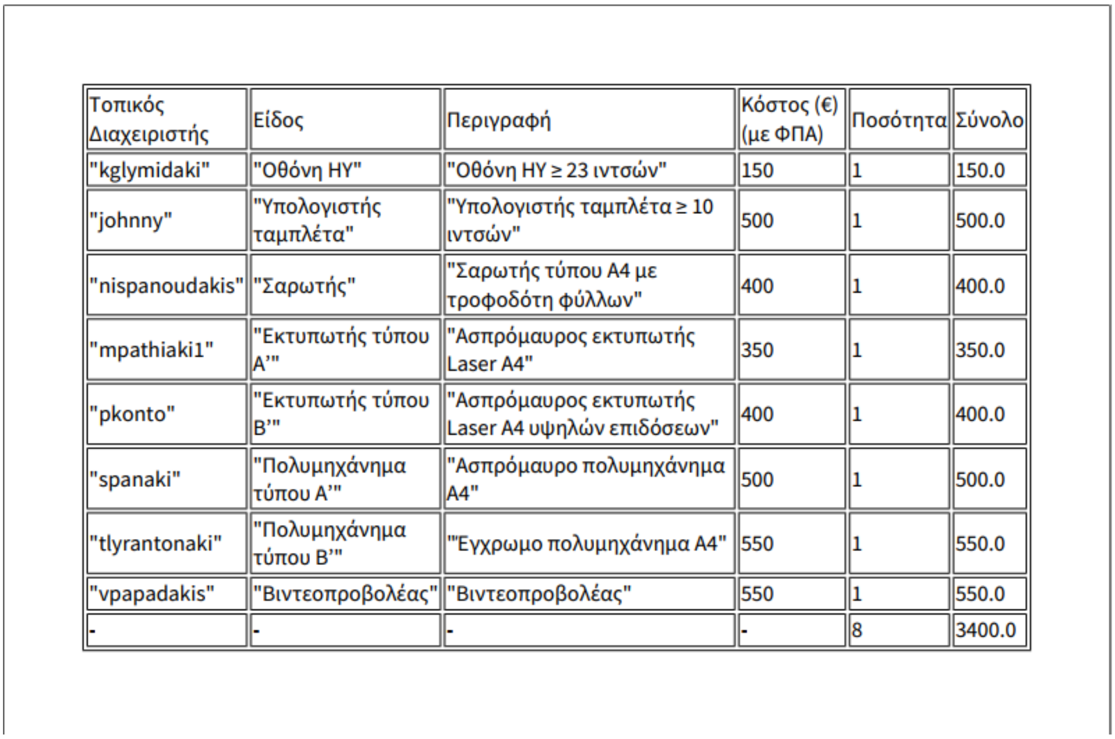
Κεντρικός Διαχειριστής

Μπορείτε να κατεβάσετε το αρχείο των προς παραγγελία προϊόντων κλικάροντας στον σύνδεσμο που ακολουθεί: finalDocument.pdf

Για την επιτυχή ολοκλήρωση της Διαδικασίας Διαγωνισμού Προμηθειών Αναλώσιμων Ειδών, παρακαλώ πατήστε το πλήκτρο "Complete" στα δεξιά της φόρμας

Save
Complete
Date and Time displayed in local timezone: Europe/Athens
Powered by camunda BPM / v7.12.0

Το εξαγώγιμο τελικό pdf έγγραφο είναι της παρακάτω μορφής:



Τοπικός Διαχειριστής	Είδος	Περιγραφή	Κόστος (€) (με ΦΠΑ)	Ποσότητα	Σύνολο
"kglymidaki"	"Οθόνη ΗΥ"	"Οθόνη ΗΥ ≥ 23 ιντσών"	150	1	150.0
"johnny"	"Υπολογιστής ταμπλέτα"	"Υπολογιστής ταμπλέτα ≥ 10 ιντσών"	500	1	500.0
"nispanoudakis"	"Σαρωτής"	"Σαρωτής τύπου Α4 με τροφοδότη φύλλων"	400	1	400.0
"mpathiaki1"	"Εκτυπωτής τύπου Α'"	"Ασπρόμαυρος εκτυπωτής Laser A4"	350	1	350.0
"pkonto"	"Εκτυπωτής τύπου Β'"	"Ασπρόμαυρος εκτυπωτής Laser A4 υψηλών επιδόσεων"	400	1	400.0
"spanaki"	"Πολυμηχάνημα τύπου Α'"	"Ασπρόμαυρο πολυμηχάνημα Α4"	500	1	500.0
"tlyrantonaki"	"Πολυμηχάνημα τύπου Β'"	"Έγχρωμο πολυμηχάνημα Α4"	550	1	550.0
"vpapadakis"	"Βιντεοπροβολέας"	"Βιντεοπροβολέας"	550	1	550.0
-	-	-	-	8	3400.0

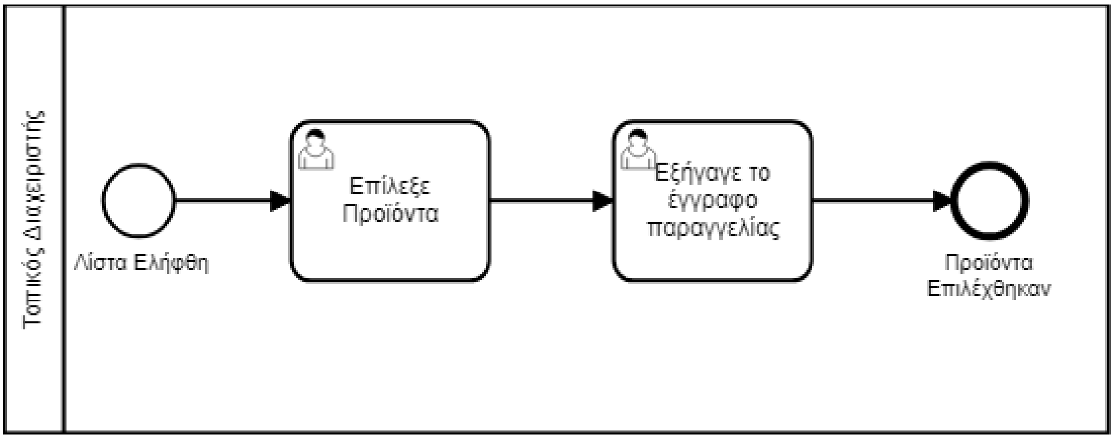
- **Local Admin Instructions**

PM SYSTEM

ΟΔΗΓΙΕΣ ΧΡΗΣΗΣ PM SYSTEM ΠΡΟΣ ΔΙΑΧΕΙΡΙΣΤΕΣ ΣΧΟΛΩΝ/ΤΜΗΜΑΤΩΝ ΠΟΛΥΤΕΧΝΕΙΟΥ ΚΡΗΤΗΣ

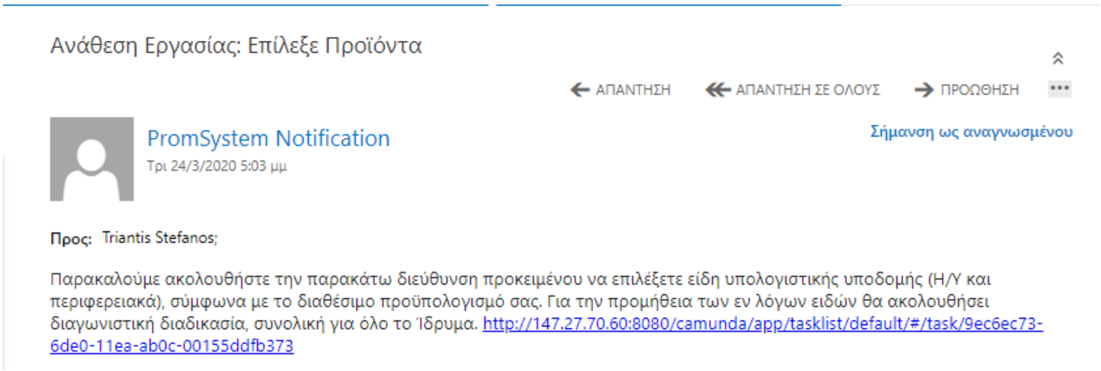
Οι Διαχειριστές των επιμέρους Σχολών/Τμημάτων του Πολυτεχνείου Κρήτης εμπλέκονται με τον ρόλο του «Τοπικού Διαχειριστή» στην Διαδικασία Διαγωνισμού Προμηθειών Αναλώσιμων Ηλεκτρονικών Ειδών του Ιδρύματος. Πιο συγκεκριμένα, είναι οι αρμόδιοι χρήστες που καλούνται να επιλέξουν Είδη με συγκεκριμένες ορισθείσες (από τον «Κεντρικό Διαχειριστή») προδιαγραφές (Περιγραφή, Κόστος, URL Ενδεικτικού Αρχείου Προδιαγραφών).

Το κομμάτι της Διαδικασίας που τους αφορά απεικονίζεται γραφικά (σε μορφή διαγράμματος BPMN) παρακάτω:



Η Διαδικασία αυτή (Διαλογή Προϊόντων) καλείται αυτόματα κάθε φορά που ο Κεντρικός Διαχειριστής υποβάλλει την φόρμα με την Λίστα «Προϊόντων και Προδιαγραφών».

Κάθε ένας από τους δηλωθέντες (ως «Τοπικός Διαχειριστής») στο Σύστημα (Camunda BPM), λαμβάνει ένα αυτοματοποιημένο email notification στον προσωπικό ακαδημαϊκό του λογαριασμό όπως είναι το παρακάτω:


Ανάθεση Εργασίας: Επίλεξε Προϊόντα

PromSystem Notification
Τρι 24/3/2020 5:03 μμ

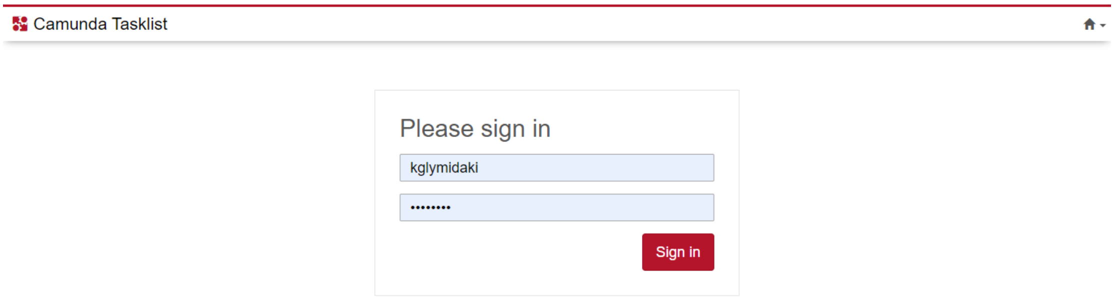
Προς: Triantis Stefanos;

Παρακαλούμε ακολουθήστε την παρακάτω διεύθυνση προκειμένου να επιλέξετε είδη υπολογιστικής υποδομής (Η/Υ και περιφερειακά), σύμφωνα με το διαθέσιμο προϋπολογισμό σας. Για την προμήθεια των εν λόγων ειδών θα ακολουθήσει διαγωνιστική διαδικασία, συνολική για όλο το Ίδρυμα. http://147.27.70.60:8080/camunda/app/tasklist/default/#/task/9ec6ec73-6de0-11ea-ab0c-00155ddfb373

Πάνω (και αριστερά) στο email notification φαίνεται ο «Τίτλος» που αφορά στην Ανάθεση Εργασίας (task) ακολουθούμενος από το «Όνομα» της εργασίας («Επίλεξε Προϊόντα» στην προκειμένη περίπτωση).

Στο μέσον (και αριστερά) φαίνεται ο «Αποστολέας» του αυτοματοποιημένου email ("PromSystem Notification" στην προκειμένη περίπτωση) με την ημερομηνία και ώρα αποστολής.

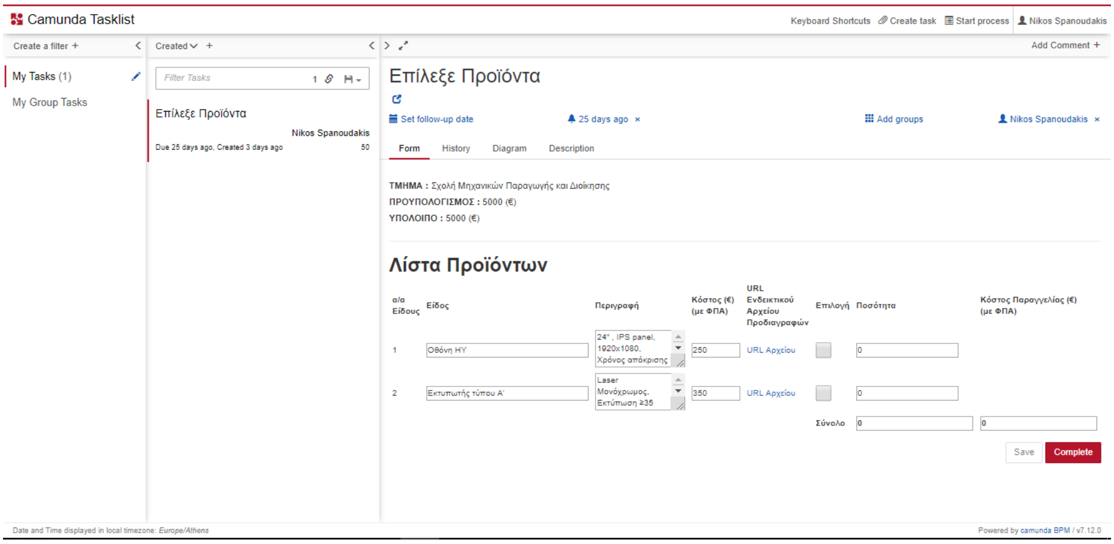
Στο κάτω μέρος του email notification φαίνεται ο «Παραλήπτης» (ο αρμόδιος για το task χρήστης) ακολουθούμενος από το «Λεκτικό» με την ενημέρωση και τον σχετικό URL σύνδεσμο που παραπέμπει στην pre-login σελίδα για την σύνδεση στην εφαρμογή "Tasklist" προκειμένου να μπορέσει ο χρήστης να δει την φόρμα εργασίας του και να ξεκινήσει ακολούθως την επιλογή προϊόντων από την διαθέσιμη Λίστα.



Please sign in

kglymidaki

••••••••



Επίλεξε Προϊόντα

Nikos Spanoudakis

Due 25 days ago, Created 3 days ago 50

Επίλεξε Προϊόντα

ΤΜΗΜΑ : Σχολή Μηχανικών Παραγωγής και Διοίκησης
ΠΡΟΥΠΟΛΟΓΙΣΜΟΣ : 5000 (€)
ΥΠΟΛΟΙΠΟ : 5000 (€)

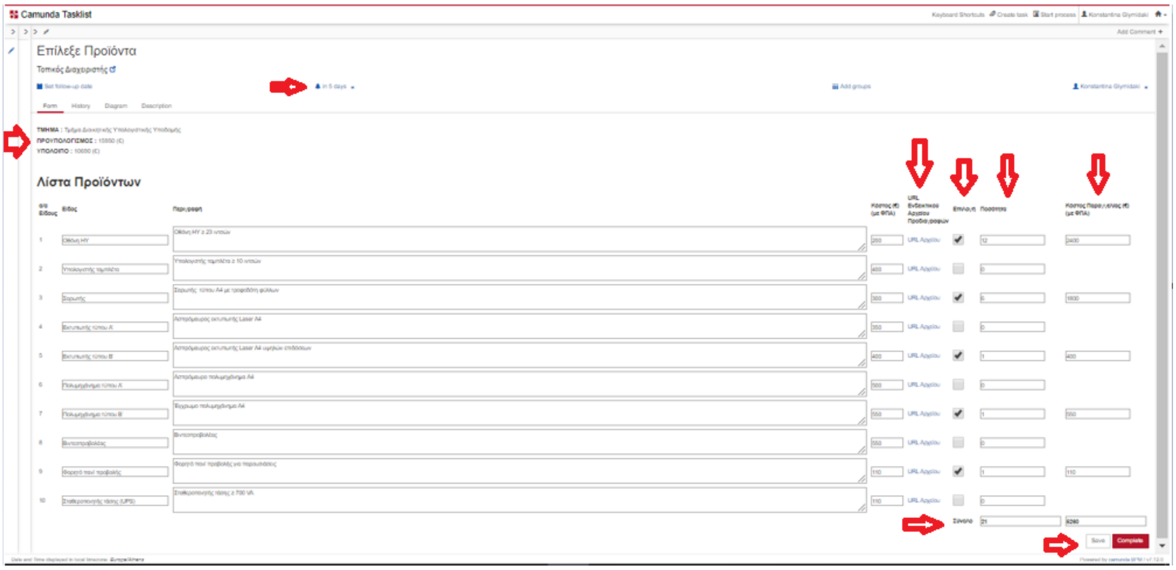
Λίστα Προϊόντων

α/α Είδους	Είδος	Περιγραφή	Κόστος (€) (με ΦΠΑ)	URL Ενδεικτικού Αρχείου Προδιαγραφών	Επιλογή	Ποσότητα	Κόστος Παραγγελίας (€) (με ΦΠΑ)
1	Οθόνη HY	24" , IPS panel, 1920x1080, Χρόνος απόκρισης	250	URL Αρχείου	□	0	
2	Εκτυπωτής τύπου A'	Laser Μονόχρωμος, Εκτύπωση ≥35	350	URL Αρχείου	□	0	
					Σύνολο	0	0

Date and Time displayed in local timezone: *Europe/Athens*

Powered by camunda BPM / v7.12.0

Η φόρμα εργασίας που φορτώνεται (δεξιά στην παραπάνω εικόνα) είναι της παρακάτω μορφής:



Επίλεξε Προϊόντα

Τοπικός Διαχειριστής

ΤΜΗΜΑ : Τμήμα Διοικητικής Υπολογιστικής Υποδομής
ΠΡΟΥΠΟΛΟΓΙΣΜΟΣ : 15950 (€)
ΥΠΟΛΟΙΠΟ : 10690 (€)

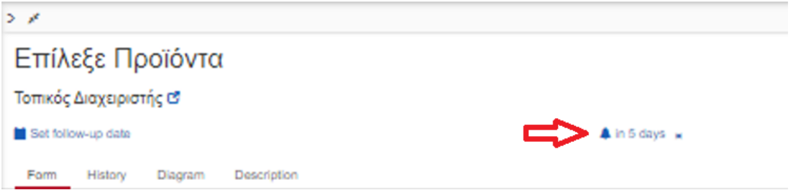
Λίστα Προϊόντων

α/α Είδους	Είδος	Περιγραφή	Κόστος (€) (με ΦΠΑ)	URL Ενδεικτικού Αρχείου Προδιαγραφών	Επιλογή	Ποσότητα	Κόστος Παραγγελίας (€) (με ΦΠΑ)
1	Οθόνη ΗΥ	Οθόνη ΗΥ ≥ 23 ιντσών	200	URL Αρχείου	☑	12	2400
2	Υπολογιστής ταμπλέτα	Υπολογιστής ταμπλέτα ≥ 10 ιντσών	400	URL Αρχείου	☐	0	
3	Σαρωτής	Σαρωτής τύπου A4 με τροφοδότη φύλλων	300	URL Αρχείου	☑	6	1800
4	Εκτυπωτής τύπου Α'	Ασπρόμαυρος εκτυπωτής Laser A4	350	URL Αρχείου	☐	0	
5	Εκτυπωτής τύπου Β'	Ασπρόμαυρος εκτυπωτής Laser A4 υψηλών επιδόσεων	400	URL Αρχείου	☑	1	400
6	Πολυμηχάνημα τύπου Α'	Ασπρόμαυρο πολυμηχάνημα A4	500	URL Αρχείου	☐	0	
7	Πολυμηχάνημα τύπου Β'	Έγχρωμο πολυμηχάνημα A4	550	URL Αρχείου	☑	1	550
8	Βιντεοπροβολέας	Βιντεοπροβολέας	550	URL Αρχείου	☐	0	
9	Φορητό πανί προβολής	Φορητό πανί προβολής για παρουσιάσεις	110	URL Αρχείου	☑	1	110
10	Σταθεροποιητής τάσης (UPS)	Σταθεροποιητής τάσης ≥ 700 VA	110	URL Αρχείου	☐	0	
					Σύνολο	21	5260

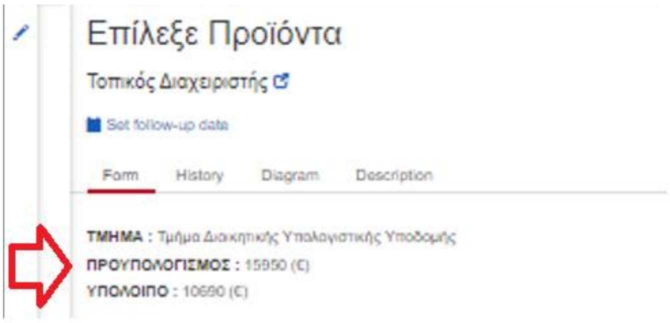
Date and Time displayed in local timezone: Europe/Athens

Στο σημείο αυτό αξίζει να αναφερθούν τα βασικά σημεία της παραπάνω φόρμας εργασίας:

- Καταληκτική Ημερομηνία Ολοκλήρωσης και Υποβολής της φόρμας εργασίας:



- Δεδομένα αναφορικά με το Όνομα της Σχολής/Τμήματος που εκπροσωπεί ο χρήστης, τον Διαθέσιμο (για την παραγγελία του) Προϋπολογισμό καθώς και το Διαθέσιμο Υπόλοιπο (υπολογίζεται “on-the-fly” ανάλογα με τις επιλογές του στην φόρμα):



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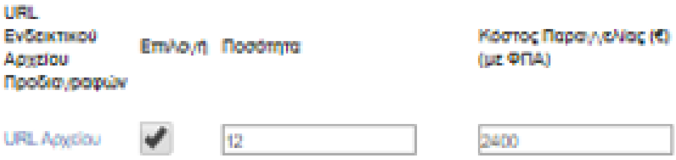
ΥΠΟΛΟΙΠΟ : 10690 (€)

- Η αλληλεπίδραση του χρήστη με την φόρμα αφορά στις παρακάτω επιλογές:



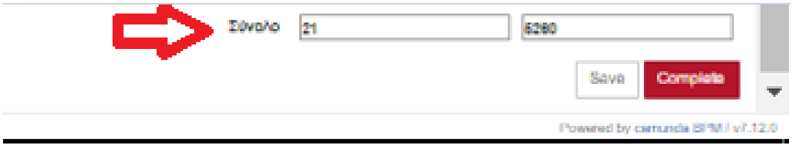
URL Ενδεικτικού Αρχείου Προδιαγραφών	Επιλογή	Ποσότητα	Κόστος Παραγγελίας (€) (με ΦΠΑ)
URL Αρχείου	☑	12	2400

  - ✓ URL Ενδεικτικού Αρχείου Προδιαγραφών: Επιλέγοντας τον σύνδεσμο (URL Αρχείου) ο χρήστης παραπέμπεται στην σελίδα μιας Cloud εφαρμογής (π.χ. Dropbox, Microsoft OneDrive, Google Drive, κλπ) όπου και δύναται να δει και να κατεβάσει (στον προσωπικό του υπολογιστή) το σχετικό αρχείο με την περιγραφή των Τεχνικών Προδιαγραφών του προϊόντος που τον ενδιαφέρει.

  - ✓ Checkbox Επιλογής: Με επιλεγμένο το checkbox, αυτομάτως εμφανίζονται δεξιά τα πεδία της «Ποσότητας» καθώς και του υπολογιζόμενου (“on-the-fly”) επιμέρους κόστους για το επιλεγμένο (αριστερά) προϊόν.

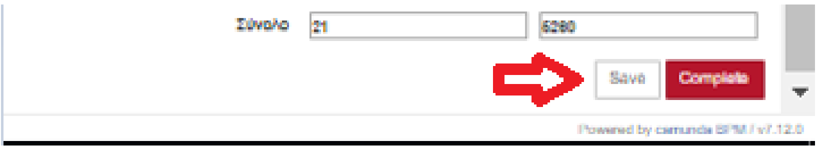
  - ✓ Ποσότητα: Ο χρήστης (με επιλεγμένο πάντα το προϊόν αριστερά) δύναται να προσαφαιρεί τεμάχια που επιθυμεί από το εκάστοτε επιλεγμένο προϊόν.

- Το συνολικό Κόστος των επιλογών του από την διαθέσιμη Λίστα καθώς και το Σύνολο των Ειδών (τεμάχια) που έχει δηλώσει:



Σύνολο 21 6280

- Ο χρήστης δύναται να αποθηκεύσει (με τις προσωρινές επιλογές του έως ότου αποφασίσει να υποβάλλει) την φόρμα, επιλέγοντας “Save”. Αξίζει να αναφερθεί ότι επιλέγοντας “Save” δεν θα εμφανιστεί αναδυόμενο μήνυμα στην οθόνη του (π.χ. “Your form is currently saved”).



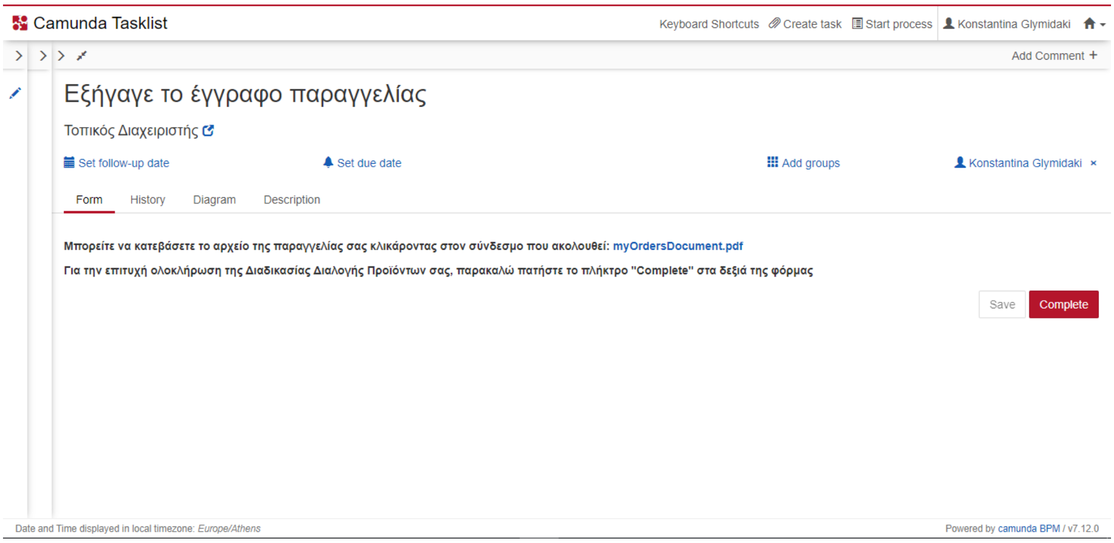
Σύνολο 21 6280

Για να διαπιστώσει ότι όντως οι προσωρινές επιλογές του έχουν αποθηκευτεί, αρκεί είτε να κάνει ανανέωση (F5) της σελίδας του από τον web browser που χρησιμοποιεί, είτε να αποσυνδεθεί και να συνδεθεί εκ νέου στην εφαρμογή και στην φόρμα εργασίας του.

- Σε περίπτωση που το Συνολικό Κόστος Παραγγελίας Ειδών δεν καλύπτεται από τον Διαθέσιμο Προϋπολογισμό της Σχολής/Τμήματος (αρνητικό «Υπόλοιπο»), ο χρήστης δεν δύναται να υποβάλλει την συγκεκριμένη φόρμα.
  Μόνο εφόσον υπάρχει θετικό (ή μηδενικό) «Υπόλοιπο» μπορεί να υποβληθεί οριστικά η φόρμα (με την επιλογή "Complete").

Με την οριστική υποβολή της προηγούμενης φόρμας εργασίας, ο χρήστης παραπέμπεται στην επόμενη (διαδοχικά στην εφαρμογή) φόρμα όπου και δύναται να κατεβάσει (στον προσωπικό του υπολογιστή) το εξαγόμενο (σε μορφή pdf) έγγραφο με λεπτομέρειες που αφορούν στην Παραγγελία του.

Η Διαδικασία Διαλογής Προϊόντων ολοκληρώνεται για κάθε Τοπικό Διαχειριστή μόνο εφόσον υποβάλλει (με την επιλογή "Complete") την παρακάτω φόρμα!!!



Εξήγαγε το έγγραφο παραγγελίας

Τοπικός Διαχειριστής

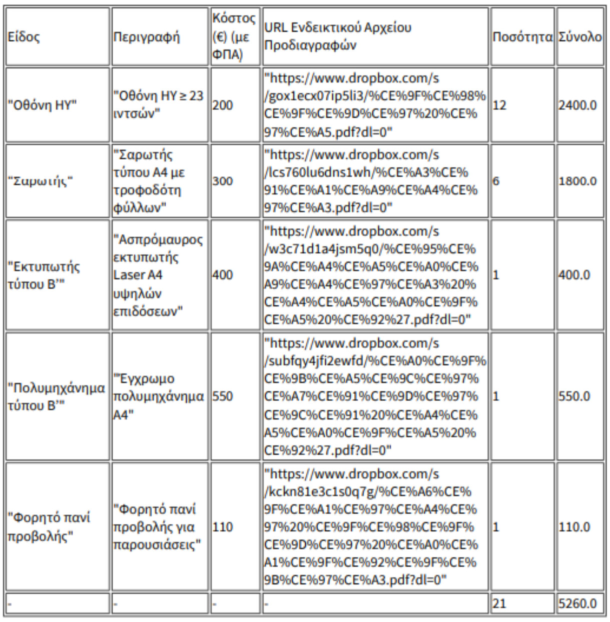
Μπορείτε να κατεβάσετε το αρχείο της παραγγελίας σας κλικάροντας στον σύνδεσμο που ακολουθεί: myOrdersDocument.pdf

Για την επιτυχή ολοκλήρωση της Διαδικασίας Διαλογής Προϊόντων σας, παρακαλώ πατήστε το πλήκτρο "Complete" στα δεξιά της φόρμας

Date and Time displayed in local timezone: *Europe/Athens*

Powered by camunda BPM / v7.12.0

Το εξαγώγιμο pdf έγγραφο είναι της παρακάτω μορφής:



Είδος	Περιγραφή	Κόστος (€) (με ΦΠΑ)	URL Ενδεικτικού Αρχείου Προδιαγραφών	Ποσότητα	Σύνολο
"Οθόνη HY"	"Οθόνη HY ≥ 23 ιντσών"	200	"https://www.dropbox.com/s/gox1ecx07ip5li3/%CE%9F%CE%98%CE%9F%CE%9D%CE%97%20%CE%97%CE%A5.pdf?dl=0"	12	2400.0
"Σαρωιής"	"Σαρωτής τύπου A4 με τροφοδότη φύλλων"	300	"https://www.dropbox.com/s/lcs760lu6dns1wh/%CE%A3%CE%91%CE%A1%CE%A9%CE%A4%CE%97%CE%A3.pdf?dl=0"	6	1800.0
"Εκτυπωτής τύπου B’"	"Ασπρόμαυρος εκτυπωτής Laser A4 υψηλών επιδόσεων"	400	"https://www.dropbox.com/s/w3c71d1a4jsm5q0/%CE%95%CE%9A%CE%A4%CE%A5%CE%A0%CE%A9%CE%A4%CE%97%CE%A3%20%CE%A4%CE%A5%CE%A0%CE%9F%CE%A5%20%CE%92%27.pdf?dl=0"	1	400.0
"Πολυμηχάνημα τύπου B’"	"Έγχρωμο πολυμηχάνημα A4"	550	"https://www.dropbox.com/s/subfqy4jfi2ewfd/%CE%A0%CE%9F%CE%9B%CE%A5%CE%9C%CE%97%CE%A7%CE%91%CE%9D%CE%97%CE%9C%CE%91%20%CE%A4%CE%A5%CE%A0%CE%9F%CE%A5%20%CE%92%27.pdf?dl=0"	1	550.0
"Φορητό πανί προβολής"	"Φορητό πανί προβολής για παρουσιάσεις"	110	"https://www.dropbox.com/s/kckn81e3c1s0q7g/%CE%A6%CE%9F%CE%A1%CE%97%CE%A4%CE%9F%20%CE%9F%CE%98%CE%9F%CE%9D%CE%97%20%CE%A0%CE%A1%CE%9F%CE%92%CE%9F%CE%9B%CE%97%CE%A3.pdf?dl=0"	1	110.0
-	-	-	-	21	5260.0

8.3 Questionnaire

ΤΙΤΛΟΣ	Α/Α	ΕΡΩΤΗΣΗ
ΕΡΕΥΝΑ ΙΚΑΝΟΠΟΙΗΣΗΣ ΣΥΜΜΕΤΕΧΟΝΤΩΝ ΑΠΌ ΤΗΝ ΠΙΛΟΤΙΚΗ ΕΦΑΡΜΟΓΗ ΤΟΥ "PM SYSTEM" ΣΤΗΝ ΔΙΑΔΙΚΑΣΙΑ ΔΙΑΓΩΝΙΣΜΟΥ ΠΡΟΜΗΘΕΙΩΝ ΣΤΟ ΠΟΛΥΤΕΧΝΕΙΟ ΚΡΗΤΗΣ		
ΓΕΝΙΚΕΣ ΠΛΗΡΟΦΟΡΙΕΣ	1	Έτος Γέννησης
	2	Φύλο
	3	Ρόλος στο Ίδρυμα
	4	Προηγούμενη Εμπειρία Χρήσης Ανάλογων Συστημάτων Λογισμικού (π.χ. BPMS, https://helpdesk.tuc.gr/)
	5	Χρονική Στιγμή Συμμετοχής στην Πιλοτική Εκτέλεση της εν λόγω Διαδικασίας
ΠΟΣΟΤΙΚΑ ΔΕΔΟΜΕΝΑ	6	Εάν έχετε συμμετάσχει στο παρελθόν σε αντίστοιχη συμβατική διαδικασία προμηθειών πόσο χρόνο χρειαστήκατε (σε λεπτά ή δυνατόν) για την ορθή διεκπεραίωση της εργασίας σας;
	7	Πως σας φαίνεται ο παραπάνω χρόνος (συγκριτικά) με τον αντίστοιχο χρόνο ορθής διεκπεραίωσης κάποιας εργασίας (task) μέσω της χρήσης του PM System;
	8	Πόσο χρόνο χρειαστήκατε (κατόπιν σχετικής ειδοποίησης από το PM System) για την σύνδεσή σας στην εφαρμογή προκειμένου να διεκπεραιώσετε την εργασία (task) σας κατά την πιλοτική εκτέλεση της εν λόγω Πιλοτικής Διαδικασίας Προμηθειών (σε λεπτά ει δυνατόν);
	9	Πως σας φαίνεται ο παραπάνω χρόνος (σύνδεσης στην εφαρμογή);
ΠΟΙΟΤΙΚΑ ΔΕΔΟΜΕΝΑ	10	Νομίζω ότι θα ήθελα να χρησιμοποιώ συχνά το PM System.
	11	Το PM System ήταν περισσότερο περίπλοκο από όσο θα χρειαζόταν.
	12	Νομίζω ότι το PM System ήταν εύκολο στη χρήση.
	13	Νομίζω ότι θα χρειαζόμουν την υποστήριξη ενός τεχνικού για να μπορέσω να χρησιμοποιήσω το σύστημα PM System.
	14	Βρήκα ότι οι διάφορες λειτουργίες του PM System ήταν σωστά ενσωματωμένες.
	15	Νόμιζα ότι υπήρχε πάρα πολύ ασυνέπεια στο PM System.
	16	Θα φανταζόμουν ότι οι περισσότεροι άνθρωποι θα μπορούσαν να μάθουν γρήγορα την χρήση του PM System.
	17	Βρήκα το σύστημα PM System πολύ δύσκολο στη χρήση.
	18	Ένιωσα πολύ αυτοπεποίθηση χρησιμοποιώντας το σύστημα PM System.
	19	Έπρεπε να μάθω πολλά πράγματα πριν μπορέσω να ξεκινήσω να χρησιμοποιώ το PM System.
ΤΕΛΙΚΕΣ ΣΥΜΠΕΡΑΣΜΑΤΙΚΕΣ ΕΡΩΤΗΣΕΙΣ	20	Με την χρήση του PM System θα περιοριστούν τα (όποια ενδεχομένως) λάθη προκύπτουν κατά την εκτέλεση της εν λόγω Διαδικασίας.
	21	Θεωρείτε ότι υπήρξε κάτι που σας δυσκόλεψε/δεν σας άρεσε κατά την πιλοτική εκτέλεση της εν λόγω Διαδικασίας μέσω της χρήσης του PM System; Αν ναι, μπορείτε να μας πείτε τι ήταν;
	22	Θεωρείτε ότι υπήρξε κάτι που σας διευκόλυνε/σας άρεσε κατά την πιλοτική εκτέλεση της εν λόγω Διαδικασίας μέσω της χρήσης του PM System; Αν ναι, μπορείτε να μας πείτε τι ήταν;
	23	Θεωρείτε ότι το υφιστάμενο σύστημα (PM System) χρήζει περαιτέρω ανάπτυξης, βελτίωσης ή και επανασχεδιασμού.

8.4 S.U.S. Excel Analysis

Questionnaire													
Participants	1	2	3	4	5	6	7	8	9	10	Statistical Results		
Question											Mean	Median	Standard Deviation
10	5	4	4	4	3	3	4	4	5	5	4,1	4	0,737865
11	1	1	2	2	3	3	3	2	2	3	2,2	2	0,788811
12	5	5	5	4	3	3	5	4	5	5	4,4	5	0,843274
13	2	1	1	1	3	2	1	1	1	1	1,4	1	0,699206
14	5	5	4	3	3	2	3	4	4	5	3,8	4	1,032796
15	1	1	2	1	3	2	2	1	1	1	1,5	1	0,707107
16	5	4	5	5	3	4	5	4	5	5	4,5	5	0,707107
17	1	1	1	1	3	2	1	1	1	1	1,3	1	0,674949
18	5	5	5	4	3	3	4	4	5	5	4,3	4,5	0,823273
19	1	1	1	1	3	1	1	2	1	1	1,3	1	0,674949
Analysis													
Question	LTS	LTS	LTS	AS	AS	O	LTS	AS	LTS	LTS			
10	4	3	3	3	2	2	3	3	4	4			
11	4	4	3	3	2	2	2	3	3	2			
12	4	4	4	3	2	2	4	3	4	4			
13	3	4	4	4	2	3	4	4	4	4			
14	4	4	3	2	2	1	2	3	3	4			
15	4	4	3	4	2	3	3	4	4	4			
16	4	3	4	4	2	3	4	3	4	4			
17	4	4	4	4	2	3	4	4	4	4			
18	4	4	4	3	2	2	3	3	4	4			
19	4	4	4	4	2	4	4	3	4	4	Statistical Results		
Sum	39	38	36	34	20	25	33	33	38	38	Mean	Median	Standard Deviation
Sum * 2.5	98	95	90	85	50	63	83	83	95	95	83,5	87,5	15,6436

LTS : Laboratory Teaching Staff
AS: Administrative Staff
O: Other